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Professor F. Hernandez Altemir Head of Department of Oral and Maxillofacial Surgery University Hospital Miguel Servet Fray Luis Amigo, 8. Planta Oletra B Zaragoza, Spain DP 50006

Dear Professor Hernandez,

Thank you very much for your hard work in putting together the compendium of references and articles concerning your pioneering work in the mid-facial splitting procedure. I must admit after our discussion I reviewed my own book on skull base surgery and Dr. Cocke to whom I gave credit for the development of the mid-facial splitting procedure, references your work in two references, number 86 and number 87, on page 236 of my book, "Surgery of the Skull Base".

Your contribution is duly noted and your picture and the reference will be added to my talk when given in the future.

Thank you again for your diligence in correcting my oversight.

Sincerely,

Paul J. Donald, M.D., R.C.S.(C)

Professor and Vice Chair

Department of Otolaryngology-Head and Neck Surgery Director, Center for Skull Base Surgery

PJD/mkm

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# Unilateral Upper and Lower Subtotal Maxillectomy Approaches to the Cranial Base: Microsurgical Anatomy

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OBJECTIVE: The relationship of the maxilla, with its thin walls, to the nasal and oral cavities, the orbit, and the infratemporal and pterygopalatine fossae makes it a suitable route for accessing lesions involving both the central and lateral cranial base. In this study, we compared the surgical anatomy and exposure obtained by two unilateral transmaxillary approaches, one directed through an upper subtotal maxillectomy, and the other through a lower subtotal maxillectomy.

METHODS: Cadaveric specimens examined, with 3 to 40× magnification, provided the material for this study. RESULTS: Both upper and lower maxillectomy approaches open a surgical field extending from the ipsilateral internal carotid artery to the contralateral Eustachian tube; however, they differ in the direction of the access and the areas exposed. The lower maxillectomy opens a combination of the transmaxillary, transnasal, and transoral routes to extra- and intradural lesions of the central cranial base. Performing additional osteotomies of the mandibular coronoid process and the sphenoid pterygoid process provides anterolateral access to the lateral cranial base, including the pterygopalatine and infratemporal fossae, and the parapharyngeal space. The upper maxillectomy opens the transmaxillary and transnasal routes to the central cranial base but not the transoral route. The structures exposed in the lateral cranial base, after removing the coronoid and pterygoid processes, include the pterygopalatine and infratemporal fossae and the parapharyngeal space. Exposure can be extended by a frontotemporal craniotomy, which provides access to the anterior and middle cranial fossae and the basal cisterns.

CONCLUSION: The upper and lower subtotal maxillectomy approaches provide wide but differing access to large parts of the central and lateral cranial base depending on the site of the osteotomies. (Neurosurgery 46:1416–1453, 2000)

Key words: Cranial base, Infratemporal fossa, Maxilla, Maxillectomy, Microsurgical anatomy, Pterygopalatine fossa, Skull base, Transmaxillary

he maxilla, the largest bone in the facial skeleton, has a unique relationship to the cranial base (Fig. 1). It forms part or all of the floor and lateral wall of the nasal cavity, the roof of the oral cavity, the orbital floor, the upper jaw, and the walls of the infratemporal and pterygopalatine fossae. The relationship of the maxillary sinus, with its thin walls, to all of the above structures makes it a suitable route for accessing large parts of the central and lateral cranial base. Numerous anterior approaches to the cranial base, including those directed through the nasal and oral cavities, sphenoid sinus, mandible, palate, cervical region, and anterior cranial fossa, provide only a limited midline access that is confined to a

small part of the central cranial base (1, 4, 12, 13, 23, 25, 28). In contrast, approaches directed through a unilateral maxillectomy provide a wide and direct route to lesions involving both the central and lateral cranial base. They also can be flexibly applied to lesions involving a variety of sites by varying the position of the osteotomies, and in selected patients, these approaches may be combined with a craniotomy (7–9, 15, 18, 19, 21). This adaptability is one of the main advantages of these approaches; however, combining the various osteotomies for exposure of a specific lesion requires an understanding of the complex anatomy of the unilateral maxillectomy approaches.

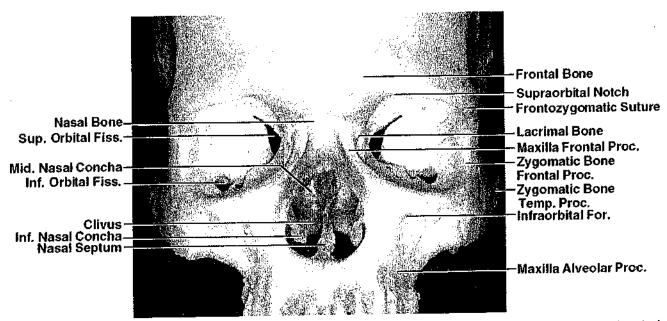


FIGURE 1. Osseous relationships. A, anterior view of the facial skeleton. The middle one-third of each half of the face is the site of three large cavities. The orbit and nasal cavities open anteriorly, and the maxillary sinus is enclosed by a thin shell of bone. The orbit and nasal cavities are separated from the anterior cranial fossa above by a thin roof, and the nasal cavity and maxillary sinus are bounded below, and separated from, the oral cavity by the hard palate. The orbital rim is formed superiorly by the frontal bone, medially and inferiorly by the maxilla, and laterally by the zygomatic bone. The infraorbital foramen opens below the midpoint of the inferior orbital rim. The supraorbital notch, which may be bridged across to create a foramen, is situated at the junction of the medial one-third and lateral two-thirds of the superior orbital rim. The anterior nasal aperture is formed by the nasal bones above, and the maxillae laterally and below. The nasal cavity is divided sagittally by the nasal septum, and it opens posteriorly through the posterior nasal aperture into the nasopharynx. The clivus is observed through the nasal cavity in the area behind the nasal septum and the middle and inferior conchae. Ant., anterior; Fiss., fissure; For., foramen; Gr., greater; Horiz., horizontal; Inf., inferior; Infratemp., infratemporal; Lat., lateral; Less., lesser; Med., medial; Mid., middle; Occip., occipital; Post., posterior; Proc., process; Sup., superior; Temp., temporal.

# MATERIALS AND METHODS

Five adult cadaver specimens were dissected using 3 to 40× magnification. Colored silicone was injected into the vascular structures to facilitate their definition. The lower subtotal maxillectomy approach examined in this study resembles the approach described by Cocke and Robertson (9) and Cocke et al. (10), which they term the extended unilateral maxillectomy/maxillotomy. The upper subtotal maxillectomy approach examined resembles the technique described by Arriaga and Janecka (2) and Janecka et al. (18, 19) as the facial translocation approach. The goal was not to replicate these two approaches exactly, but to define the anatomic relationships important in completing these approaches. The mobilized segment of the maxilla was detached from the soft tissues for this study, but in selected patients the maxilla may be mobilized as an osteoplastic maxillotomy hinged to a cheek or palatal soft tissue flap to preserve the blood supply of the mobilized maxilla.

#### RESULTS

The maxilla has a body and zygomatic, frontal, alveolar, and palatine processes, and it articulates with the zygomatic, frontal, ethmoid, palatine, sphenoid, and nasal bones, as well

as the vomer (Fig. 1). The body encloses the maxillary sinus, and it is located above the upper teeth, forming much of the floor of the orbit. The medial surface surrounds the anterior nasal aperture and forms much of the lateral wall of the nasal cavity. The posterior and posterolateral wall of the body forms the anterior wall of the pterygopalatine and infratemporal fossae (Fig. 2). It joins with the lacrimal bone to create an opening through which the nasolacrimal duct descends and serves as the site of inferior nasal concha attachment. It also contains canals and foramina through which numerous branches of the maxillary nerve pass, including the infraorbital branch, as well as the anterosuperior, middle superior, and posterosuperior alveolar nerves. It joins with the palatine bone to complete the bony passages for the greater and lesser palatine nerves.

Our results are arranged in the following stages: 1) the facial stage, which includes the skin and soft tissue incisions; 2) the skeletal stage, which focuses on the site of the maxillary and other osteotomies; 3) the retromaxillary stage, which includes exposure of the infratemporal and pterygopalatine fossae and the parapharyngeal space; 4) the central craniocervical stage, which includes accessing the nasal and oral cavities, pharynx, ethmoid and sphenoid sinuses, orbit, clivus, upper cervical vertebra, and pituitary gland and adjacent part

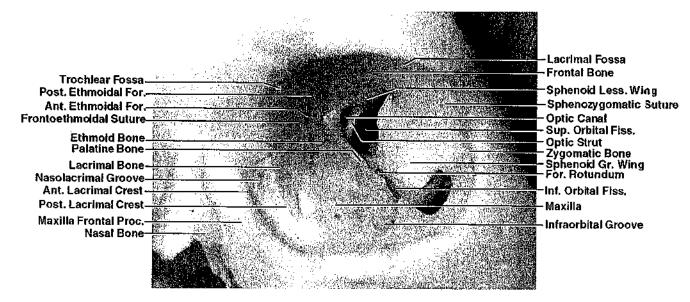


FIGURE 1. B, anterolateral view of the left orbit. The orbit communicates with the middle cranial fossa through the superior orbital fissure, with the suprasellar area through the optic canal, with the anterior cranial fossa by the anterior and posterior ethmoidal foramina, with the nasal cavity though the nasolacrimal canal, with the infratemporal fossa via the anterolateral part of the inferior orbital fissure, and with the pterygopalatine fossa by the posteromedial end of the inferior orbital fissure. The infraorbital groove arises at the junction of the wider anterolateral and narrow posteromedial parts of the inferior orbital fissure. The anterolateral edge of the inferior orbital fissure is widest at the inferior end of the sphenozygomatic suture, which joins the sphenoid greater wing and the zygomatic frontal process in the area of the thinnest part of the lateral orbital wall. The lacrimal fossa accommodates the lacrimal gland, and the trochlear fossa is the site of attachment of the trochlea of the superior oblique.

of the cavernous sinus; and 5) the intracranial stage, which includes exposure of the anterior and middle cranial fossae, basal cisterns, and lateral wall of the cavernous sinus (Fig. 3).

# Facial stage

Both approaches examined in this study were performed through a Weber-Fergusson facial skin incision, although the lower subtotal maxillectomy may be completed using a degloving technique, in which the incisions are concealed within the nose and mouth (9).

# Lower maxillectomy

The lower maxillectomy began with an incision extending vertically from the vermilion border of the upper lip, along the philtral ridge, around the nasal ala, and upward to the medial canthal region (Fig. 4). After the vertical incision, an incision was made in the apex of the gingivobuccal gutter extending through the mucoperiosteum from the midline to the tuberosity of the maxilla, which provided access to the posterolateral maxillary wall. In the lower maxillectomy technique, an infraorbital incision is needed infrequently, and the medial palpebral ligament, nasolacrimal duct, and infraorbital nerve usually are preserved because the maxillary osteotomy is located below the infraorbital foramen. If required, however, the incision can be extended horizontally beneath the lower eyelid to the lateral canthus, curving slightly downward to the root of the zygomatic arch; care must be taken to avoid injury to the anterior filaments of the temporal branch

of the facial nerve. Ectropion and lymphedema, which are associated with the horizontal skin incision on the cheek below the lower eyelid, can be avoided with the use of a conjunctival incision through the inferior fornix. The cheek flap is elevated by subperiosteal dissection, exposing the anterior and lateral maxilla, nasal and zygomatic bones, anterior nasal aperture, and the masseter muscle. The cheek flap contains the maxillary and zygomatic periostea and the facial muscles. The infraorbital nerve and vessels emerge on the face via the infraorbital foramen, which opens downward and medially between the maxillary attachments of the levator labii superioris above and the levator anguli oris below. The infraorbital neurovascular bundle is usually preserved, but infrequently may be divided if wider lateral exposure is required. If divided, it can be reapproximated at the conclusion of the operation. To expose the oral surface of the hard palate, its mucoperiosteum is incised in an anteroposterior direction lateral to the planned palatal osteotomy, and a palatal flap is elevated. The greater palatine artery descends through its canal at the junction of the maxilla laterally and the palatine bone medially, emerges on the palate's oral surface, and runs forward near the alveolar border of the hard palate.

# Upper maxillectomy

For the upper maxillectomy, the Weber-Fergusson lateral rhinotomy incision is combined with lower conjunctival, transverse temporal, hemicoronal, and preauricular incisions, as needed (Fig. 5). The cheek flap, which contains the facial

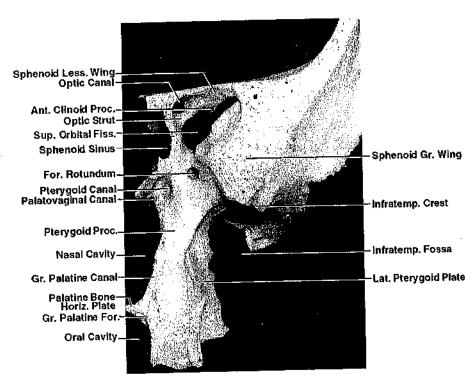


FIGURE 1. C, anterior view of the left half of the sphenoid bone, which has four parts: a body, greater wings, lesser wings, and a pterygoid process. The pterygopalatine fossa is located between the pterygoid process and the posterior maxillary wall below the orbital apex. It communicates with the middle cranial fossa through the foramen rotundum, with the region of the foramen lacerum via the pterygoid canal, with the nasopharynx by the palatovaginal canal, with the infratemporal fossa through the pterygomaxillary fissure, with the nasal cavity via the sphenopalatine foramen, and with the oral cavity by the greater and lesser palatine canals.

muscles, branches of the facial nerve, the parotid gland, and the masseter fascia, is reflected as far as the maxillary attachment of the buccinator inferiorly, the level of the hard palate anteriorly, and the trunk of the facial nerve exiting the stylomastoid foramen posteriorly. The temporal branch of the facial nerve runs within the temporoparietal fascia, a continuation of the galeal layer that is usually thin, loose, and mixed with the adipose tissue around the zygomatic arch; it supplies the frontalis, corrugator supercilii, and orbicularis oculi. An upper lip split, gingivobuccal incisions, and palatal mucoperiosteal incisions are performed only when a hard palate osteotomy is required.

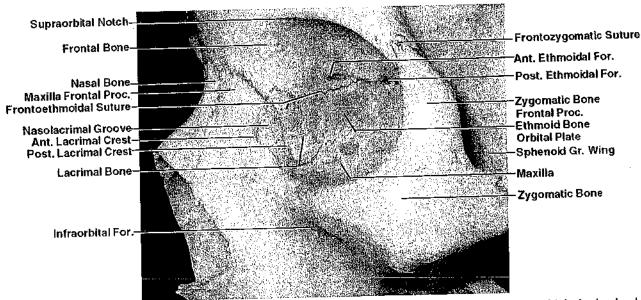
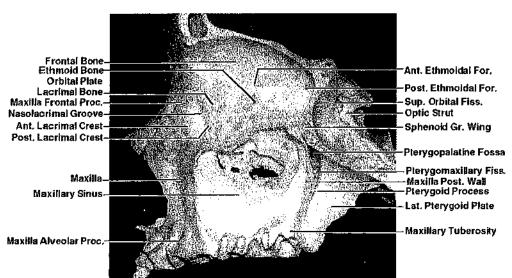


FIGURE 1. D, lateral view of the middle one-third of the facial skeleton. The nasolacrimal groove, in which the lacrimal sac sits, is located in the anterior part of the medial orbital wall; it is formed anteriorly by the maxillary frontal process and posteriorly by the lacrimal bone. The anterior and posterior lacrimal crests, which form the anterior and posterior edges of the nasolacrimal groove, are ridges on the maxillary and lacrimal bones, respectively. The anterior and posterior ethmoidal foramina, which transmit the anterior and posterior ethmoidal branches of the ophthalmic artery and the nasociliary nerves, are situated in or just above the frontoethmoidal suture at the level of the medially situated cribriform plate.

FIGURE 1. E. lateral view after removal of the lateral wall of both the orbit and maxillary sinus. The medial orbital wall comprises the frontal process of the maxilla, the lacrimal bone, and the orbital plate of the ethmoid (lamina papyracea). The pterygopalatine fossa is bounded anteriorly by the posterior maxillary wall and posteriorly by the pterygoid process, and it and communicates laterally through the pterygomaxillary fissure with the infratemporal fossa. The medial wall of the maxillary sinus forms much of the lateral wall of the nasal cavity.



As the temporal incision in a patient is completed, an attempt is made to identify the temporal branch of the facial nerve before it is transected in preparation for reapproximation during closure, although the small size of this branch may make its identification and reapproximation difficult or

impossible. The remaining branches of the facial nerve are contained in the cheek flap and are preserved. A lower conjunctival incision is incorporated to achieve a better cosmetic result than that obtained with a transverse incision across the upper cheek. The infraorbital nerve, which is crossed in ele-

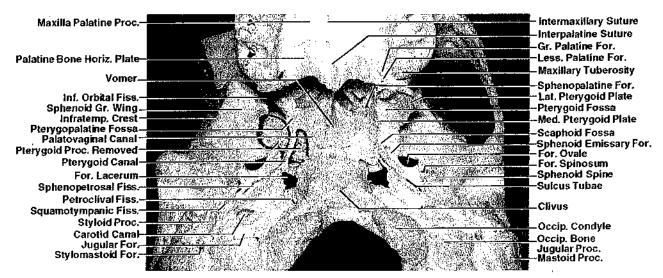


FIGURE 1. F, inferior view of the cranial base. The right pterygoid process has been sectioned at its junction with the sphenoid greater wing and body and removed to expose the pterygopalatine fossa and the pterygoid and palatovaginal canals. The pterygoid canal, which transmits the vidian nerve formed by the union of the superficial and deep petrosal nerves, passes above the root of the medial pterygoid plate. It opens anteriorly into the medial portion of the pterygopalatine fossa and posteriorly into the anterolateral aspect of the foramen lacerum. The palatovaginal canal transmits the pharyngeal branches of the maxillary nerve and artery. The pterygoid fossa, the site of the attachment of the medial pterygoid, is situated between the medial and lateral pterygoid plates. The scaphoid fossa, the attachment site of the anterior portion of the tensor veli palatini, is located just lateral to the root of the medial pterygoid plate, below the pterygoid canal, and medial to the inconstant sphenoid emissary foramen. The sulcus tubae, which is the attachment site of the cartilaginous part of the Eustachian tube to the cranial base, is located on the extracranial surface of the sphenopetrosal fissure, anterolateral to the foramen lacerum and the carotid canal and posteromedial to the foramen lacerum and spinosum, and the sphenoid spine. The upper and middle thirds of the clivus are bordered laterally by the foramen lacerum and the petroclival fissure. The lower clivus is bordered by the occipital condyle and the hypoglossal canal, which passes above the condyle. The greater and lesser palatine foramina, which transmit the greater and lesser palatine nerves and vessels, open at the posterolateral edge of the hard palate between the maxillary tuberosity laterally and the horizontal plate of the palatine bone medially.



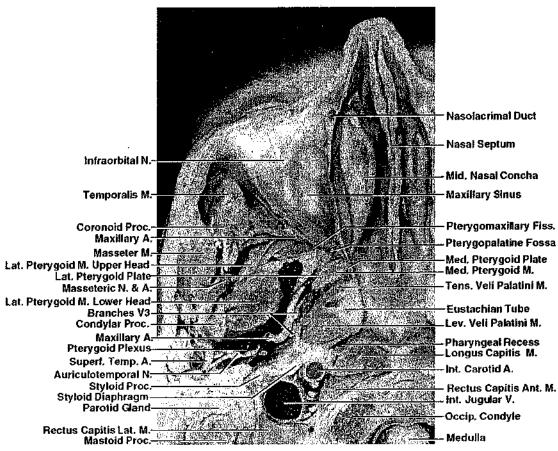


FIGURE 2. Inferior views of an axial section of the cranial base. A, the infratemporal fossa is surrounded by the maxillary sinus anteriorly, the mandible laterally, the pterygoid process anteromedially, and the parapharyngeal space posteromedially. It contains the mandibular nerve and maxillary artery and their branches, the medial and lateral pterygoid muscles, and the pterygoid venous plexus. The lower part of the nasal cavity and the nasopharynx, both related to the central cranial base, are laterally

bounded from front to back by the nasolacrimal duct, the maxillary sinus, the pterygopalatine fossa, the medial pterygoid plate, and the Eustachian tube. The pharyngeal recess (Rosenmüller's fossa) projects laterally from the posterolateral corner of the nasopharynx; its deep edge faces the internal carotid artery laterally and the foramen lacerum above. The posterior nasopharyngeal wall is separated from the lower clivus and the upper cervical vertebra by the longus capitis muscle, and the nasopharyngeal roof rests against the upper clivus and the posterior part of the sphenoid sinus floor. A., artery; Ant., anterior; Br., branch; Car., carotid; CN, Cranial Nerve; Fiss., fissure; For., foramen; Gang., ganglion; Gr., greater; Inf., inferior; Int., internal; Lat., lateral; Less., lesser; Lev., levator; Lig., ligament; M., muscle; Med., medial; Mid., middle; N., nerve; Occip., occipital; Post., posterior; Proc., process; Sup., superior; Superf., superficial; Temp., temporal; Tens., tensor; V., vein.

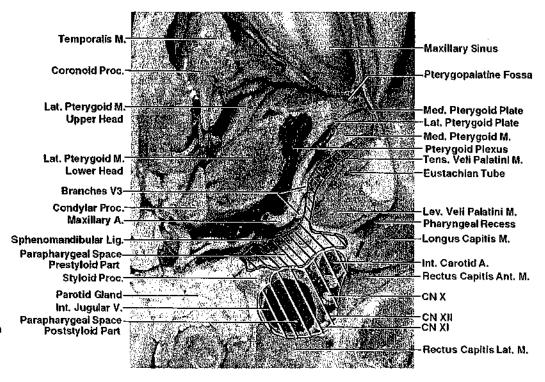
vating the cheek flap, is marked for reconstruction in closing. The hemicoronal incision exposes the lateral orbital rim and the temporalis. After reflection of the frontotemporal scalp flap, the masseter is detached from the zygoma and retracted inferiorly to expose the maxillary tuberosity and the mandibular coronoid process, and the temporalis is elevated from the temporal squama.

If access to the medial orbit or ethmoid sinus is needed, the vertical limb of the paranasal incision can be extended upward in a curvilinear manner to the inferomedial edge of the eyebrow, just medial to the palpable supraorbital notch or foramen, as for a lateral rhinotomy or medial maxillectomy approach (Fig. 6). The medial orbit is exposed by detaching the medial palpebral ligament, mobilizing the lacrimal sac from the nasolacrimal groove, and displacing the periorbita laterally. The medial palpebral ligament is separated into two leaves, anterior and posterior, by the lacrimal sac. The anterior leaf, a strong tendinous band, crosses in front of the lacrimal

sac and attaches to the maxillary frontal process in front of the nasolacrimal groove (Fig. 6). This ligament is transected and tagged so that it can be reapproximated precisely at the time of closure, preserving canthal balance. The thinner posterior leaf located behind the lacrimal sac is weakly attached to the lacrimal bone, together with the lacrimal part of the orbicularis oculi and the medial check ligament. Laterally, the medial palpebral ligament divides into upper and lower parts, each attached to the medial end of the corresponding tarsus.

The lacrimal drainage pathway includes the superior and inferior lacrimal canaliculi, the lacrimal sac, and the nasolacrimal duct. The superior and inferior lacrimal canaliculi begin at the puncta in the eyelids and open into the lateral wall of the lacrimal sac beneath the anterior leaf of the medial palpebral ligament. The lacrimal sac lies in the nasolacrimal groove, formed anteriorly by the thick maxillary frontal process and posteriorly by the thin lacrimal bone (Fig. 6, B and C). The anterior lacrimal crest, located at the anterior margin of the

FIGURE 2. B, enlarged view; note the pre- and poststyloid compartments of the parapharyngeal space (highlighting). The styloid diaphragm, which is formed by the anterior part of the carotid sheath, separates the parapharyngeal space into pre- and poststyloid parts. The prestyloid compartment, which is a narrow fatcontaining space between the medial pterygoid and tensor veli palatini, separates the infratemporal fossa from the medially located lateral nasopharyngeal region containing the tensor and levator veli palatini and the Eustachian tube. The poststyloid compartment, which is located behind the prestyloid part,



contains the internal carotid artery, the internal jugular vein, and Cranial Nerves IX through XII. The pterygopalatine fossa is surrounded by the maxillary sinus anteriorly, the pterygoid process posteriorly, the nasal cavity medially, and the infratemporal fossa laterally.

nasolacrimal groove, is palpable as a small tubercle that serves as a guide to the lacrimal sac (Fig. 1, B, D, and E). The closed upper end of the lacrimal sac is situated below the frontomaxillary and frontolacrimal sutures. The nasolacrimal duct descends from the lacrimal sac through the nasolacrimal

canal and opens in the inferior nasal meatus under the inferior nasal concha (Fig. 6, B and C). Transecting the lacrimal sac at its lower end, and ligating the anterior and posterior ethmoidal arteries just proximal to the anterior and posterior ethmoidal canals, allows displacement of the orbital contents

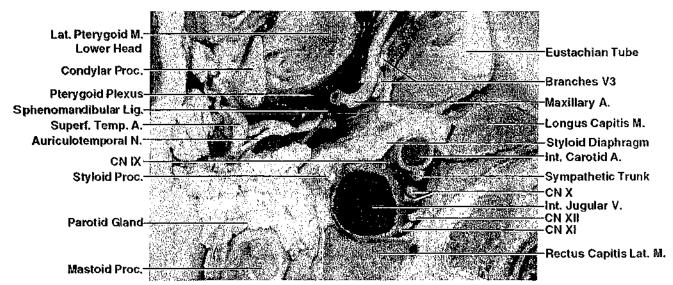


FIGURE 2. C, enlarged view of the poststyloid part of the parapharyngeal space containing the internal carotid artery, the internal jugular vein, and Cranial Nerves IX through XII descending in the medial part of the interval between the artery and the vein. The styloid diaphragm, which is formed by the anterior part of the carotid sheath, separates the pre- and poststyloid parts of the parapharyngeal space. The styloid process and facial nerve are anterolateral and lateral to the internal jugular vein. The internal carotid artery courses lateral to the longus capitis.

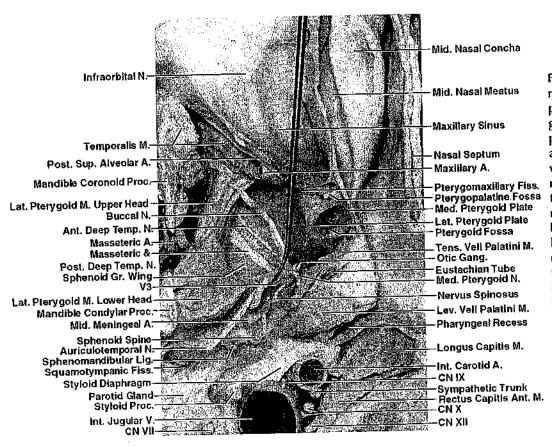


FIGURE 2. D, the medial pterygoid and part of the lateral pterygoid, some fat in the parapharyngeal space, and the pterygoid venous plexus have been removed. This exposes the otic ganglion and the mandibular nerve and its branches, including the buccal, deep temporal, masseteric, lingual, inferior alveolar, and auriculotemporal nerves, branches to the pterygoids, and the nervus spinosus, which passes through the foramen spinosum.

laterally for exposure of the medial orbital apex (Fig. 6D). The nasolacrimal duct and lacrimal sac may be reconstructed at the conclusion of the procedure.

# Skeletal stage

For both the upper and lower maxillectomy, the anterior and lateral aspects of the maxilla, part of the zygoma, and the anterior nasal aperture are exposed; however, the approaches differ in that the lower maxillectomy requires exposure of the oral surface of the hard palate, whereas the upper maxillectomy requires exposure of the orbital floor and the zygomatic arch (Figs. 3–5). Before completion of the osteotomy, miniplate sites are carefully marked for restoration of skeletal contour and occlusion during closure.

# Lower maxillectomy

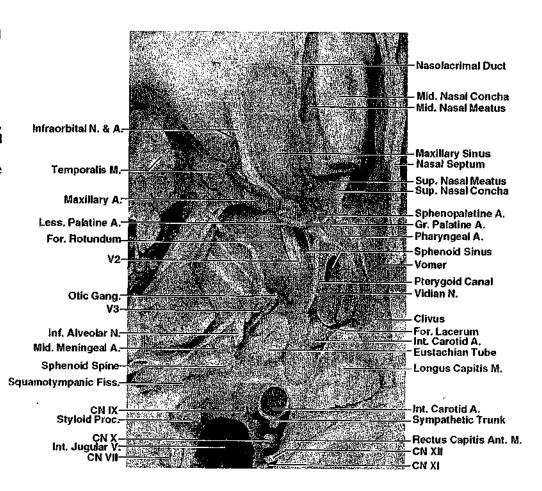
To perform the lower maxillectomy, the upper level of the osteotomy is extended just beneath the infraorbital foramen anteriorly, which disconnects the lower two-thirds, including the hard palate and alveolar ridge, from the upper one-third, leaving the orbital floor formed by the roof of the maxillary sinus and the zygomatic arch intact. The anterior portion of the masseter is detached from the zygoma. Partial removal of the inferior edge of the zygomatic body then exposes the mandibular coronoid process and the pterygomaxillary area for proximal exposure of the maxillary artery and control of bleeding from its more distal branches during the osteotomy

(Fig. 4, A and B). The coronoid process and temporalis may be divided to provide wider access to the maxillary artery in the infratemporal fossa (Fig. 4C).

The hard palate osteotomy begins with a vertical cut in the alveolar ridge between the central and lateral incisors, then proceeds backward in a parasagittal plane on the ipsilateral side of the nasal septum, parallel to the intermaxillary and interpalatine sutures to the posterior edge of the hard palate. Avoiding division of the soft palate allows the maxilla to be hinged to a pedicle, which preserves some blood supply to the maxilla. The osteotomy is completed with a horizontal cut through the lateral maxillary wall and a vertical cut extending across the front of the posterior maxillary wall and through the retromolar region, reaching the medial maxillary wall and the perpendicular plate of the palatine bone, which is wedged into the lateral nasal wall between the maxilla and the sphenoid pterygoid process. The bone cut continues forward through the inferior or middle nasal meatus to the anterior nasal aperture, possibly leaving a shell of posterior maxillary wall attached to the pterygoid process. The posterior wall of the maxillary sinus is thin, difficult to cut precisely, and easily fractured, which creates the possibility of leaving some of it in place as the maxilla is mobilized.

The greater palatine canal, which is approximately 10 mm long, is bounded laterally by the posteromedial maxillary wall and medially by the palatine perpendicular plate. It transmits the corresponding nerve and vessels, which descend from the pterygopalatine fossa to reach the oral surface of the hard

FIGURE 2. E, the pterygoid process has been removed, further exposing the pterygopalatine fossa containing the terminal part of the maxillary artery and its sphenopalatine, infraorbital, pharyngeal, and greater and lesser palatine branches. The pterygoid canal and the foramen rotundum, which are bounded on the medial side by an extension of the sphenoid sinus, have been opened to expose the vidian and maxillary nerves. The floor of the infraorbital groove, which is located in the roof of the maxillary sinus, has been removed to expose the infraorbital nerve and artery. The cartilage, which fills the lower margin of the foramen lacerum, has been removed to expose the posterior orifice of the pterygoid canal and the internal carotid artery coursing above the foramen.



palate at the greater palatine foramen medial to the molar tooth, approximately 6 to 7 mm in front of the pterygomaxillary suture (Figs. 1, C and F, and 41). The greater palatine artery is sectioned during the last osteotomy, unless the artery is freed from the bony canal or unless the retromolar osteotomy, through the pterygomaxillary suture, is situated in front of the canal. Brisk bleeding from the artery may be controlled by occlusion of the maxillary artery at the pterygomaxillary fissure or by preoperative embolization.

The osteotomy may extend behind the posterior maxillary wall, in which case the posterior limit of the exposure is the pterygopalatine fossa located between the maxilla and pterygoid process, or it can be extended behind the pterygopalatine fossa and through the pterygoid process if necessary. The lower maxilla can be hinged to a pedicle of soft palate to preserve some of the maxilla's blood supply, but in this study the maxilla was completely detached to provide a better display of the anatomic detail. After mobilizing the lower maxilla, the reachable areas include the nasal and oral cavities, the oro- and nasopharynx, and the anterior part of the infratemporal fossa, which at this stage is covered by the buccal fat pad underlying the cheek and may be very prominent (Fig. 4H).

### Upper maxillectomy

To perform the upper maxillectomy, the upper osteotomy is extended through the orbital rim and floor, and the lower

cut is directed above the level of the alveolar process along the inferior meatus medially and just above the maxillary attachment of the buccinator laterally, leaving the hard palate intact (Fig. 5F). It includes a cut in the orbital floor behind and parallel to the inferior orbital rim, extending from the anterolateral edge of the inferior orbital fissure toward the medial and lateral orbital walls, after the infraorbital nerve is unroofed and elevated from the floor with the orbital contents (Fig. 5E). The infraorbital nerve, which is a branch of the maxillary nerve, enters the orbit through the inferior orbital fissure and passes forward successively in the infraorbital groove, canal, and foramen to reach the cheek. The anterolateral end of the inferior orbital fissure, which usually is wider than the medial part, provides communication between the orbit and the anterosuperior aspect of the infratemporal fossa, and is covered posteriorly by the most anterior part of the temporalis (Figs. 1, A and B, and 2). Reflection of a frontotemporal scalp flap allows the temporalis to be detached from the anterior part of the temporal fossa, exposing the lateral orbital rim for osteotomy.

The lateral orbital osteotomy begins at the anterolateral edge of the inferior orbital fissure, extends upward along the lateral wall near the suture between the orbital surface of the greater sphenoid wing and the zygomatic frontal process, where the wall is thinnest, and finally turns anteriorly to cross the lateral orbital rim. After a cut of the zygomatic arch,

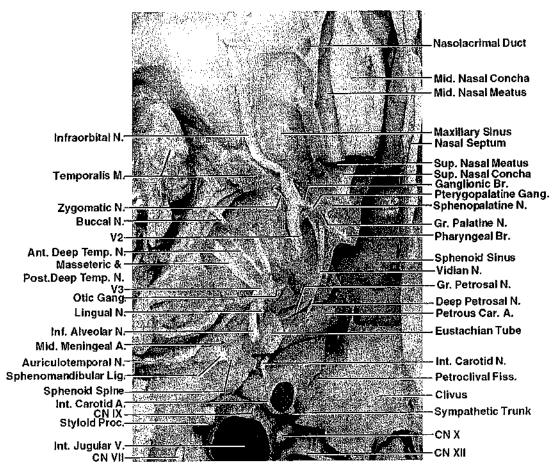


FIGURE 2. F, the arterial structures in the pterygopalatine fossa have been removed to expose the neural relationships. The pterygopalatine ganglion is situated medial to the maxillary nerve and is connected to it by ganglionic branches. The right half of the sphenoid sinus has been opened, and the petrous carotid has been exposed by removing petrous bone underlying the carotid canal. The Eustachian tube, which has been divided at the root of its cartilaginous part, is situated immediately anterolateral to the petrous carotid. The clivus is bounded laterally by the external surface of the petroclival fissure, in which the inferior petroclival vein courses.

osteotomy is performed at the posterior wall of the maxillary sinus. Pterygomaxillary separation in the retromolar region is not necessary for the upper maxillectomy; thus, the neurovascular contents of the greater palatine canal and the osseous connection between the hard palate, posterior maxilla, and pterygoid process are preserved. At this point, the exposure includes the nasal cavity by opening the lateral nasal wall, and the periorbita covering the lower and lateral orbit. The posterior pharyngeal wall facing the clivus is visible through the nasal cavity from the anterior midline; however, the exposure is limited laterally by the pterygoid process and below by the hard palate. Lateral access to the infratemporal fossa is still blocked by the mandible and the temporalis.

The lacrimal apparatus is not transected unless medial orbital or ethmoidal dissection is required (Fig. 6). The anterior and lateral walls of the nasolacrimal canal are formed by the maxilla and the posteromedial wall by the lacrimal bone superiorly and the inferior nasal concha inferiorly. The lateral wall of the nasolacrimal canal is formed by the most anterior part of the medial wall of the maxillary sinus. To preserve the entire nasolacrimal canal and duct, the osteotomy along the orbital floor extends laterally to the upper opening of the nasolacrimal canal, then crosses the lower orbital rim laterally to the medial wall of the maxillary sinus, and continues obliquely to the anterior nasal aperture at the level of the inferior nasal meatus. If access to the ethmoid sinus and

medial orbit is required after the above cuts, an osteoplastic flap consisting of the nasal bone and maxillary frontal process can be elevated. If the oblique cut along the anterior maxillary wall is directed more horizontally to a higher point on the anterior nasal aperture (at the level of the middle nasal meatus between the middle and inferior nasal conchae), the nasolacrimal duct must be divided during the osteotomy.

After transecting the lacrimal sac at the entrance to the canal, the osteotomy can be extended up the medial orbital wall as high as the suture with the frontal bone (Fig. 6D). The anterior border of the medial orbital wall, formed by the anterior lacrimal crest of the maxillary frontal process, joins posteriorly with the lacrimal bone to complete the nasolacrimal groove. The posterosuperior part of the nasolacrimal groove faces the anterior ethmoid sinus, and the anteroinferior part is related medially to the middle nasal meatus. The medial orbital osteotomy, if it is necessary, should be performed below the frontoethmoidal suture line at the site of the anterior and posterior ethmoidal canals, which are located lateral to and at the level of the intracranial surface of the cribriform plate (Fig. 6, D and E).

#### Retromaxillary stage

The retromaxillary area accessed during lower and upper maxillectomy includes the infratemporal and pterygopalatine fossae and the parapharyngeal space (Fig. 2). The difference in

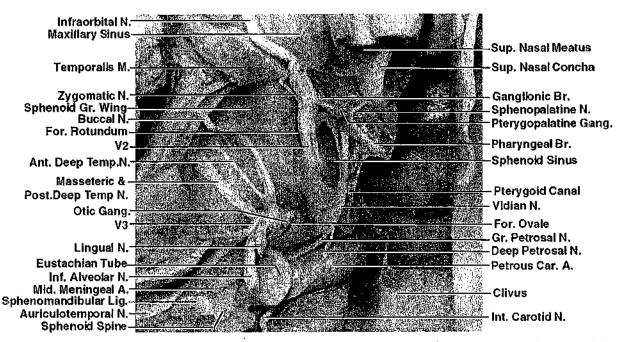


FIGURE 2. G, enlarged view of the neural structures in the pterygopalatine and infratemporal fossa and the pterygoid canal. The branches joining or emanating from the pterygopalatine ganglion include the greater and lesser palatine, sphenopalatine, vidian, and pharyngeal nerves.

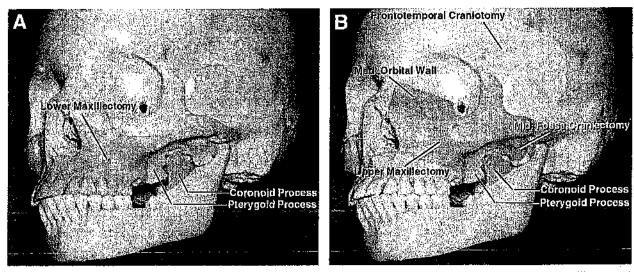


FIGURE 3. Basic and extended units for completing the upper and lower subtotal maxillectomies. A, the lower maxillectomy is performed by a combination of osteotomies through the maxillary body, hard palate, and pterygomaxillary junction and can be extended by removing the coronoid and pterygoid processes. B, the upper maxillectomy is accomplished by performing osteotomies through the maxillary body above the alveolar process, lower orbital rim, and zygomatic arch and can be extended by removing the pterygoid and coronoid processes. The procedure can be combined with a frontotemporal craniotomy and removal of the floor of the middle cranial fossa. An osteotomy in the medial orbital wall is optional for anterior midline access.

exposure with the two approaches will be discussed after reviewing the anatomy of these areas.

Infratemporal fossa (Figs. 1F; Fig. 2; Fig. 4, D–G; and Fig. 5, G–K)

Removal of the lateral part of the posterior maxillary wall, which is performed in both the upper and lower maxillectomy, exposes

the anterior part of the infratemporal fossa. Visualization of the infratemporal fossa is improved by dividing the coronoid process above the level of the mandibular foramen, at the site where the inferior alveolar nerve and artery enter the mandibular canal. The mandibular foramen or canal is not violated if the cut at the root of the coronoid process is located above a line extending obliquely downward from the mandibular incisura.



FIGURE 4. Lower subtotal maxillectomy approach. A, the incision crosses the upper lip and the paranasal, infraorbital, and buccogingival areas. The cheek flap has been reflected laterally by subperiosteal dissection, exposing the maxilla and zygomatic bone and the upper edge of the masseter. The infraorbital nerve and artery have been divided to gain the widest exposure. The approach is commonly completed using only the lateral rhinotomy incision without the lateral infraorbital extension, or by a degloving technique without an incision on the face or transection of the infraorbital nerve, which may be reapproximated at the conclusion of the procedure. A., artery; Access., accessory; A.I.C.A., anteroinferior cerebellar artery; Ant., anterior; Asc., ascending; Atlanto-occip., atlanto-occipital; Br., branch; Car., carotid; Cav., cavernous; CN, Cranial Nerve; Fiss., fissure; For., foramen; Gang., ganglion; Gr., greater; Inf., inferior; Int., internal; Intercav., intercavernous; Intracav., intracavernous; Lat., lateral; Less.; lesser; Lev., levator; Lig., ligament; M., muscle; Med., medial; Mid., middle; N., nerve; P.I.C.A., posteroinferior cerebellar artery; Post., posterior; Proc., process; S.C.A., superior cerebellar artery; Sup., superior; Superf., superficial; Temp., temporal; Tens., tensor; TM, temporomandibular; V., vein.

The osseous boundaries of the infratemporal fossa are the posterolateral maxillary surface anteriorly, the lateral pterygoid plate anteromedially, the mandibular ramus laterally, and the tympanic part of the temporal bone and the styloid process posteriorly. The fossa is domed anteriorly by the infratemporal surface of the greater sphenoid wing, at the site of the foramina ovale and spinosum, and posteriorly by the squamous part of the temporal bone (Figs. 1F and 2, F and G). The inferior, posteromedial, and superolateral aspects are open without bony walls.

The lateral pterygoid muscle crosses the upper part of the infratemporal fossa taking origin from upper and lower heads: the upper head arises from the infratemporal surface and infratemporal crest of the greater sphenoid wing, and the lower originates from the lateral surface of the lateral pterygoid plate (Fig. 2; Fig. 4, C and D; and Fig. 5G). Both heads pass posterolaterally, inserting on the neck of the mandibular condylar process and the articular disc of the temporomandibular joint. The medial pterygoid muscle crosses the lower part of the infratemporal fossa and arises with superficial and deep heads; the superficial head arises from the lateral aspect of the palatine pyramidal process and the maxillary tuberosity, and it passes superficial to the lower head of the lateral

pterygoid. The deep head originates from the medial surface of the lateral pterygoid plate and the pterygoid fossa between the two pterygoid plates, and it passes deep to the lower head of the lateral pterygoid (Fig. 2, A and B; Fig. 4, C-F; and Fig. 5, G-I). Both heads descend backward and laterally to attach to the medial surface of the mandibular ramus below the mandibular foramen. The anterior part of the lower head of the lateral pterygoid is situated between the anterior part of the two heads of the medial pterygoid. The sphenomandibular ligament, located medially to the mandibular condylar process, descends from the sphenoid spine to attach to the lingula of the mandibular foramen. The structures located or passing between the sphenomandibular ligament and the mandible are the lateral pterygoid and the auriculotemporal nerve superiorly, and the inferior alveolar nerve, the parotid gland, the maxillary artery, and its inferior alveolar branch inferiorly (Figs. 2C, and 4, K and N).

The maxillary artery is divided into three segments: mandibular, pterygoid, and pterygopalatine (Figs. 4D and 5G). The mandibular segment arises from the external carotid artery near the posterior border of the condylar process, passes between the process and the sphenomandibular ligament along the inferior border of the lower head of the lateral

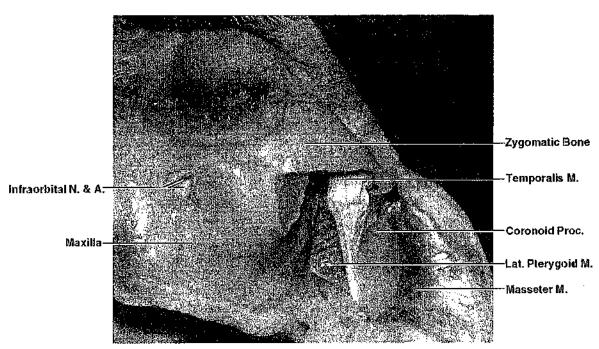


FIGURE 4. B, the masseter has been detached from the zygoma and retracted laterally, and the inferior part of the zygoma has been removed to expose the coronoid process and the temporalis attachment.

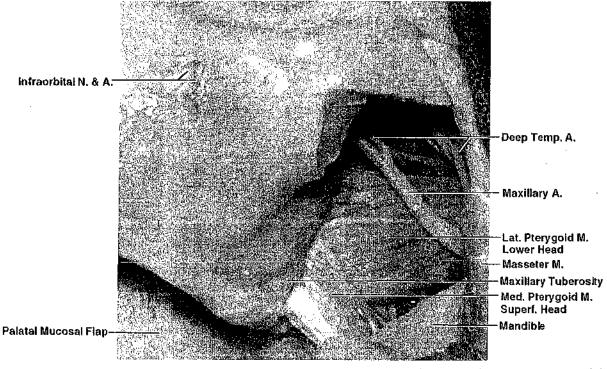
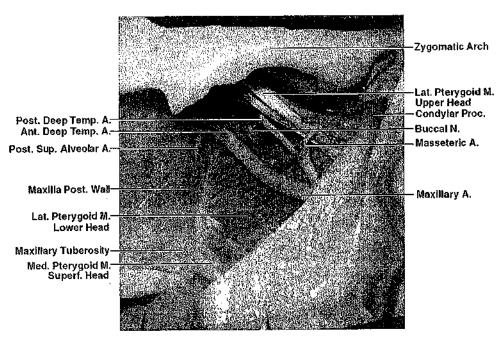


FIGURE 4. *C,* the coronoid process and the lower part of the temporalis have been removed to expose the maxillary artery and the lateral and medial pterygoids in the infratemporal fossa. The temporalis attachment and coronoid process can be retracted and reattached at the conclusion of the procedure. A mucosal flap has been elevated from the lower palatal surface using subperiosteal dissection.

pterygoid, and gives rise to the deep auricular, anterior tympanic, middle and accessory meningeal, and inferior alveolar arteries. The middle meningeal ascends medial to the lateral pterygoid to enter the foramen spinosum, the accessory men-

ingeal arises from the maxillary or middle meningeal to enter the foramen ovale, and the inferior alveolar descends to enter the mandibular foramen (Figs. 4F and 5H). The pterygoid segment usually courses lateral to, but occasionally medial to, FIGURE 4. D, anterolateral view of the infratemporal fossa. The pterygoid segment of the maxillary artery passes lateral to the lower head of the lateral pterygoid, which arises from the lateral surface of the lateral pterygoid plate and attaches to the neck of the condylar process and the capsule of the temporomandibular joint. The superficial head of the medial pterygoid arises from the maxillary tuberosity and the palatine pyramidal process and descends superficial to the lower head of the lateral pterygoid where it attaches to the medial surface of the mandibular angle. The upper head of the lateral pterygoid arises from the region of the infratemporal crest and the adjacent part of the greater wing of the sphenoid.



the lower head of the lateral pterygoid and gives rise to the deep temporal, pterygoid, masseteric, and buccal arteries. The pterygopalatine segment courses between the two heads of the lateral pterygoid and enters the pterygopalatine fossa by passing through the pterygomaxillary fissure. Its branching will be described with the pterygopalatine fossa.

The pterygoid venous plexus is located in the infratemporal fossa and has two parts: a superficial part located between the temporalis and lateral pterygoid, and a deep part situated between the lateral and medial pterygoids anteriorly and between the lateral pterygoid and the parapharyngeal space posteriorly (Figs. 2, A-C, and 4E). The deep part is more prominent and connects with the cavernous sinus by emissary veins passing through the foramina ovale and spinosum and occasionally through the sphenoidal emissary foramen (foramen of Vesalius) (Fig. 1F). The main drainage of the pterygoid plexus is through the maxillary vein to the internal jugular vein.

The mandibular nerve enters the infratemporal fossa by passing through the foramen ovale on the lateral side of the parapharyngeal space, where it gives rise to several smaller branches, and then divides into smaller anterior and a larger posterior trunks (Fig. 2, D-G; Fig. 4, F-K; and Fig. 5, H-J). The anterior trunk gives rise to the deep temporal and masseteric nerves, which supply the temporalis and the masseter, respectively, and the nerve to the lateral pterygoid, all of which run anterolaterally to reach these muscles. The buccal nerve, which conveys sensory fibers, passes anterolaterally between the two heads of the lateral pterygoid and descends lateral to the lower head to reach the buccinator and the buccal mucosa. The nerve to the lateral pterygoid occasionally runs with the buccal nerve. The posterior trunk gives off the lingual, inferior alveolar, and auriculotemporal nerves, which descend medial to the lateral pterygoid. These nerves are predominantly sensory with the exception of the mylohyoid nerve, which arises

from the inferior alveolar nerve above the mandibular foramen and supplies the anterior belly of the digastric and the mylohyoid.

The lingual and inferior alveolar nerves, the former coursing anterior to the latter, pass between the lateral and medial pterygoids. The auriculotemporal nerve usually splits to encircle the middle meningeal artery and passes posterolaterally between the mandibular ramus and the sphenomandibular ligament. The chorda tympani nerve, which contains the taste fibers from the anterior two-thirds of the tongue and the parasympathetic secretomotor fibers to the submandibular and sublingual salivary glands, enters the infratemporal fossa through the petrotympanic fissure at the medial edge of the sphenoid spine. It descends medial to the auriculotemporal and inferior alveolar nerves and joins the lingual nerve. The otic ganglion is situated immediately below the foramen ovale on the medial side of the mandibular nerve (Figs. 2, D-G, and 4F). The ganglion receives the lesser petrosal nerve, which courses along the floor of the middle fossa anterolateral to the greater petrosal nerve to exit through the foramen ovale or the more posteriorly situated canaliculus innominatus, and it conveys parasympathetic secretomotor fibers to the parotid gland via the auriculotemporal nerve (Fig. 5, Q--S). The medial pterygoid nerve arises from the medial aspect of the mandibular nerve close to the otic ganglion and descends to supply the medial pterygoid and tensor veli palatini. The nervus spinosus, a meningeal branch, also arises near the otic ganglion and ascends through the foramen spinosum to innervate the middle fossa dura.

Parapharyngeal space

Both the upper and lower maxillectomy access the upper part of the parapharyngeal space (Figs. 2B and 4F). The space, overall, is shaped like an inverted pyramid, with its base on the cranial base superiorly and its apex at the hyoid bone

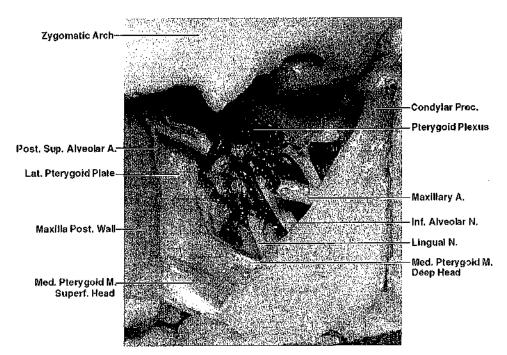
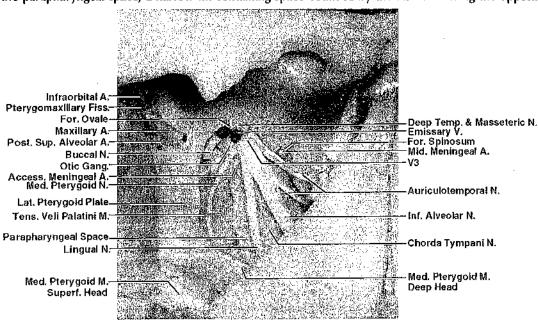


FIGURE 4. E, the lateral pterygoid has been removed to expose the deep part of the pterygoid venous plexus, which connects with the cavernous sinus by the emissary veins passing through the foramina ovale and spinosum, and occasionally through the inconstant sphenoidal emissary foramen, which if present is located medial to the foramen ovale. The lingual and inferior alveolar nerves descend through the pterygoid venous plexus.

FIGURE 4. F, the pterygoid plexus has been removed to expose the otic ganglion, as well as the mandibular nerve and its lingual, inferior alveolar, auriculotemporal, buccal, medial pterygoid, deep temporal, and masseteric branches. The chorda tympani nerve passes medial to the middle meningeal artery and the auriculotemporal and inferior alveolar nerves, and joins the lingual nerve to be distributed to the tongue and the sublingual and submandibular glands. The middle meningeal artery ascends between the two rootlets of the auriculotemporal nerve to reach the foramen spinosum, and an accessory meningeal artery ascends medial to the lingual and inferior alveolar nerves to pass through the foramen ovale. The anterior portion of the parapharyngeal space, a narrow fat-containing space bounded by the fascia covering the opposing surfaces of the tensor



veli palatini and medial pterygoid, separates the infratemporal fossa from the medially situated lateral nasopharyngeal region, which contains the Eustachian tube and the tensor and levator veli palatini. The anterior portion of the parapharyngeal space has been partially removed to expose the tensor veli palatini, which hides the Eustachian tube located on its posteromedial surface.

inferiorly. It is subdivided into prestyloid and poststyloid compartments by the styloid diaphragm, a fibrous sheet that also constitutes the anterior part of the carotid sheath. The prestyloid part, situated anteriorly between the fascia covering the opposing surfaces of the medial pterygoid and tensor

veli palatini, is a thin fat-filled compartment separating the structures in the infratemporal fossa from the Eustachian tube and tensor and levator veli palatini in the lateral nasopharyngeal wall. The upper portion of the prestyloid part is situated between two fascial sheets, which are oriented in a sagittal

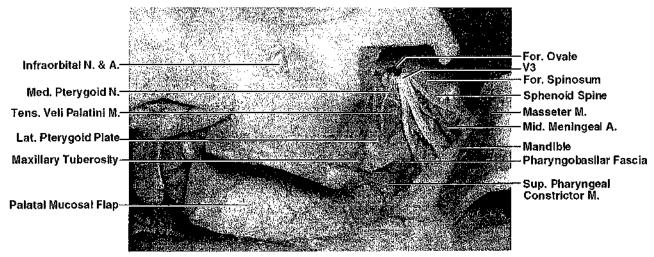


FIGURE 4. G, anterolateral view before maxillectomy. The infratemporal fossa has been exposed through the space gained by removing the coronoid process and part of the zygoma. The lateral and medial pterygoids have been removed. The mucosal flap on the lower palatal surface is hinged and reflected to the opposite side. The fascial walls of the parapharyngeal space have been removed to expose the tensor and levator veli palatini. The medial pterygoid nerve descends lateral to the tensor veli palatini.

plane. The lateral sheet arises from the medial surface of the medial pterygoid, and it passes upward, backward, and medial to the mandibular nerve and the middle meningeal artery, incorporating the sphenomandibular ligament posteriorly and reaching the retromandibular deep lobe of the parotid gland.

The medial sheet is formed by the fascia overlying the lateral surface of the tensor veli palatini and is continuous inferiorly with the fascia over the superior pharyngeal constrictor and posteriorly with the thick styloid diaphragm, which envelopes the stylopharyngeus, styloglossus, and

stylohyoid and blends into the carotid sheath. The superior border is located where the two fascial sheets fuse together and insert in the cranial base along a line extending backward from the pterygoid process lateral to the origin of the tensor veli palatini, and medial to the foramina ovale and spinosum to the sphenoid spine and the posterior margin of the glenoid fossa. The sharply angled inferior boundary is situated at the junction of the posterior digastric belly and the greater hyoid cornu. The poststyloid part, which contains the internal carotid artery, internal jugular vein, and the initial extracranial segment of Cranial Nerves IX through XII, is separated from

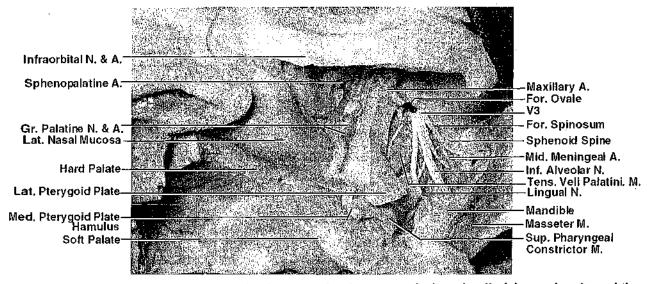


FIGURE 4. H, the lower subtotal maxillectomy has been completed to expose the lateral wall of the nasal cavity and the retromaxillary region. The mucosal lateral wall and floor of the nasal cavity remain intact. The pterygoid process and plates block access to the central cranial base. The greater palatine nerve and artery arise in the pterygopalatine fossa and descend in front of the sphenoid pterygoid process. The soft palate has been divided for this maxillectomy; however, the maxilla may be hinged to a soft palate pedicle and folded down into the mouth to preserve the maxillary blood supply.

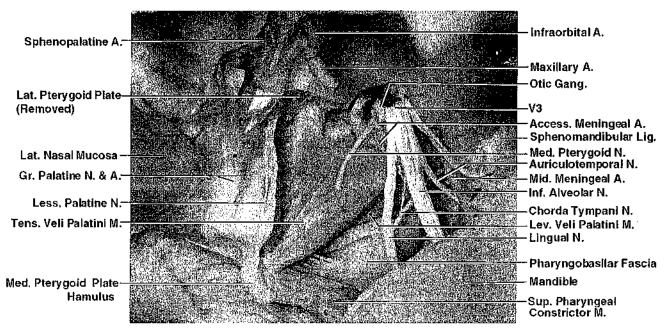


FIGURE 4. I, enlarged view. The lateral pterygoid plate has been removed to expose the tensor veli palatini, which descends medial to the mandibular nerve on the anterolateral side of the Eustachian tube and lateral to the medial pterygoid plate and the levator veli palatini. The tendon of the tensor veli palatini loops medially around the pterygoid hamulus on the lower edge of the medial pterygoid plate to insert into the soft palate. The foramen ovale is located posterolateral to the base of the lateral pterygoid plate.

the infratemporal fossa by the posterolateral portion of the prestyloid part. The parapharyngeal space has been included in the infratemporal fossa in some descriptions of this region (3, 26).

# Pterygopalatine fossa

Both the upper and lower maxillectomies expose the pterygopalatine fossa (Fig. 1, C, E, and F; Fig. 2, A, B, and D-G; Fig.

4, I-L; Fig. 5G; and Fig. 6E). The posterior wall of the maxillary sinus, which forms the anterior wall of the fossa, is so thin and fragile that it may fracture from the mobilized maxilla and require separate removal to expose the anterior face of the fossa. The fossa is bounded posteriorly by the sphenoid pterygoid process, medially by the palatine perpendicular plate, which bridges the interval between the maxilla and pterygoid

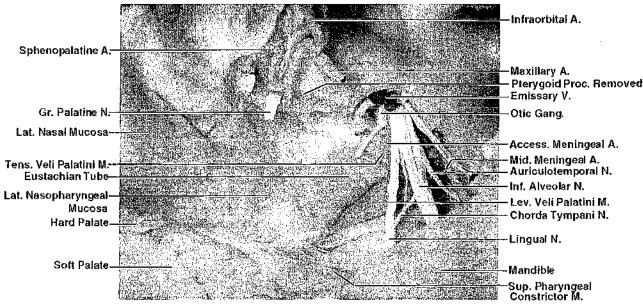


FIGURE 4. J, the pterygoid process, medial pterygoid plate, and tensor veli palatini have been removed to expose the Eustachian tube, levator veli palatini, and the lateral nasopharyngeal wall, which blends anteriorly into the lateral nasal wall.

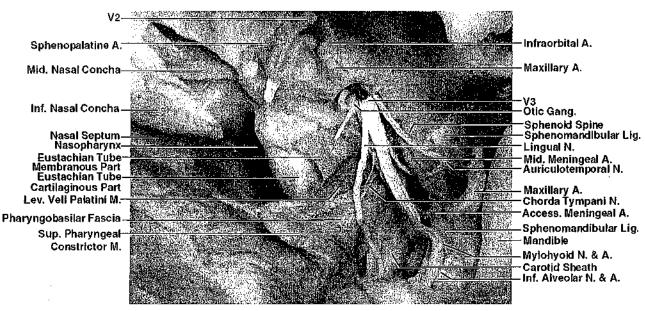


FIGURE 4. *K,* the lateral membranous portion of the Eustachian tube has been exposed and the lateral wall of the nasopharynx and nasal cavity has been opened. The lateral apex of the pharyngeal recess, which is covered only by the pharyngobasilar fascia, is located below and behind the levator veli palatini and superior to the upper border of the superior pharyngeal constrictor. The cervical carotid, surrounded by the carotid sheath, ascends lateral to the pharyngeal recess. Part of the mandible has been removed to expose the sphenomandibular ligament, a fibrous band extending from the sphenoid spine to the lingula of the mandible. This is located at the medial aspect of the mandibular foramen where the inferior alveolar nerve and artery enter. The structures located between the ligament and the mandible include the mandibular segment of the maxillary artery, the middle and accessory meningeal and inferior alveolar arteries, and the auriculotemporal and inferior alveolar nerves.

process, and it opens superiorly through the medial part of the inferior orbital fissure into the orbital apex. The fossa contains the maxillary nerve, pterygopalatine ganglion, maxillary artery and their branches, all embedded in fat tissue. Its lateral boundary, the pterygomaxillary fissure, opens into the infratemporal fossa and allows passage of the maxillary artery from the infratemporal into the pterygopalatine fossa where the artery gives rise to its terminal branches. The lower part of the fossa is funnel-shaped with its inferior apex opening into the greater and lesser palatine canals, which transmit the

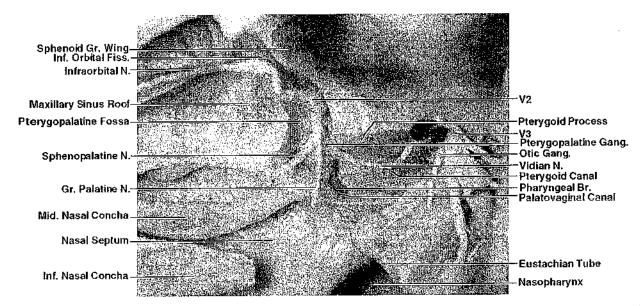


FIGURE 4. L, inferolateral view of the pterygopalatine fossa and its neural contents, including the pterygopalatine ganglion and the maxillary, sphenopalatine, and greater palatine nerves. The root of the pterygoid process has been drilled to expose the pterygoid and palatovaginal canals, which transmit the vidian nerve and the pharyngeal branch of the maxillary nerve, respectively.



FIGURE 4. M, the ipsilateral pharyngeal wall between the Eustachian tube and the stylopharyngeus muscle has been retracted to the opposite side to expose the anterior arch of C1 and the longus colli and capitis. Retracting the longus capitis exposes the attachment of the longus colli to the anterior tubercle of C1.

greater and lesser palatine nerves and vessels, and communicate with the oral cavity. The sphenopalatine foramen, located in the upper part of the fossa's medial wall, conveys the sphenopalatine nerve and vessels, and it opens into the superior nasal meatus just above the root of the middle nasal concha. The foramen is formed anteriorly by the palatine bone's orbital process, posteriorly by the sphenoidal process,

and inferiorly by the upper end of the perpendicular plate, which also forms the medial wall of the fossa. The foramen rotundum opens just below the superior orbital fissure through the superior part of the posterior wall of the fossa (Figs. 1, B and C, and 2, E–G).

The pterygoid canal opens through the pterygoid process inferomedial to the foramen rotundum, and conveys the vid-

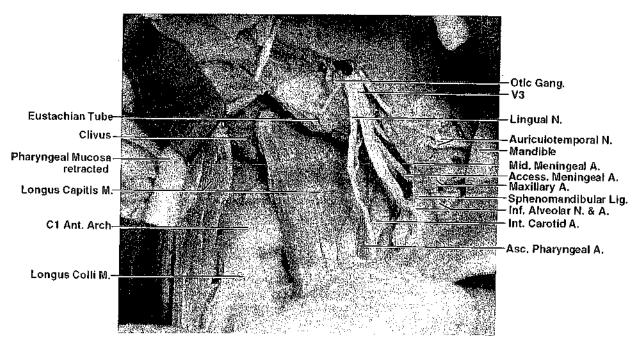


FIGURE 4. N, the clivus has been exposed by dividing the Eustachian tube and retracting the nasopharyngeal roof to the opposite side. Division of the stylopharyngeus permits retraction of the lower part of the lateral pharyngeal wall to the opposite side and aids in exposing the internal carotid and ascending pharyngeal arteries lateral to the longus capitis.



FIGURE 4. O, the longus capitis and colli have been retracted laterally to expose the clivus, the anterior arch of C1, and the dens and body of C2.

ian nerve carrying autonomic fibers to the pterygopalatine ganglion. After entering the fossa, the maxillary nerve gives off ganglionic branches to the pterygopalatine ganglion, then deviates laterally just beneath the inferior orbital fissure, giving rise to, in order, the zygomatic and posterosuperior alveolar nerves outside the periorbita. It then turns medially as the infraorbital nerve passing through the inferior orbital fissure to enter the infraorbital groove, where the anterosuperior and

middle superior alveolar nerves arise, finally exiting the infraorbital foramen to terminate on the cheek.

The pterygopalatine ganglion, located in front of the pterygoid canal and inferomedial to the maxillary nerve, receives communicating rami from the maxillary nerve and gives rise to the greater and lesser palatine nerves from the lower surface of the ganglion, the sphenopalatine nerve and pharyngeal branch from the medial surface, and the orbital branch from

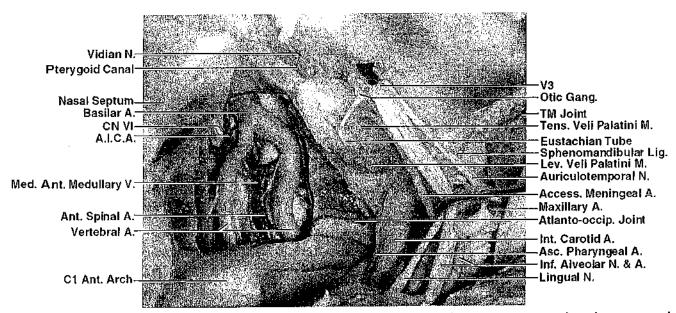


FIGURE 4. P, the middle and lower thirds of the clivus and the anterior aspect of the foramen magnum have been removed and the dura opened to expose the medulla, the pons, and the basilar and vertebral arteries.



FIGURE 4. Q, the anterior wall of the sphenoid sinus, the posterior part of the nasal septum, and the base of the medial pterygoid plate have been removed to expose a well-pneumatized sphenoid sinus and the anterior sellar wall.



FIGURE 4. R, the sellar floor and adjacent sinus wall have been removed to expose the pituitary gland, intracavernous carotid arteries, optic nerves, ophthalmic arteries, and intercavernous sinuses. The posterior wall of the sphenoid sinus, which forms the anterior surface of the upper clivus, has been removed to expose the pons and the basilar and superior cerebellar arteries. The short segment of the internal carotid artery (arrow) above the Eustachian tube courses on the cartilage of the lower aspect of the foramen lacerum and at this point turns upward to form the posterior vertical segment of the internal carotid artery defines the lateral limit of clival exposure.

the superior surface. The vidian nerve is formed by the union of the greater petrosal nerve, which conveys parasympathetic fibers arising from the facial nerve at the level of the geniculate ganglion, and the cleep petrosal nerve, which conveys sympathetic fibers from the

carotid plexus, to reach the lacrimal gland and nasal mucosa. The parasympathetic fibers synapse in the pterygopalatine ganglion, whereas the sympathetic fibers synapse in the superior cervical sympathetic ganglion.

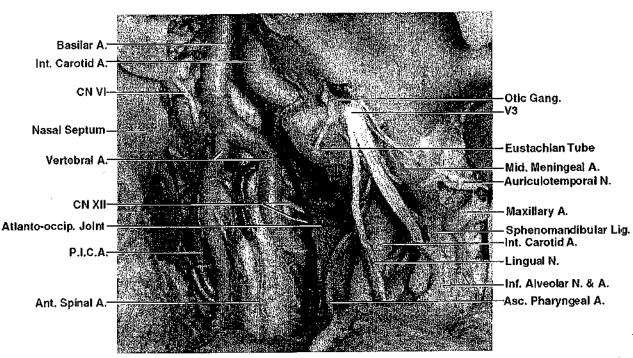


FIGURE 4. S, the anterior arch of C1 and the dens have been removed to expose the lower medulla, the upper cervical spinal cord, and the vertebral and anterior spinal arteries.

The third or pterygopalatine segment of the maxillary artery enters the pterygopalatine fossa by passing through the pterygomaxillary fissure (Fig. 2E; Fig. 4, H and I; Fig. 5G; and Fig. 6E). This segment courses in an anterior, medial, and su-

perior direction and gives rise to the infraorbital artery, which passes through the inferior orbital fissure and courses with the infraorbital nerve; the posterosuperior alveolar artery, which descends to pierce the posterolateral wall of the

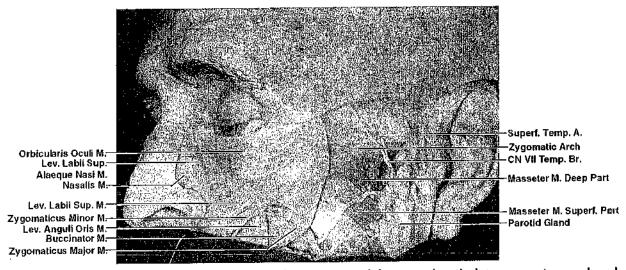


FIGURE 5. Upper subtotal maxillectomy. A, this approach uses paranasal, lower conjunctival, transverse temporal, and preauricular incisions. In the usual approach, the cheek flap is elevated as a single layer using subperiosteal dissection. In this dissection, each layer of the cheek flap was dissected separately to illustrate the structures in the flap. This exposes the facial muscles, the facial nerve branches, and the parotid gland. The temporal branch of the facial nerve, which is divided in completing the temporal incision, is tagged in preparation for reapproximation at closure. A., artery; Access., accessory; Ant., anterior; Br., branch; Cav., cavernous; CN, Cranial Nerve; For., foramen; Gang., ganglion; Gr., greater; Inf., inferior; Infratemp., infratemporal; Int., internal; Lat., lateral; Less., lesser; Lev., levator; Lig., ligament; M., muscle; Med., medial; Mid., middle; N., nerve; Post., posterior; Proc., process; Sup., superior; Superf., superficial; Temp., temporal; Tens., tensor; TM, temporomandibular; Transv., transverse; V., vein.



FIGURE 5. B, the parotid gland has been removed to expose the facial nerve at the stylomastoid foramen. The infraorbital part of the orbicularis oculi has been removed to expose the underlying muscles. The infraorbital nerve and vessels exit the infraorbital foramen beneath the levator labii superioris. The masseter, which is crossed by the parotid duct, attaches along the lower margin of the zygomatic arch.

maxilla; the recurrent meningeal branches, which pass through the foramen rotundum; the greater and lesser palatine arteries, which descend through the greater and lesser palatine canals; the vidian artery to the pterygoid canal; the pharyngeal branch to the palatovaginal canal; and finally the sphenopalatine artery, which passes through the sphenopalatine foramen to reach the nasal cavity and is considered the terminal branch of the maxillary artery because of its large diameter. The arterial structures in the pterygopalatine fossa are located anterior to the neural structures. Identification of the arteries in the middle of the fossa is difficult because of their tortuosity and the variability of branching. The venous

component of the fossa usually is scarce, and at times no significant veins are found with the exception of the sphenopalatine vein, which runs in the periosteum of the anterior wall of the fossa and empties laterally into the pterygoid venous plexus.

# Summary of the retromaxillary exposure

### Upper maxillectomy

The upper maxillectomy, with removal of the coronoid process and zygomatic arch, provides anterior, anterolateral, and lateral accesses to the pterygopalatine and infratemporal

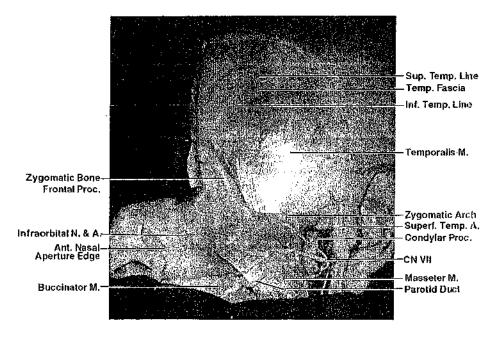
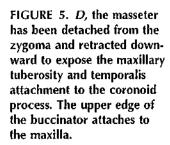
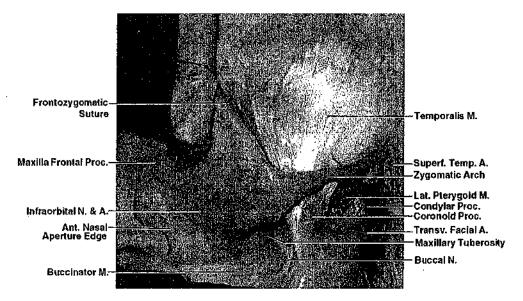


FIGURE 5. *C*, the hemicoronal incision and reflection of the frontotemporal scalp flap expose the lateral orbital rim, frontal bone, and the temporalis muscle. The cheek flap, containing the facial muscles, branches of the facial nerve, the parotid gland, and the masseter fascia has been reflected inferiorly to the level of the maxillary attachment of the buccinator muscle.





fossae and the parapharyngeal space (Fig. 5, G-K). The lateral view of the upper part of the infratemporal fossa using this approach is shorter and wider than that provided by the lower maxillectomy. The lateral route to the lower part of the infratemporal fossa is limited by the inferiorly reflected temporalis and the mandibular ramus. Anterior access to the lower portion of the fossa and the more posteriorly located poststyloid area is deep, and it is limited below by the remaining hard palate. Resection or mobilization of the mandibular condylar process provides an even wider lateral view of the fossa, particularly its posterior portion.

# Lower maxillectomy

The lower maxillectomy offers anterior and anterolateral access to the pterygopalatine and infratemporal fossae and the parapharyngeal space from below, in combination with the transoral route (Fig. 4, H-L). The internal carotid artery, internal jugular vein, and lower cranial nerves in the post-

styloid region can be accessed by opening the styloid diaphragm. However, lateral access is limited, and anterior exposure of the upper part of the infratemporal fossa is deeper and more restricted than the lateral exposure afforded by the upper maxillectomy.

# Central craniocervical stage

Both the lower and upper maxiliectomy provide access to the posterior nasopharyngeal wall for direct incision in the midline with exposure of the clivus down to C1, but only the lower maxillectomy provides oropharyngeal access for midline exposure as low as C4 (Fig. 4, M–S; Fig. 5, N–P; and Fig. 6, G and H). However, the midline exposure in both maxillectomies is restricted by the pterygoid process, the Eustachian tube, and the lateral pharyngeal wall. Removing the pterygoid process, the adjacent part of the Eustachian tube, and the tensor and levator veli palatini, then retracting the ipsilateral pharyngeal



FIGURE 5. E, the periorbita has been elevated from the orbital floor. The infraorbital nerve and artery proceed across the orbital floor. The lacrimal sac has been exposed above the orbital opening of the nasolacrimal canal.

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FIGURE 5. F, the orbital, maxillary, and zygomatic osteotomies have been compiled and the lower half of the orbital rim, the anterior, medial, and lateral walls of the maxillary body, and the zygomatic arch have been removed. The lower horizontal cut, located at Le Fort I level, extends above the apical roots and hard palate, along the inferior nasal meatus medially, and above the maxillary attachment of the buccinator laterally. The maxillectomy does not include the posterior maxillary wall or cross the greater and lesser palatine canals. The lateral nasal mucosa wall was included with the maxillectomy, which exposed the nasal cavity. The infraorbital nerve may be preserved for reconstruction when this exposure is closed.

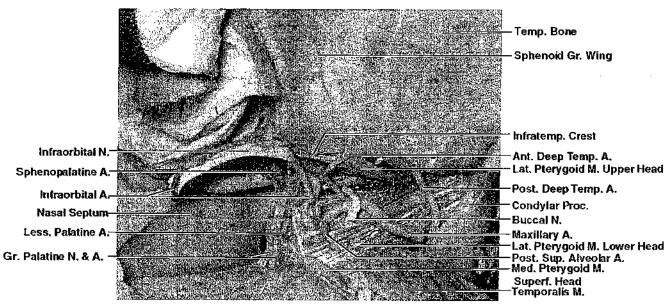


FIGURE 5. G, the posterior sinus wall has been removed to expose the pterygopalatine fossa and the greater and lesser palatine nerves and arteries. The base of the coronoid process was divided, and the temporalis was reflected downward to expose the infratemporal fossa. The lateral pterygoid has two heads: an upper head arising from the greater sphenoid wing along the infratemporal crest, and a lower head arising from the lateral pterygoid plate. The buccal nerve passes between the upper and lower heads. The maxillary artery, which in this case ascends forward lateral to the lateral pterygoid, may also pass medial to this muscle.

wall toward the opposite side widens the anterior and anterolateral access extending from the nasopharynx, sphenoid sinus, and clivus to the upper cervical region.

The pterygoid process, which may be removed in either of the two approaches, is formed by the medial and lateral plates, which fuse anteriorly (Fig. 1, C and F; Fig. 2D; Fig. 3; Fig. 4H; and Fig. 5H). The process faces the pterygopalatine fossa anteriorly, the infratemporal fossa laterally, and the posterior nasal aperture at the junction of the nasal cavity and nasopharynx medially. It is attached above to the junction of

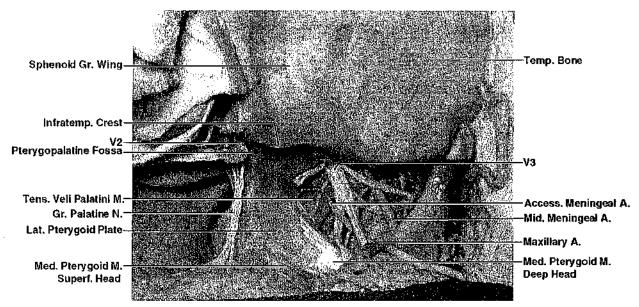


FIGURE 5. *H*, the maxillary artery has been divided distal to the origin of the deep temporal arteries that supply the temporalis. The lateral pterygoid has been removed to expose the deep head of the medial pterygoid, which arises from the opposing surfaces of the medial and lateral pterygoid plates facing the pterygoid fossa. Removal of the lateral pterygoid also exposes the mandibular nerve and branches below the foramen ovale and the middle meningeal artery below the foramen spinosum.

the greater wing and sphenoid body. The root of the lateral plate is located below the foramen rotundum and the medial portion of the middle cranial fossa. The base of the medial plate is usually bounded above by the sphenoid sinus, depending on the degree of pneumatization of the sinus. The pterygoid canal is located in the root of the medial plate inferomedial to the foramen rotundum and below the lateral

wing of the sphenoid sinus. The posterior edge of the root of the lateral plate projects backward to the foramen ovale. The posterior border of the root of the medial plate, which is located below the posterior opening of the pterygoid canal and the anterolateral aspect of the foramen lacerum, attaches to the anterior margin of the pharyngeal edge of the Eustachian tube.

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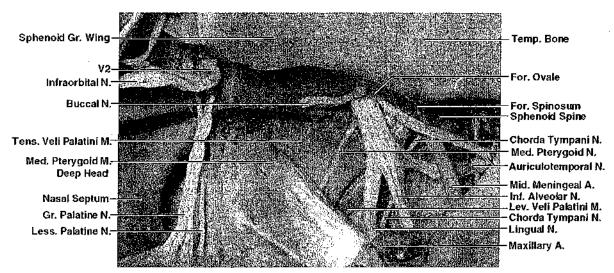


FIGURE 5. I, the lateral pterygoid plate has been removed to expose the origin of the deep head of the medial pterygoid. The auriculotemporal nerve usually splits into two roots that encircle the middle meningeal artery. The chorda tympani exits the temporal bone, enters the infratemporal fossa on the medial side of the sphenoid spine, and descends medial to the middle meningeal artery and the branches of the mandibular nerve to join the lingual nerve coursing anterior to the inferior alveolar nerve. The medial pterygoid nerve arises from the medial surface of the mandibular nerve near the otic ganglion and descends on the lateral surface of the tensor veli palatini to reach the deep surface of the medial pterygoid. The upper part of the parapharyngeal space extends into the thin fat-containing plane between the medial pterygoid and the tensor veli palatini.



FIGURE 5. J, the medial pterygoid has been removed to expose the tensor and levator veli palatini and the medial pterygoid plate. The tensor veli palatini has a long narrow origin, which extends backward from the scaphoid fossa at the root of the medial pterygoid plate and medial to the foramina ovale and spinosum and the sphenoid spine. The lateral wall of the pharyngeal recess (Rosenmüller's fossa), which is covered by the pharyngobasilar fascia, is a lateral extension of the nasopharynx behind the Eustachian tube and the levator veli palatini.

Removing the pterygoid process increases access to the lateral nasopharyngeal region, which includes the Eustachian tube and the tensor and levator veli palatini. The Eustachian tube descends anteromedially from the tympanic cavity to the nasopharynx (Fig. 2; Fig. 4, J–L; and Fig. 5, K and N–Q). The initial segment adjoining the tympanic cavity has solid walls formed by the temporal bone. Further anteromedially, the tube has a combination of fibrous and cartilaginous parts; the former forms only the lateral wall, and the latter forms the superior, medial, and inferior walls. The cartilaginous part is fused above to the extracranial groove (the sulcus tubae) between the petrous temporal bone and the sphenoid greater wing. The Eustachian tube is bounded laterally by the tensor veli palatini, posteriorly and

inferiorly by the levator veli palatini, and medially by the nasopharyngeal mucosa and pharyngobasilar fascia. The horizontal segment of the petrous carotid courses along the posteromedial margin of the Eustachian tube, and these structures usually are separated by a thin layer of bone.

The tensor veli palatini lies lateral to the Eustachian tube, the levator veli palatini, and the medial pterygoid plate (Fig. 2, A-D; Fig. 4I; and Fig. 5J). Its broad thin attachment to the cranial base extends backward and laterally from the scaphoid fossa at the medial aspect of the root of the medial pterygoid plate, between the foramina ovale laterally and the lacerum medially, and then between the foramen spinosum laterally and the orifice of the bony part of the Eustachian tube



FIGURE 5. K, the tensor veli palatini and the medial pterygoid plate have been removed to expose the Eustachian tube. The levator veli palatini is situated below and behind the Eustachian tube. The pharyngeal orifice of the Eustachian tube hugs the posterior edge of the medial pterygoid plate. The internal carotid ascends lateral to the pharyngobasilar fascia covering the pharyngeal recess.

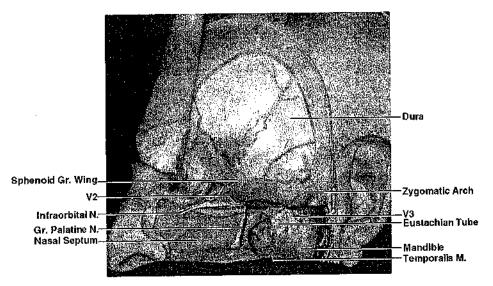


FIGURE 5. L, a frontotemporal craniotomy has been completed.

medially to end behind the sphenoid spine. It descends narrowing anteriorly to become a small tendon, which turns medially and crosses beneath the medial pterygoid hamulus to insert in the soft palate. The levator veli palatini attaches to the extracranial surface of the petrous temporal bone just in front of the lower opening of the carotid canal and partly to the lower aspect of the cartilaginous part of the Eustachian tube. It then descends below and behind the Eustachian tube, posteromedial to the tensor veli palatini, and lateral to the nasopharynx to insert in the soft palate.

Posterior to the levator veli palatini, the nasopharynx has a blind lateral wing, the pharyngeal recess (Rosenmüller's fossa), which is bounded posteriorly by the longus capitis and laterally by the pharyngobasilar fascia (Fig. 2, A–D). The apex of the posterolaterally projecting fossa faces the internal carotid and the ascending pharyngeal arteries. The pharyngobasilar fascia lines the lateral and posterior walls of the nasopharyngeal mucosa, and it attaches to the cranial base

superiorly, the posterior edge of the medial pterygoid plate anteriorly, and the superior pharyngeal constrictor below and behind. The fascia tightly attaches above to the fibrocartilaginous tissue covering the extracranial surface of the petroclival fissure. Posteriorly, the fascia attaches to the clivus immediately anterior to the prevertebral fascia overlying the longus capitis, and in the midline it joins the pharyngeal raphe of the superior pharyngeal constrictor, which is attached to the pharyngeal tubercle on the lower clival surface approximately 1 cm above the foramen magnum.

# Summary of central craniocervical exposure

Lower maxillectomy

The lower maxillectomy produces an excellent anterior exposure of the posterior part of the central cranial base through the combined transnasal, transoral, and transmaxillary routes, which is enhanced by removing the pterygoid process (Fig. 4,

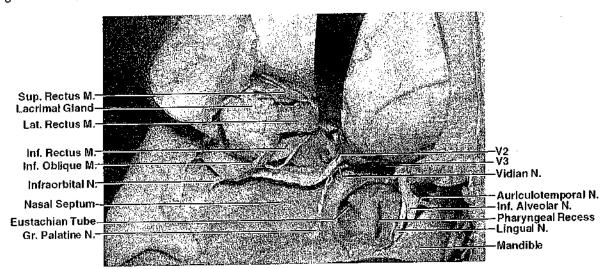


FIGURE 5. M, the removal of the greater sphenoid wing has been extended medially to open the lateral orbit, the superior orbital fissure, and the foramina ovale and rotundum. The periorbita has been opened to expose the lacrimal gland and extraocular muscles. The contralateral Eustachian orifice and pharyngeal recess are exposed behind the nasal septum.

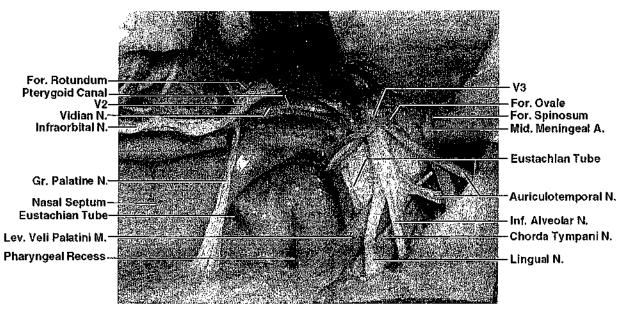


FIGURE 5. N, the removal of the floor of the middle fossa formed by the greater sphenoid wing opens the foramina rotundum, ovale, and spinosum, and the pterygoid canal. The pterygoid canal, through which the vidian nerve courses, crosses the base of the medial pterygoid plate and extends from the anterolateral edge of the foramen lacerum posteriorly to the pterygopalatine fossa anteriorly. Its anterior end is situated medial to and below the foramen rotundum.

M-R). The exposure can be increased by retracting the pharyngeal mucomuscular flap, which is composed of the pharyngobasilar fascia, the superior pharyngeal constrictor, the soft palate, the tonsillar pillars, the palatal tonsil, and the divided retromolar buccal mucosa to the opposite side. The pharyngeal dissection is directed in front of the prevertebral fascia overlying the longus capitis and the longus colli, and it requires opening the posterior part of the parapharyngeal space and detaching the stylopharyngeus as well as the tensor and levator veli palatini from the pharyngeal wall and soft palate. The main obstacle to accessing the clivus is the cartilaginous part of the Eustachian

tube. Pharyngeal retraction below the Eustachian tube exposes the anterior arch of C1 and the C2 to C4 vertebral bodies (*Fig. 4M*). Transection of the Eustachian tube and detachment of the pharyngobasilar fascia from the cranial base expose the posterior portion of the sphenoid body and the entire clivus (*Fig. 4N*). Exposing the lower half of the clivus requires retraction of the longus capitis on each side of the midline (*Fig. 4O*).

After these maneuvers, the internal carotid artery, internal jugular vein, and Cranial Nerves IX through XII define the lateral limit of the exposure. Removing the posterior nasal septum, above or in combination with removal of the ptery-

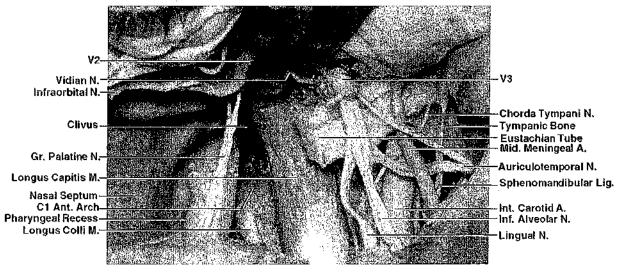


FIGURE 5. O, the left half of the posterior nasopharyngeal wall and the levator veli palatini have been removed to expose the retropharyngeal region, where the longus capitis ascends in front of the anterior arch of the atlas and attaches above to the clivus. The cervical carotid ascends behind the Eustachian tube and lateral to the longus capitis.

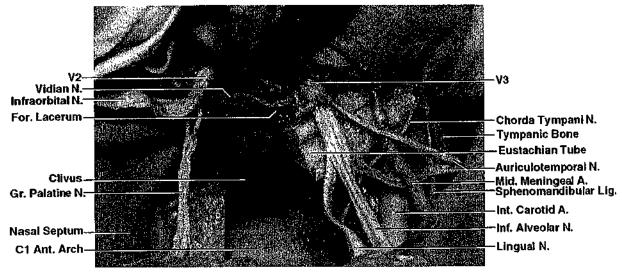


FIGURE 5. P, the longus capitis has been removed to expose the clivus and the anterior arch of C1.

goid process, allows for wide opening of the sphenoid sinus and the ipsilateral posterior ethmoid sinus (Fig. 4Q). The septal mucosa, if elevated as a pedicled flap, can be reflected to provide a vascularized layer that reinforces the closure of the clival dura. The structures that can be exposed through the sphenoid sinus are the medial wall of the cavernous sinus, including the intracavernous carotid artery, the optic nerve and ophthalmic artery in the optic canal, and the pituitary gland (Fig. 4R). The roof of the nasal cavity, lower surface of the cribriform plate, and anterior and middle ethmoid sinuses usually can be accessed without performing an additional osteotomy of the medial or inferior orbital rim.

# Upper maxillectomy

The upper maxillectomy yields anterior access to the posterior part of the central cranial base that is limited by the Eustachian tube superiorly and the hard palate inferiorly, even after the pterygoid process is removed (Fig. 5, N-P). Retracting the ipsilateral pharyngeal wall to the opposite side with division of the Eustachian tube produces somewhat limited access to the clivus and C1.

# Intracranial stage

Upper maxillectomy

Combining the upper maxillectomy with a frontotemporal craniotomy provides intradural access to the anterior and middle cranial fossae, the frontal and temporal lobes, and the basal cisterns by the subfrontal, pterional, pretemporal, and subtemporal routes (Fig. 5, L and Q). Removal of the greater sphenoid wing and floor of the middle cranial fossa opens the superior orbital fissure, foramina rotundum, ovale, and spi-

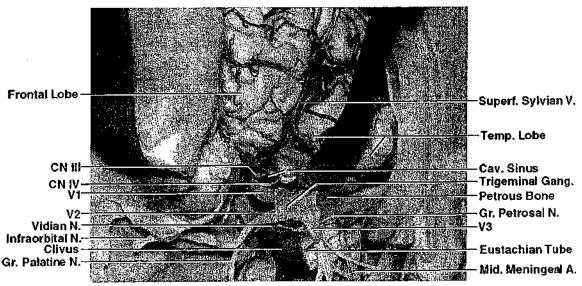


FIGURE 5. Q, the temporal lobe has been elevated, and the dura covering the frontal and temporal lobes and lateral wall of the cavernous sinus has been opened.

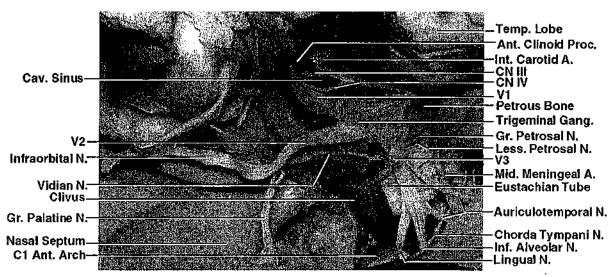


FIGURE 5. R, magnified view of the structures passing through the cavernous sinus, superior orbital fissure, and the foramina rotundum and ovale. The oculomotor, trochlear, and ophthalmic nerves are exposed in the lateral wall of the cavernous sinus. The supraclinoid portion of the internal carotid artery is exposed above the tentorial edge.

nosum, and it accesses the lateral wall of the cavernous sinus (Fig. 5, M-R). Drilling the base of the pterygoid plate exposes the pterygoid canal inferomedial to the foramen rotundum. Entry to the sphenoid sinus is obtained by drilling its lateral wall between the ophthalmic and maxillary nerves, or by drilling the anterior part of the root of the pterygoid process above the pterygoid canal. However, the space between the pterygoid canal and foramen rotundum is limited (Fig. 5S). Continued extradural dissection to the posterior part of the middle cranial fossa exposes the anterior surface of the petrous temporal bone, the trigeminal ganglion in Meckel's cave, and the greater and lesser petrosal nerves in their

grooves on the floor of the middle fossa. Drilling the apex of the petrous temporal bone behind the petrous carotid with opening of the dura accesses the anterolateral aspect of the upper brainstem, although the exposure is very limited. Anterior transposition of the petrous carotid is required to reach the central part of the clivus from this lateral exposure. The lateral access is best suited to exposing lesions at the petroclival junction rather than those centrally located in the clivus.

#### Lower maxillectomy

The lower maxillectomy, with removal of the clivus and anterior elements of the upper cervical vertebrae, provides

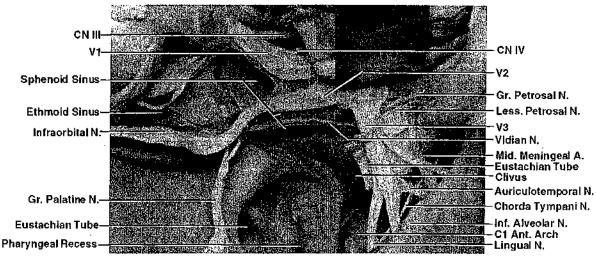


FIGURE 5. S, the lateral wall of the sphenoid sinus between the ophthalmic and maxillary nerves, and above and below the anterior part of the vidian nerve, has been opened to expose a well-pneumatized sphenoid sinus. The greater and lesser petrosal nerves (the former behind) cross the upper surface of the petrous temporal bone. The vidian nerve, formed at the edge of the foramen lacerum by the union of the greater and deep petrosal nerves, runs forward through the pterygoid canal in the base of pterygoid process to reach the pterygopalatine ganglion in the pterygopalatine fossa.

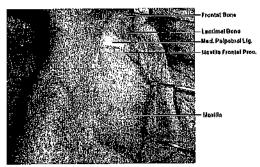


FIGURE 6. Exposure along the medial maxilla and orbit. A, the left paranasal incision extends to the lower edge of the eyebrow. The flap has been reflected using subperiosteal dissection to expose the maxillary frontal process and the attachment of the medial palpebral ligament. A., artery; A.I.C.A., anteroinferior cerebellar artery; Ant., anterior; Br., branch; Car., carotid; For., foramen; Gang., ganglion; Gr., greater; Inf., inferior; Intracav., intracavernous; Lat., lateral; Lig., ligament; M., muscle; Med., medial; Mid., middle; N., nerve; Post., posterior; Proc., process; Sup., superior.

reasonable intradural access to the front of the pons, the medulla, and the cervical spinal cord above C4 as well as the basilar and vertebral arteries (Fig. 4, P–S). The vital structures that provide the lateral limits to the extradural bone removal and the intradural exposure include the petrous and intracavernous carotid, especially the artery on the ipsilateral side; the abducent nerve in Dorello's canals, particularly the contralateral nerve located at the anterosuperior end of the petrous apex; and the hypoglossal canals and occipital condyles. Opening the basilar venous plexus, which crosses behind the upper clivus and the posterior wall of the sphenoid sinus, may result in profuse hemorrhaging.

# DISCUSSION

Among the various anterior routes to the central cranial base, the route most frequently selected for lesions involving the lower clivus and adjacent vertebral bodies has been the transoral approach (12, 13). The upper and middle portions of the clivus are also accessible by the Le Fort I transverse maxillotomy, and the additional median section of either the hard or both the hard and soft palates increases the clival exposure, although Cocke and Robertson (9) and Cocke et al. (10) conclude that the unilateral maxillectomy provides a more extensive exposure than some bilateral approaches, such as the Le Fort I (1, 4, 23, 28). The hemimaxillectomy approach described by Hernández-Altemir (16) accessed both the transmaxillary and transoral routes. Subsequent modifications and extensions have provided added exposure of both the central and the lateral cranial base, permitting en bloc excision of large neoplasms by selecting and combining the osteotomies on the basis of the extent of disease (7, 8, 10, 15, 18, 19, 21).

The osteotomies for completing the upper and lower maxillectomy approaches are divided into four basic units: maxillary body, orbital rim, hard palate, and zygomatic arch; and

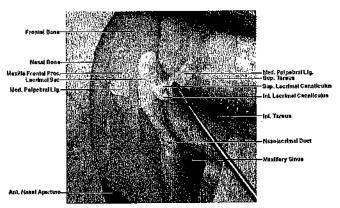


FIGURE 6. B, the medial palpebral ligament has been divided and retracted laterally to expose the lacrimal canaliculi and the underlying lacrimal sac, which sits in the nasolacrimal groove.

three extended units: coronoid process, pterygoid process, and frontotemporal craniotomy (Fig. 3). The maxillary sinus is a core space for these approaches through which the retromaxillary area can be reached without violating any vital structure, although the transantral route alone provides very limited exposure (11). Removal of the medial orbital rim provides access to the ethmoid and frontal sinuses, cribriform plate, and the anterior face of the sphenoid sinus through the medial orbital route as in the lateral rhinotomy or medial maxillectomy approach; however, temporary sectioning of the medial palpebral ligament and the nasolacrimal duct usually is necessary (27). If the osteotomy involves the lower orbital rim and floor, the infraorbital nerve must be transected. A palatal osteotomy combined with a cut through the maxillary body below the orbital floor enables transmaxillary access to be combined with transoral access, and increases the anterior exposure of the central cranial base. Zygomatic arch osteotomy facilitates the lateral exposure of the upper part of the infratemporal fossa and the middle cranial fossa by allowing reflection of division of the temporalis muscle. Transection of the coronoid process opens the lateral aspect of the infratemporal fossa and allows early exposure of the maxillary artery for control of bleeding, which is common during the maxillary osteotomy. The sphenoid pterygoid process separates the central from the lateral cranial base and blocks anterolateral access to the central cranial base. Removing the pterygoid process provides exposure extending from the central to the lateral cranial base and allows for wide anterolateral access to the clivus and upper cervical spine. The frontotemporal craniotomy, when combined with an orbitozygomatic osteotomy and removal of the floor of the middle cranial fossa, provides lateral access to the cavernous sinus, the sphenoid sinus, and the petrous apex extradurally, and the frontal and temporal lobes and the basal cisterns intradurally.

The lower maxillectomy is performed by a combination of osteotomies through the maxillary body, the hard palate, and the pterygomaxillary junction, and it may be extended by cuts through the pterygoid and coronoid processes (Fig. 3A). Through a combination of the transmaxillary, transmasal,

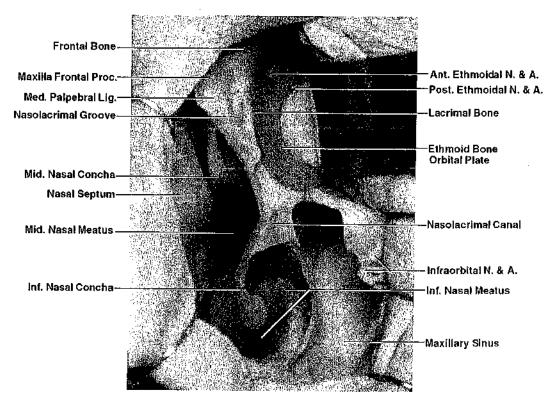


FIGURE 6. C, the anteromedial maxilla has been opened to show the relationship among the nasal cavity, maxillary sinus, and nasolacrimal duct. The part of the maxillary frontal process to which the medial palpebral ligament attaches has been preserved. The inferior concha is a bone that projects medially and inferiorly from the maxilla. The majority of the maxillary sinus is situated lateral to the inferior meatus; however, the sinus opens into the middle meatus.

transoral, and transpalatal routes, this approach offers excellent upwardly directed anterior access to the central cranial base, as well as anterolateral access to the lateral cranial base after removal of the coronoid process. The structures accessed by this approach in the central cranial base include the nasal cavity, the lower surface of the cribriform plate, the nasopharynx, the ethmoid and sphenoid sinuses, the optic canal, the pituitary fossa, the medial cavernous sinus, the entire clivus and the upper cervical spine to C4 extradurally, the pons, the medulla, and the upper spinal cord, and the whole length of

the basilar artery and the vertebral arteries intradurally. In the lateral cranial base, the structures accessed by this approach include the pterygopalatine and infratemporal fossae and the parapharyngeal space and its poststyloid region. This approach includes neither osteotomy in the orbital rim or zygomatic arch nor craniotomy, and it preserves the facial and infraorbital nerves, nasolacrimal duct, and the medial palpebral ligament. The entire ethmoid sinus, as well as the roof of the nasal cavity including the cribriform plate, can be reached by the lower maxillectomy without an additional osteotomy

FIGURE 6. D, the medial wall of the orbit, which is formed by the lacrimal and ethmoid bones, has been exposed. Dividing the lacrimal sac or nasolacrimal duct and the anterior and posterior ethmoidal arteries and nerves allows lateral retraction of the orbital contents to expose the medial orbital wall as far posterior as the orbital apex and optic canal.



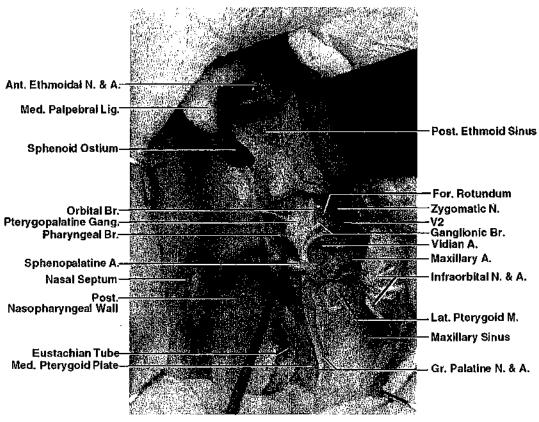


FIGURE 6. E, the medial part of the posterior maxillary wall has been removed to expose the pterygopalatine ganglion, which is located behind the sinus in the medial part of the pterygopalatine fossa and in front of the sphenoid pterygoid process and pterygoid canal. The maxillary nerve enters the pterygopalatine fossa through the foramen rotundum, which is located lateral and superior to the pterygoid canal, and it communicates with the pterygopalatine ganglion by ganglionic branches. The pterygopalatine ganglion and related branches, including the

sphenopalatine, greater and lesser palatine, orbital, and pharyngeal branches, usually are located behind the maxillary artery, which has been retracted downward. The greater palatine canal descends along the posteromedial wall of the maxilla in the groove between the maxilla and the palatine perpendicular plate. The pharyngeal orifice of the Eustachian tube hugs and is attached to the posterior edge of the medial pterygoid plate. The maxillary artery enters the pterygopalatine fossa by passing through the pterygomaxillary fissure. It gives rise to numerous branches, including the infraorbital, posterosuperior alveolar, sphenopalatine, greater and lesser palatine, and vidian arteries, which usually are located in front of the pterygopalatine ganglion and its branches. The medial and inferomedial orbital walls also have been removed to expose the posterior ethmoid air cells and the anterior face and ostium of the sphenoid sinus.

of the medial or inferior orbital rim. A maxillotomy pedicled either on a palatal or cheek flap is preferable, if possible, to maxillectomy because the pedicle aids in preserving blood supply to the maxilla and teeth (6, 8, 10, 16). The sublabial midfacial degloving technique eliminates the facial scar, although the exposure is limited if the oral commissure is small, and it may not provide the more extensive access obtained with the Weber-Fergusson incision (9).

The upper maxillectomy, accomplished by a combination of osteotomies through the maxillary body above the alveolar process, lower orbital rim, and zygomatic arch, and extended by cuts through the base of the pterygoid or coronoid processes, provides a more lateral route to the central and lateral cranial base. It may be combined with a frontotemporal craniotomy for intracranial exposure (Fig. 3B). In this study, the structures adequately exposed by this approach in the central cranial base included the nasal cavity, the lateral and inferior aspects of the orbit, the posterior ethmoid sinus, the nasopharynx, the sphenoid sinus, the lateral cavernous sinus, the entire clivus, and the C1 anterior arch extradurally, as well as the anterolateral aspect of the lower brainstem and upper cervical

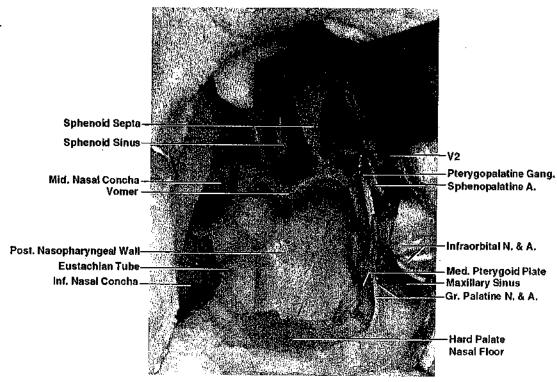
cord intradurally; and in the lateral cranial base, the pterygo-palatine and infratemporal fossae, the parapharyngeal space and its poststyloid area, the anterior and middle cranial fossae, and the petrous apex extradurally. This approach also provides intradural access by the subfrontal, pterional, pretemporal, and/or subtemporal routes to the areas below the frontal and temporal lobes and to the basal cisterns. An additional osteotomy in the medial orbital wall allows for anterior midline access to the entire ethmoid sinus, cribriform plate, and anterior aspect of the sphenoid sinus.

The lateral approaches, such as the preauricular subtemporal/infratemporal approach and the Fisch Type C postauricular approach provide lateral access to the cranial base, including the infratemporal fossa, petrous apex, clivus, nasopharynx, and sphenoid sinus without facial incisions. However, they provide limited access to the central cranial base, and anterior midline access is severely restricted compared with the more anterior route through the maxilla (14, 24). The Fisch Type C approach also requires facial nerve transposition, which often results in temporary or permanent facial weakness. A palatal osteotomy is not included in the upper maxillectomy; however, it can be

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FIGURE 6. F, the approach has been redirected toward the midline to expose the posterior nasopharyngeal wall. The anterior face of the sphenoid sinus has been opened to expose several septa within the sinus. Access to the central cranial base is limited bilaterally by the pterygoid processes and the Eustachian openings into the nasopharynx along the posterior edge of the medial pterygoid plates. The sphenopalatine artery sends branches across the face of the sphenoid, which may result in troublesome bleeding when the face of the sphenoid is opened.



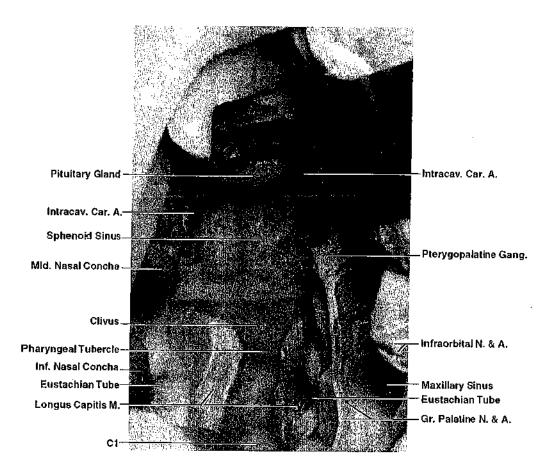


FIGURE 6. G, the sphenoid septi and the anterior sellar wall have been removed to expose the pituitary gland. The nasopharyngeal mucosa has been opened in the midline, and the longus capitis attachments to the lower half of the clivus have been reflected laterally in preparation for clival opening.

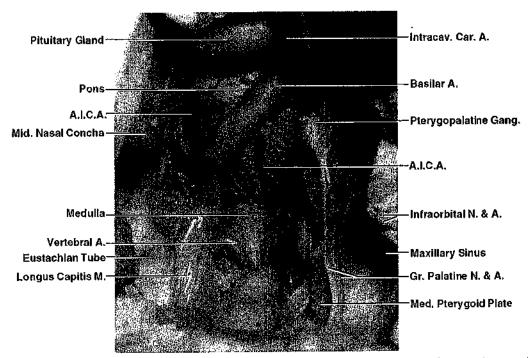


FIGURE 6. H, the clivus and dura have been opened to expose the anterior pontine and meduliary surfaces and the basilar artery. The exposure is limited bilaterally by the intracavernous carotid arteries, the pterygopalatine ganglion, the medial pterygoid plates, and the Eustachian tubes. Further posteriorly, if the pterygoid process and the medial part of the Eustachian tube are resected, the exposure is limited by the cervical carotid arteries, the jugular foramen, and the hypoglossal canals.

combined, as in the lower maxillectomy approach, to gain greater access to the central cranial base.

The lower maxillectomy provides more anterior and inferior access to the cranial base, whereas the upper maxillectomy approach yields a more lateral and superior opening. However, these two techniques are complementary and their osteotomy units can be combined to provide a wider exposure. The upper maxillectomy potentially can be combined with even more extended procedures such as the presigmoid transpetrosal approach posteriorly, the midline mandibular osteotomy inferiorly, and/or contralateral transfacial access (17, 21). Exposure from the upper clivus down to the level of C4 can be achieved by the transmandibular approach alone; however, from our preliminary examination, it is improbable that the median mandibulotomy improves the exposure achieved by the lower maxillectomy approach (5, 20).

Disadvantages and complications associated with these approaches include facial scarring, transection of the infraorbital nerve and the temporal branch of the facial nerve, impaired lacrimal drainage, medial canthus and dental misalignment, Eustachian tube dysfunction and serous otitis, disturbed mastication, facial deformity, and temporal depression secondary to the use of temporalis flap. The facial incisions usually do not irreversibly sacrifice any structure of functional and esthetic importance (8, 16, 19). The lower conjunctival incision overcomes the problems of visible infraorbital scar, ectropion, and lymphedema (19, 22). A peripheral neurorrhaphy after transection of the temporal branch of the facial nerve usually results in recovery (19). Reconstruction of the infraorbital

nerve, placement of nasolacrimal stents, reapproximation of the medial palpebral ligament, placement of ventilating tubes in the Eustachian tube, and careful manipulation of the osteotomies in the maxilla, zygoma, and possibly the mandibular coronoid or condylar processes aid in minimizing permanent side effects.

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### **COMMENTS**

The authors present another article that over time will become a classic in a long line of works from Professor Rhoton and his laboratory. These approaches are relatively unfamiliar territory to the majority of neurosurgeons. An article such as this goes far in enhancing our understanding of the anatomy in the infratemporal fossa and retropharyngeal region.

Both approaches presented provide good alternatives to a Fisch Type C approach, because with these approaches facial nerve mobilization is unnecessary. At a minimum, temporary facial nerve morbidity is expected with the Fisch Type C procedure. The lower subtotal maxillectomy approach is best suited to the treatment of extradural lesions. There are certainly alternatives for lesions that are also located intradurally and that do not traverse the oro- and nasopharyngeal spaces. I use every possible means to avoid traversing the oropharyngeal space to reach the intradural compartment. The reader should keep in mind that a communication between the oropharynx or nasopharynx is also possible using the upper approach presented here. When using this type of approach for an invasive cancer in the infratemporal fossa, there can be extension to the upper airway and violation of this region during surgery. Communication is then possible to the intradural compartment, if the turnor extends intracranially and is resected from that compartment. If the upper airway does come into communication with the intracranial compartment, it is probably best to perform some type of airway diversion procedure to prevent a tension pneumocephalus. This can be accomplished either by tracheostomy or temporarily by passing nasal airways.

Hitotsumatsu and Rhoton have presented a very detailed and useful monograph on the anatomy of the subtotal maxillectomy approaches. This will be added to the body of work that Dr. Rhoton has provided, which I consider a primary reference for contemporary cranial base surgery.

> J. Diaz Day Los Angeles, California

This excellent article is an anatomic study of upper and lower subtotal maxillectomy approaches to the cranial base. Readers must understand the division between anatomic studies and clinical experience. Anatomic studies form the basis of a surgical approach or allow the surgeon to refine the operation; however, they do not provide actual information regarding issues such as intraoperative bleeding, postoperative complications, and healing. During maxillectomy exposure, bleeding from the pterygoid venous plexus can be significant. If the internal carotid or extracranial vertebral arteries become exposed to the nasopharyngeal secretions, rupture of the artery can occur postoperatively as a result of infected arteries. If the dura mater is breached, postoperative cerebrospinal fluid leakage and infection may be difficult to control. Postoperative trismus, soft tissue and bone loss with facial deformity, and numbness of the teeth also may be observed after maxillectomy exposure. Before

using these complex cranial base exposures in their practice, surgeons would be well advised to observe other surgeons who perform these operations commonly.

Laligam N. Sekhar Sajjan Sarma Annandale, Virginia

Hitotsumatsu and Rhoton provide a detailed anatomic description of transmaxillary approaches to the cranial base and the infratemporal and pterygopalatine fossa in particular. However, as the authors mention, these approaches may carry considerable side effects related to dental occlusion, lacrimal function, and so forth. Any such approach requires considerable experience and should be undertaken by cranial base teams with interdisciplinary cooperation of neurosurgeons, otorhinolaryngologists, and maxillofacial surgeons.

My concern with such demanding cranial base approaches always centers on the right indications for use. Certainly, a wide exposure of the cranial base is provided with the approaches described here. However, when do we really need such extensive approaches? Surgeons with little experience may be tempted to "overexpose" a lesion and subject the patient to unnecessary risks. In most instances, we can use much simpler techniques, such as a transethmoidal or pterional approach to follow the disease into the neighboring structures. In those patients in whom a transmaxillary approach is indeed indicated, this article by Hitotsumatsu and

Rhoton will be of fundamental importance for understanding the microsurgical anatomy of this region.

> Madjid Samii Hannover, Germany

This article contains beautiful pictures that the authors must have expended great effort to obtain. It is worthwhile not only for neurosurgeons, but also for maxillofacial surgeons and head and neck surgeons. The current anatomic presentations on the transmaxillary approach have differed because the maxilla occupies a large space in the face. In this article, the approach was classified into two categories: the lower and the upper maxillary approaches. The lower approach covers the same surgical area as the Le Fort I approach. The upper approach covers a wider area, which is accessed around the orbit. According to the authors, the upper maxillary approach was more manageable if divided into medial and lateral approaches. Because the deep craniobasal structures are clearly separated by the remarkable wall consisting of the pterygoid plates, the Eustachian tube, and the attached muscles, it is difficult to obtain a combined surgical field from the pharynx to the infratemporal fossa, as shown in Figure 4H-S, without incurring a loss of function. Figures 5 and 6 demonstrate more practical anatomy, presented clinically by the transfacial approach and orbitozygomatic infratemporal approach, respectively.

> Takeshi Kawase Tokyo, Japan



# ESTOMA

## REVISTA MEDICA DE ESTOMATOLOGIA Y PROFILAXIS



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### UN CASO DE ANGIOFIBROMA JUVENIL GIGANTE DE CAVUM INTERVENIDO POR LA TECNICA DE DESARTICULACION TEMPORAL PEDICULADA A MEJILLA DE MAXILAR SUPERIOR

Por el Dr. F. HERNANDEZ ALTEMIR

Con la colaboración de los Dres: Bandrés\*, Contin\*\*, Dehesa\*\*\*, Ferrandez\*\*\*\*, Gómez Perún\*\*\*\*\*, Martinez Tello\*\*\*\*\*\*, Rived\*\*\*\*\*\*\*, Ucar\*\*\*\*\*\*\*\* y Valero\*\*\*\*\*\*\*

L publicar este caso clínico, se debe fundamentalmente a dos causas, una la de tratarse de un caso de angiofibroma de cavum de grandes limensiones y que se hacía aparente, como ya veremos, en diversas rigiones de muy difícil accesibilidad quirúrgica y a que si se hubiera intervenido por las técnicas hasta ahora descritas, hubiera exigido mutiliaciones de estructuras importantes de los maxilares superiores, naso-palatinas y dentarias.

Precisamente el autor de este artículo ha desarrollado en este caso línico, su técnica de Desarticulación temporal pediculada a mejilla del maxilar superior (es) como vía de abordaje transfacial a las regiones

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- ' \*\*\*\*\*\*\* Dra. Valero: Jefe Clínico de Neuroradiología del Departamento de Radioelectrología (Jefe Prof. Solsona).

fundamentalmente retromaxilares y para otras indicaciones y que se encuentra pendiente de presentación en el seno de la Real Academia de Medicina de Zaragoza, dentro del curso actual. Quizá se trate de una de las técnicas menos cruentas y mutilantes que se han descrito para el tratamiento de los angiofibromas gigantes de cavum y que además ofrece otras posibilidades, para el tratamiento quirúrgico de otro tipo de patología y que no describo aquí, aunque no quiero dejar de resaltar, el magnífico campo quirúrgico que con la misma se obtiene para acceder a los espacios retromaxilares, cigomático malares, pterigomaxilares, cavum y seno esfenoidal, suelo de órbita, etc. La técnica tiene algo que ver con mis técnicas de disección radical de cuello, en el sentido del abordaje en profundidad y despegando al mínimo los tejidos blandos a un lado y otro de la incisión.

Surgió también con la idea fundamental, no sólo de conseguir un campo operatorio adecuado, sino con el fin de no determinar mutilaciones ni secuelas importantes en los enfermos con angiofibromas gigantes de cavum y espacios adyacentes y conseguir su extirpación completa con menos riesgos hemorrágicos al controlar mejor las estructuras debido a la gran exposición y accesibilidad al campo quirúrgico que con la mencionada técnica se consigue y que permite operar prácticamente a cielo abierto.

### Material y métodos

F.D.S. Varón de 14 años, que desde hace varios meses y sólo con el antecedente de dos epistaxis de no mucha entidad a nivel de fosa nasal derecha, que fueron tratadas por el otorrinolaringólogo de guardia mediante cauterizaciones a nivel del tabique y que se asociaba a rinorrea abundante, es remitido al Servicio de Cirugía Oral y Maxilofacial por su estomatólogo refiriendo procesos inflamatorios y de tumefacción de región parotídeomaseterina derecha, de cinco meses de evolución, que cada vez eran más frecuentes, quedando entre cuadro y cuadro inflamación remanente. A la inspección se observa aumento de volumen de la región parotídeomaseterina y yugal derecha, la expresión parotídea no deja ver la salida de saliva a nivel del orificio parotídeo. Adenopatía subángulo mandibular de ese mismo lado. La clínica se fue haciendo con alguna celeridad más aparente a nivel de fosas nasales, aunque más en fosa nasal derecha y con ciertas fases de intermitencia que le permitían respirar mejor. Terminó produciéndose obstrucción prácticamente total de ambas fosas nasales, un gran aumento de volumen de la región témporoparotídea y yugal derecha, que determinaba dificultades para la masticación y oclusión, originándose decúbito a nivel de mucosa yugal de molares posteriores, que ocasionaba dolor y trismo progresivo. El examen de fosa nasal derecha y cavum puso de manifiesto la presencia

že una masa, que no era excesivamente aparente y modificada en su aspecto a nivel de fosa nasal derecha probablemente por el proceso infectivo e inflamatorio concomitante. El estudio panorámico mostraba datos de difícil valoración, destacando principalmente la disminución de la transparencia maxilar y nasal y la normalidad de las estructuras alveolodentarias. Las radiografías convencionales y el estudio tomográfico, conían en evidencia veladuras de gran amplitud y así en el seno esfenoidal se podía observar una amplia pérdida de su transparencia, sobre todo en su porción anterior, a nivel de región etmoidal derecha, cavum, losa nasal y seno maxilar existían también modificaciones de su permeabilidad y contenido aérco. La termografía facial ponía en evidencia un gradiente de 1,5 grados más en el lado afecto, con respecto a su homónimo contralateral y aumento de la red vascular. Sin duda fue el scanner, el que dio la verdadera medida y localización del tumor, como el lector puede observar en la iconografía adjunta, la masa ocupaba la región pterigo y retromaxilar, la región cigomático malar, el seno maxilar, las fosas nasales, el etmoides, el suelo de la órbita, el cavum, la tinofaringe, el seno esfenoidal, la región yugal y paraparotídea y temporal, El septum nasal aparecía desplazado, todo en el lado derecho y mediofacial de la cara. El estudio arteriográfico (Dra. Valero) según técnica de Seldinger de la carótida interna y externa derecha era expresivo de la siguiente manera: territorio de la carótida externa: tumoración irrigada por la arteria facial transversa, palatina ascendente y maxilar interna. Territorio de la carótida interna: tumoración irrigada por la arteria oftálmica y ramas intracavernosas, la tumoración, refiere el informe, es de gran volumen y muy ricamente vascularizada.

Si bien en un principio el diagnóstico no fue fácil, se debió fundamentalmente a dos hechos, el primero, el que hacía muy pocos días que había sido explorado cuidadosamente por el otorrinolaringólogo de guardia, tanto a nivel de cavum, como de fosas nasales, sin sospechar nada tumoral y otro y que se relaciona con lo anteriormente dicho y es que la clínica era más aparente a nivel de región yugal y cigomáticomalar y temporal. Se plantearon en principio biópsias a nivel yugal, una de las cuales hizo sospechar proceso vascular (Dr. Dehesa), si bien la progresiva obstrucción nasal y las imágenes radiográficas y la evolución, como no, fueron lo que nos llevaron a sospechar un angiofibroma de cavum, planteándose con las precauciones debidas y bajo anastesia general una biopsia de cavum (Dr. Contín), obteniéndose una imagen anatomopatológica compatible con angiofibroma de cavum. Con este diagnóstico y puestos en contacto con el Dr. Ferrandez, endocrinólogo, se procedió a instaurar un tratamiento preoperatorio de tipo hormonal, a base de testovirón, durante unas dos semanas, no observándose ningún tipo de remisión, tal vez en esa etapa la clínica se hizo aun más aparatosa.

Dadas las conexiones del tumor descrito, con el sistema arterial dependiente como vimos en la carótida externa principalmente y de la carótida interna del lado derecho, se valoró con el Servicio de Neurocirugía (Dres. Ucar, Gómez Perun) así como con la Sección de Neuroradiología la posibilidad de realizar algún tipo de embolización arterial preoperatoria, como preconizan algunos autores, desestimándose por los riesgos que la misma podía determinar y los pocos beneficios técnicos que quizá podrían conseguirse. Sin otras opciones, se determinó por parte de este Servicio de Cirugía Oral y Maxilofacial, el control intraoperatorio de la carótida primitiva, así como la externa e interna. El paciente fue antes convenientemente estudiado desde el punto de vista general, disponiendo de un depósito de sangre que estimamos en principio de 12 unidades.

Se comenzó con intubación orotraqueal, seguida de traqueotomia, ya que las secuencias quirúrgicas que eran preciso seguir, así lo aconsejaban. Hecha pues la traqueotomia, se realizó el control de los vasos carotídeos derechos, para seguir con la técnica de "Desarticulación temporal pediculada a mejilla del maxilar superior como vía de acceso transfacial a las regiones fundamentalmente retromaxilares" donde se ubicaba gran parte de la tumoración del caso que nos ocupa. Una vez desarticulado y rechazado el maxilar superior derecho que quedaba pediculado a la mejilla por los tejidos yugales, se observó que el tumor aparecía fácilmente distinguible del resto de las estructuras tanto en lo que hace referencia, como no, a las partes duras, sino también a las blandas y así se pudo comprobar que el tumor de consistencia firme, se encontraba dispuesto de forma mamelonada típica, alrededor, encima, dentro y entre tejidos y espacios tales como la región retromaxilar y pterigomaxilar, la región etmoidal, el cavum, el seno esfenoidal, la fosa nasal derecha, la rinofaringe, el suelo de la órbita, la región temporal, la cigomáticoretromalar, la región pterigomandibular y premaseterina, por señalar las más caracterizables. En cuanto a la enucleación, el tumor se dejaba independizar con cierta facilidad de las estructuras, si bien en algunas zonas se enredaba de manera más firme, como era el caso del espacio rinofaríngeo y coanal e incluso a nivel del cavum, donde con disección roma unas veces y otras a punta de tijera se pudo ir obteniendo una pieza única de 150 gramos de peso exangüe y que representaba la totalidad del tumor, ya que los espacios eran fácilmente explorables. Llamaba la atención a nivel de seno esfenoidal, que aparecía ampliamente abierto, el que tenía unas dimensiones presumiblemente mayores de lo habitual en cuanto a su capacidad o volumen y que se logró oportunamente en las zonas que se relacionaban con el tumor extirpándose con pinza gubia fragmentos óseos a su nivel. Sólo se produjo hemorragia moderada a nivel de región pterigomaxilar que se controló con medidas locales a cielo abierto, como la técnica permite. La exéresis del tumor exigió además de la luxación del maxilar superior derecho la apertura de la mucosa de

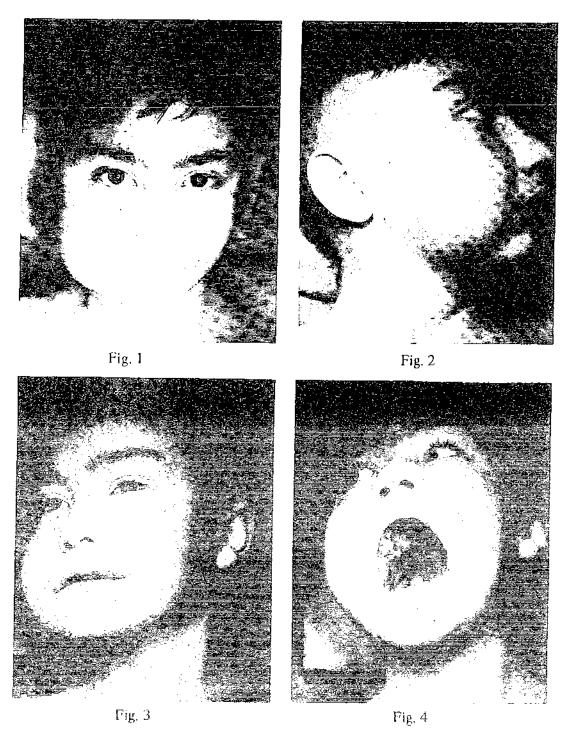
Le pared externa de la fosa nasal derecha y la sección del nervio suborbiterio que impedía la "rotación" fácil del maxilar superior en su fase de desarticulación. Hecha la extirpación se procedió a la reconstrucción Dres. Rived y Bandrés), se colocaron los taponamientos pertinentes a nivel de seno esfenoidal, fosa nasal derecha y seno maxilar devolviendo momentos antes la continuidad del nervio suborbitario, al mismo tiempo que se procedía a fijar o por que no a articular el maxilar superior derecho a su emplazamiento habitual, ayudándonos de puntos de osteosíntesis, así como de una ferulización intermaxilar y sutura de las partes blandas incindidas en el desarrollo de la técnica descrita y que no explico con detalle ni otras posibles aplicaciones, todavía en estudio y por ser motivo de otro trabajo específico sobre mi técnica de "Desarticulación temporal pediculada a mejilla del maxilar (es) superior (es) como vía de acceso transfacial a las regiones fundamentalmente retromaxilares y para otras indicaciones" y así no hacer exhaustiva la presentación del caso clínico que presento. Terminada la intervención el paciente es remitido a la UVI, donde lo único reseñable fue una atelectasia de pulmón izquierdo por intubación selectiva del bronquio correspondiente durante el traslado de quirófano a dicha Unidad y que se resolvió de la forma habitual en estos casos. Permanece con traqueotomia y alimentación por sonda nasoesofágica durante ocho o diez días, retirándose dentro de este período los taponamientos y el punto de tarsorrafía. que mantendremos por más tiempo en los próximos casos a fin de evitar cierto grado de ectropion en el párpado inferior. Se mantiene el bloque intermaxilar durante seis semanas aproximadamente.

El informe del resultado anatomopatológico (Dra. Martínez Tello) es el siguiente: Descripción macroscópica: Se recibe una pieza de morfología irregular que pesa 150 gramos y mide 11 x 8 x 4,5 cms. La superficie externa es multilobulada y de color blanco grisáceo, surcada por vasos congestivos. La superficie del corte es homogénea, de coloración parduzca y punteado rojizo, alternando con otras de coloración blanco grisácea. La consistencia es firme pero elástica. Descripción microscópica: Se observa una neoformación mesodérmica constituida por vasos de diferentes tamaños fuertemente congestivos, en el seno de un estroma fibroso, en áreas laxo en otras denso. La proliferación vascular, aunque en algunas áreas es abigarrada no muestra signos de malignidad.

### Resultados obtenidos

Los controles radiográficos postoperatorios como la observación elínica no aportan datos reseñables, pudiéndose considerar que estamos ante una evolución favorable, no sólo en el sentido de posible recurrencia del tumor (se extirpó bajo visión directa en una pieza única), sino también en el sentido reconstructivo y funcional, con una correcta rela-

ción intermaxilar y con la sospecha clara de la vitalidad de las piezas dentarias del maxilar desarticulado temporalmente. Sólo cierto grado de ectrópion a nivel de párpado inferior.



Figs. 1, 2, 3, 4: Aspecto preoperatorio.

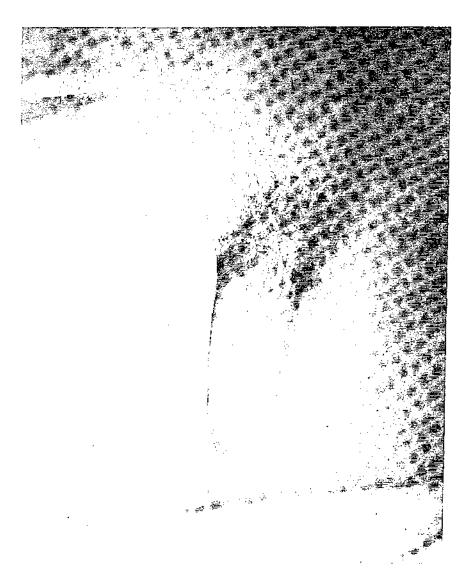
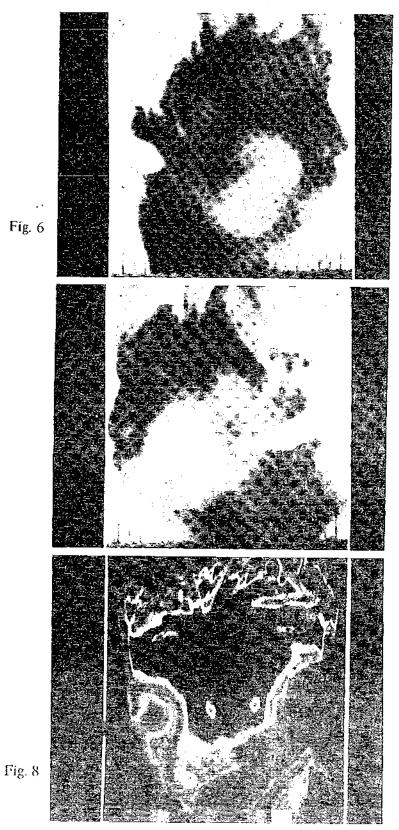


Fig. 5: Pubertad acelerada con aumento del tamaño del pene.



Figs. 6, 7, 8: Termografías.

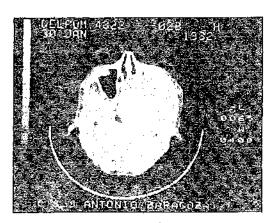


Fig. 9

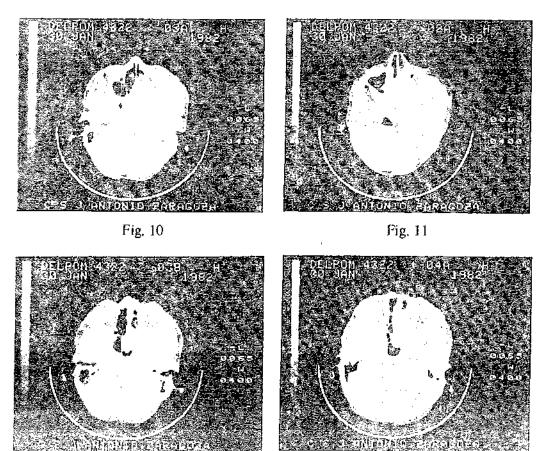
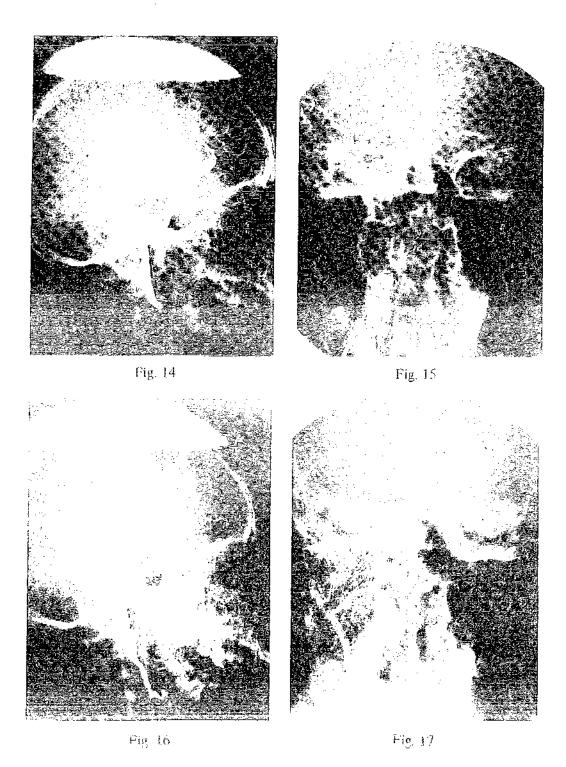


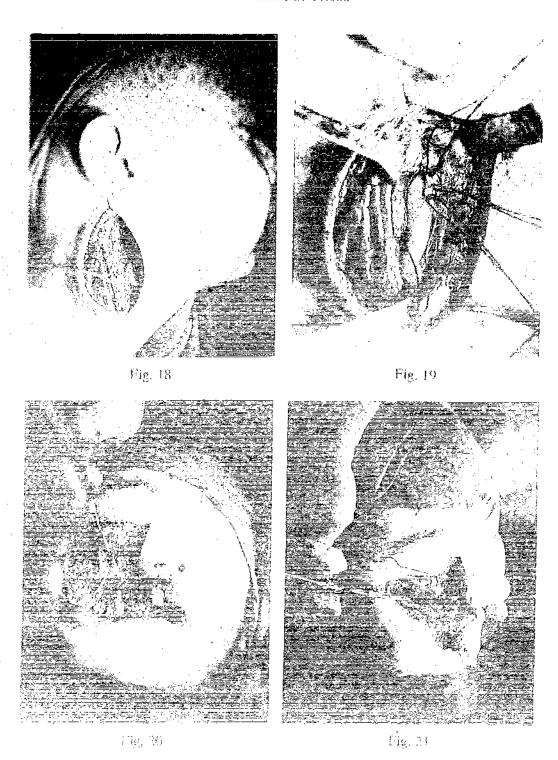
Fig. 12

Fig. 13

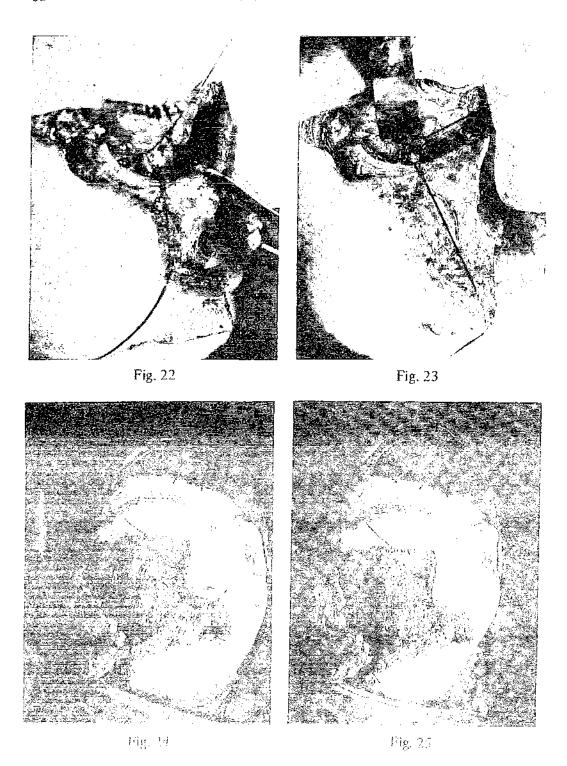
Figs. 9 a la 13: Imágenes del scannor,



Vies. 14 a 17. Estadio arteriográfico.



Figs. 13: 10: 1 (gadura de carédida erregna y control de vasos carotídeos). Figs. 30: 51: intelo de la desarriculación maximi



Figs. 32-73: Detaile de la ticemerón y sección de la rama suborbitaria.
Figs. 24-25: Deserficidación maxilar (etal con exposición de la timinación refrontazada. El maxilar apareca peda alada a la mejilla.





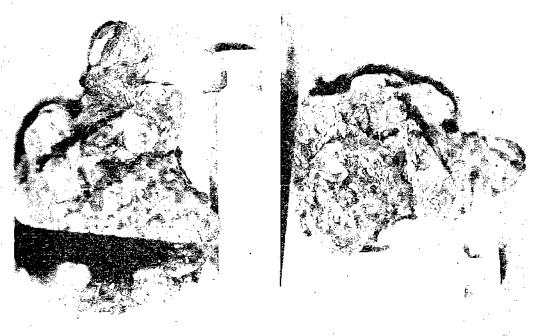


Fig. 26



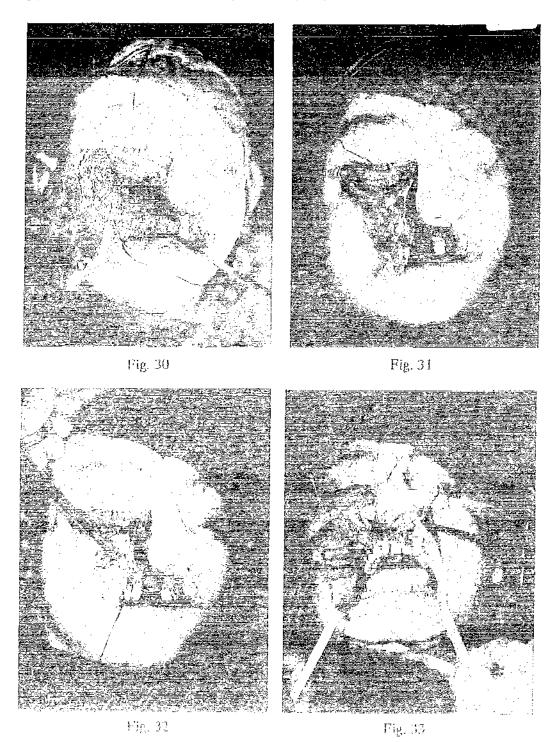


Fig. 28

Fig. 29

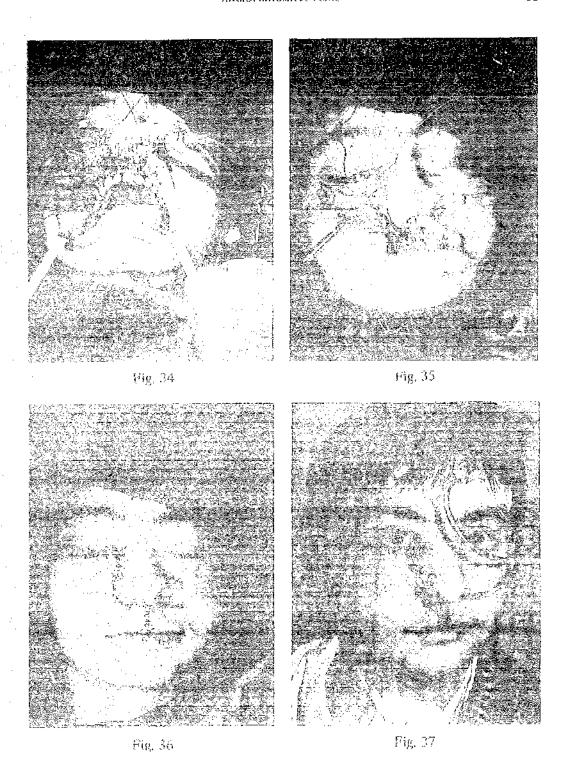
Figs. 26, 27: Pieza única operatoria. Peso 150 gramos. Huellas debidas a fallo máquina de revelado.

Figs. 28, 29: Imágenes histopatológicas - angiofibroma.

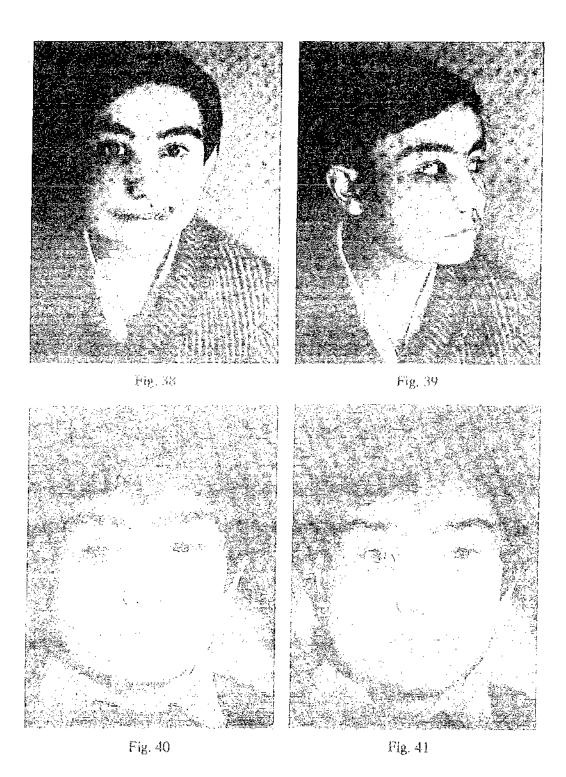


Figs. 30, 33: En la primera coma operatoris fibre del trumo, zona etmoldal y estempadal entre ouras. La nuccesa palatina despegada. En la 31 reposición del maxitar.

Figs. 17, 13: Inicio de la reconstrucción. El nervio suborbitació y a se ha suturado. No na sido necesario sacrificar unuama pieza deinaria.



Figs. 34, 35 : Ferntización e inicio sutura partes blandas. Figs. 36, 37 : Detalle de la trasocrafía y sutura. Exponamiento nasal.



Figs. 38, 39, 40 y 41. Postoporatorio. Todavía ferulizado.

### Conclusiones

Con la técnica de desarticulación temporal pediculada a mejilla del maxilar superior en este caso simple y derecha, como vía de acceso transfacial a las regiones fundamentalmente retromaxilares, se consigue una vía de acceso de gran interés a otras regiones tales como la zona prerigoidea y retropterigoidea, cavum, seno esfenoidal, fosa nasal, suelo órbita, cigomático malar, clivus, etc., y que estimo ha sido de gran utilidad en este caso concreto de angiofibroma gigante juvenil de cavum.

También debo reseñar que no ha sido preciso sacrificar con la mentionada técnica ninguna estructura maxilar ni dentaria y las pequeñas secuelas que puedan producirse creo que son fácilmente recuperables.

La ligadura de la carótida externa no ha determinado de forma tangible ninguna dificultad en la vitalidad de nuestro colgajo yugalmaxilar da próxima vez tal vez hagamos exclusivamente control arterial de forma temporal, en lugar de hacer ligadura de entrada, es más, como el campo que se obtiene permite operar bajo visión directa, tal vez no sea preciso ni siquiera el control de los vasos arteriales como fase previa a la exposición y extirpación de este tipo de tumores.

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## ESTOMA

### REVISTA MEDICA DE ESTOMATOLOGIA Y PROFILAXIS



Volumen III Núm. 1

DESARTICULACION TEMPORAL PEDICULADA A MEJILLA DEL MAXILAR SUPERIOR (ES) COMO VIA DE ABORDAJE TRANSFACIAL A LAS REGIONES FUNDAMENTALMENTE RETROMAXILARES Y PARA OTRAS INDICACIONES (VIA MAXILOPTERIGOIDEA) UNA NUEVA TECNICA

Por el Dr. Don Francisco HERNANDEZ ALTEMIR

Jefe del Servicio de Cirugía Orai y Maxilofacial
de la Ciudad Sanitaria José Antonio de Zaragoza

XISTEN territorios de difícil acceso a las técnicas quirúrgicas y muchas veces el llegar a ellos es a costa de mutilaciones o daños de las estructuras advacentes, este hecho ocurre en nuestra especialidad cuando se precisa explorar los espacios retromaxilares, pterigoideos, etmoidales, la rinofaringe, el cavum, el seno esfenoidal, el clivus, ciertas regiones de la base del cráneo, sobre todo las situadas inmediatamente por detrás de la apófisis peterigoides, la región inferior de la órbita, los espacios paramaxilares externos (región pterigomandibular) e internos (fosas nasales y estructuras adyacentes), pues bien con nuestra técnica la accesibilidad a estas regiones se facilita enormemente y con la ventaja además, de hacerlo, sin provocar daños o mutilaciones irreparables de ningún tipo, pudiendo emplearse el procedimiento con otros fines a los descritos y que más adelante apuntaremos y otro aspecto importante es que el procedimiento se puede desarrollar simultáneamente a nivel de ambos maxilares, quedando la parte media de la cara abierta como un libro y así poder trabajar en su profundidad, prácticamente a cielo abierto.

### Descripción de la técnica

Paciente bajo anestesia general con intubación nasotraqueal o traqueotomía previa, según la patología a resolver. Tarsorrafia temporal, con el paciente en decúbito supino. La incisión previamente marcada se extiende desde el bermellón del labio superior progresando casi verticalmente por el relieve externo que ofrece el filtrum del lado a intervenir hasta el surco nasolabial donde se hace horizontal, para de nuevo rodean-

do el ala de la nariz ascerider de forma teóricamente paralela e inmediatamente por encima del trayecto de la arteria y vena angulares sobrepasando la comisura palpebral interna y respetándola, para volver a hacerse horizontal y tarsal hasta la unión cigomático-temporal, incurvándose ligeramente. A nivel de la fibronucosa alveolomaxilar será precisa otra incisión vertical que va desde el reborde gingival en su porción media a buscar la incisión cutánea que comprendía la región subsanal y rodeaba el ala de la nariz. En su momento haremos la última incisión que previa infiltración de la fibromucosa palatina con un vasoconstrictor en la proporción adecuada y dando conocimiento al anestesista, se extiende desde la región gingivopalatina del canino o bicúspide contralateral hasta la región retrobuberositaria del lado a intervenir. Completada la incisión cutánea, a la que hicimos referencia en primer lugar y que comienza seccionando el labio superior, para a continuación exponer las estructuras óseas subyacentes, que existen a lo largo de la incisión cutánea descrita, de forma tal, que quedará expuesta la unión cigomático temporal, la pared lateral externa e interna de la órbita, el suelo y reborde orbitario, siguiendo la osteotomía dibujando lo que sería la apófisis frontal del maxilar hasta las proximidades de la sutura frontomaxilar, inmediatamente por delante de la cresta lagrimal anterior y la sutura nasomaxilar, para poner al descubierto, mayor parte de la superficie total del hueso propio, hasta llegar a la escotadura piriforme: aprovechando el momento, para despegar la mucosa nasal, tanto a nivel del piso de la nariz, como en su cara externa, de la forma más amplia posible, para no herirla cuando completemos las osteotomías y que de esta manera faciliten al quedar despegadas la disyunción maxilar. Expuestas ya, las superficies óseas, se inician las osteotomías, que realizo con el siguiente orden: primero una vertical a nivel de la unión cigomáticotemporal, otra horizontal y media a nivel de la porción media del reborde orbitario externo que es seguida por una osteotomía intraorbitaria situada a pocos milímetros del reborde orbitario y que extendiéndose desde la pared lateral externa de la órbita sigue el suelo de la misma hasta la región frontomaxilar, remedando la osteotomía el dibujo de lo que sería la apófisis frontal del maxilar, una vez, eso sí, que tenemos identificado el conductor lagrimal, la osteotomía desciende hasta la porción más alta y lateral de la escotadura piriforme a lo largo de la unión nasomaxilar, aquí se interrumpe y es cuando se inicia la segunda incisión a la que hicimos referencia, esto es la gingivopalatina, que ya he explicado y que permite el despegamiento de la fibromucosa palatina desde la región gingivopalatina de la región bicuspídea contralateral hasta la espina nasal posterior, sobrepasando con amplitud la zona, de tal modo, que queda fácilmente accesible la superficie palatina y paramedial del lado a intervenir, permitiendo así, que la siguiente osteotomía, que va desde el vestíbulo alveolomaxilar a nivel de la región distal del incisivo lateral, puede desarrollarse hasta el reborde palatino posterior paralela y yuxtamedialmente a la posición teórica del tabique nasal. La tercera y úl-

tima osteoto curvo se efe dispuesto el nivel del sue del maxilar, identificar, p caje lo hacen lar luxado qu do lugar, a i dículo y con otras, de las tes, si bien el plejo que di carótida exte vunción max arteria palati con escoplo, mucosa, si bi riesgos, no o yor parte de prender, son humedecida ria. De este 1 giones: pterig fosa nasal co suborbitaria, nes a las cual resis de tumo para realizar la región retr la base del cr lugar de paso El seno esfen gión hipofisa: gunas aplicac po se irán am

El proced la porción mi lugar, el dors cuatro incisiv como referen xados. Ni que na se despega otro maxilar en el otro lade

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tima osteotomía aprovecha la incisión retrotuberositaria y con escoplo curvo se efectúa la disyunción u osteotomía pterigomaxilar. Queda así dispuesto el bloque maxilar, para ser luxado con los medios habituales. A nivel del suelo de la órbita, inmediatamente por debajo y al traccionar del maxilar, se deja ver el nervio suborbitario, que es preciso marcar e identificar, para su posterior sutura, ya que hay que seccionarlo. Su marcaje lo hacemos con un punto de seda atraumática en cada cabo. El maxilar luxado queda pediculado a la mejilla y su eje de giro teórico, ha tenido lugar, a nivel de la sutura cigomático temporal. La irrigación del pedículo y con ello del maxilar dependiente, tiene lugar a expensas entre otras, de las arterias facial y facial transversa, como ramas más importantes, si bien el plexo vascular a nivel de la mejilla, es tan abundante y complejo que difícilmente puede verse la zona exangüe, incluso ligando la carótida externa del lado correspondiente. Antes de llevar a efecto, la disyunción maxilar y a nivel del agujero palatino posterior, se ha liberado la arteria palatina de su trayecto óseo, mediante una osteotomía realizada con escoplo, de esta manera, se conserva el pedículo arterial de la fibromucosa, si bien nuestra experiencia, es que puede sacrificarse sin mayores riesgos, no obstante tratamos de ser conservadores a ultranza, de la mayor parte de las estructuras, ya que de ello, lo único que se pueden desprender, son beneficios. El bloque luxado, se protege y fija con una gasa humedecida con S.S.F. para no mantenerlo expuesto de forma innecesaria. De este modo, hemos conseguido un fácil acceso, a las siguientes regiones: pterigomandibular y retromaxilar, rinofaringe y estructuras de la fosa nasal correspondiente, cavum y seno esfenoidal, etmoides, región suborbitaria, región temporal y cigomáticomalar por citar algunas, regiones a las cuales podemos llevar nuestras técnicas quirúrgicas, para la exéresis de tumores de diversa índole, localizado en estas estructuras, o bien para realizar diversos tipos de cirugía, en las zonas ahora accesibles. Así la región retropterigoidea es fácil de alcanzar y también ciertas partes de la base del cráneo, como pueden ser la zona de los agujeros y hendiduras. lugar de paso de estructuras vasculares y nerviosas de primera categoría. El seno esfenoidal es muy accesible y a su través se puede llegar a la región hipofisaria, también el clivus está ahora más a mano, por señalar algunas aplicaciones de la técnica que es probable que con el paso del tiempo se irán ampliando.

El procedimiento descrito, puede hacerse bilateralmente, quedando la porción media de la cara abierta como un libro, sólo permanecen en su lugar, el dorso y las estructuras medias de la nariz y del paladar con los cuatro incisivos, semejando una premaxila. Estas estructuras sirven luego como referencia para la correcta reducción y fijación de los maxilares luxados. Ni que decir tiene que en la técnica bilateral la fibromucosa palatina se despega de forma total y que para llevarla a efecto la luxación del otro maxilar es preciso repetir los pasos que hemos explicado pero que en el otro lado, quizá la técnica bilateral será excepcional, ya veremos.

ESQUEMA "TECNICA DE DESARTICULACION TEMPORAL PEDICULADA A MEJILLA DEL MAXILAR SUPERIOR (ES) COMO VIA DE ABORDAJE TRANSFACIAL A LAS REGIONES FUNDAMENTALMENTE RETROMAXILARES Y PARA OTRAS INDICACIONES, UNA NUEVA TECNICA.

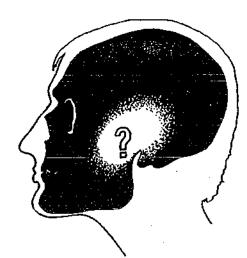


Fig. 1.— ¿Cómo llegar a las regiones fundamentalmente retromaxilares, suborbitarias, etmoidales, pterigomaxilares, etc., sin provocar graves mutilaciones y obtener un campo quirúrgico que nos permita prácticamente trabajar a cielo abierto?.

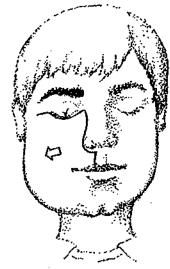


Fig. 2.- Incisión.

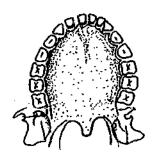


Fig. 3.— Incisión en la fibromucosa palatina.

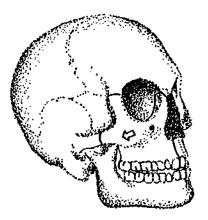


Fig. 4.—Osteotomías.

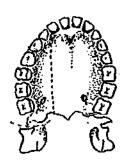


Fig. 5.—Osteotomfas,



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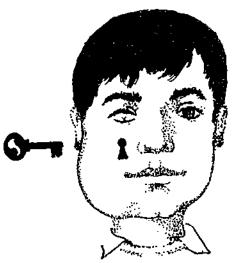


Fig. 6.— ¡Hay que abrir el maxilar.

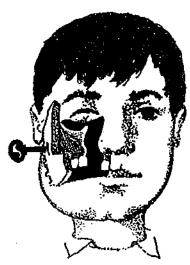


Fig. 7.

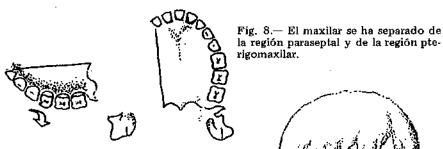
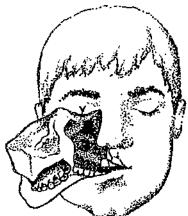


Fig. 9.— La etapa de "puerta abierta hasta atrás" se puede ver claramente en el esquema, con lo que sin sacrificar estructuras podemos llegar a las hasta ahora inaccesibles regiones pterigoma-xilares, rinofaríngeas, esfenoidales, cavum, estructuras de la base craneal, clivus, etc.



Algunas ventajas de nuestra técnica:

1.— La incisión previa, a la luxación del maxilar, está avalada por la experiencia de los cirujanos que trabajamos en esta región y su trazado, no sacrifica ninguna estructura que prácticamente no sea recuperable y desde luego ninguna importante desde el punto de vista funcional o estético.

2.— La disyunción o luxación del maxilar o maxilares, se pueden realizar también sin sacrificar estructuras, a diferencia, de lo que ocurre, con las técnicas transmaxilares o transfaciales o incluso otras que abulsionan el maxilar y requieren su posterior reimplante, con el sacrificio de las estructuras dentarias, necrosis del maxilar transplantado, entre otras.

- 3.- Con nuestra técnica, se obtiene una vía de abordaje de primerísima categoría, pudiéndose abordar fácilmente, las regiones pterigomaxilare y retropterigoideas, retromaxilares, rinofaríngeas, nasales, el cavum, el seno esfenoidal, la región orbitaria, el etmoides, la fosa nasal y las estructuras que la componen, la región temporocigomática, retromalar, el seno maxilar, el conducto nasolagrimal, la región cigomática y pterigomandibular, el clivus, y porciones de la base del cráneo, que quizá antes de nuestra técnica, resultaban más inaccesibles, si no era a costa de grandes mutilaciones de las estructuras maxilodentarias o que requerían emplear técnicas muy sofisticadas y complejas, basadas fundamentalmente en la microscopía quirúgica, sin duda complejas y que no siempre conducen a campos de fácil manejo y gran parte de las veces insuficientes. La región retropterigoidea, con nuestra técnica se puede sobrepasar fácilmente a cielo abierto camino de los agujeros y hendiduras de la base del cráneo y que son lugar de paso de estructuras vasculares y nerviosas de primera categoría. El tiempo quizá vaya demostrando algunas otras posibilidades, que ahora mismo se me escapan.
- 4.— Esta técnica, permite no sólo, el facilitar el abordaje a las zonas a las que he hecho referencia, sino también el emplearla para modificar la arquitectura de la cara en todas las direcciones del espacio, asociando las osteotomías a la colocación de injertos óseos o bien realizando ostectomías selectivas a distintos niveles, según el caso.
- 5.— Sin duda esta técnica, podrá ser aprovechada, no sólo por cirujanos orales y maxilofaciales, sino también por otorrinolaringólogos, oftalmólogos, neurocirujanos, etc., si bien es fácil que éstos precisen del concurso del cirujano oral maxilo facial, ya que no siempre, será fácil el restablecimiento de la oclusión intermaxilar, etc., si se desconocen las técnicas de las que disponen este tipo de especialistas y que a su vez están basadas en técnicas estomatológicas y protéticas muy complejas, como puede ser por ejemplo, el restablecimiento de una correcta relación intermaxilar, después de haber luxado un maxilar desdentado, por citar un ejemplo.

6.— La técnica puede emplearse de forma simultánea bilateralmente, en este caso el dorso de la nariz, el tabique óseo y cartilaginoso, el rafe medio palatino y los cuatro incisivos (semejando una premaxila) permanecerían en la línea media y servirían de referencia luego insustituible, para la reposición adecuada de los maxilares luxados.

7.— Quiero reseñar que la técnica surgió ante la necesidad de extirpar un angiofibroma gigante en un niño de 14 años con una pubertad precoz



Fig. 1.— Incisi



Fig. 2.—Incisio

Fig. 3.: Osteotomí: a un y otr lade pueden reaocurre, con e abulsionan cio de las esstras.

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### TECNICA BILATERAL



Fig. 1.— Incisión para la técnica bilateral.

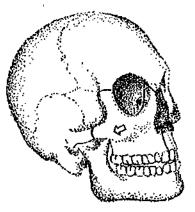


Fig. 2.—Incisión en la fibromucosa palatina.

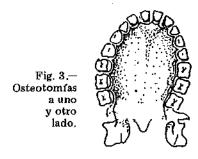




Fig. 4.— Osteotomías paraseptales y pterigomaxilares (ahora bilaterales).

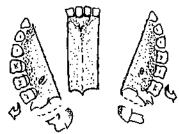


Fig. 5.— Se inicia la separación de ambos bloques maxilares, que debe hacerse de forma individual.

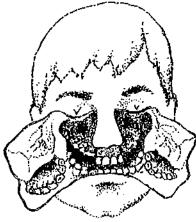


Fig. 6.— Imagen en "libro abierto" ahora el acceso es más amplio. La nariz y los dos incisivos centrales aparecen en su posición habitual y servirán de referencia para devolver los maxilares a su lugar, fijándolos con puntos de osteosíntesis y bloqueo elástico intermaxilar.

y un grado intelectual muy avanzado, el tumor se localizaba en seno esfenoidal, cavum, rinofaringe, fosa nasal derecha, seno maxilar, espacio retromaxilar, pterigomaxilar y retropterigomaxilar, región pterigomandibular y coronoidea, región temporal, zona cigomáticotemporal, suelo de órbita etmoides, espacio premaseterino y retromalar, haciendo procidencia en región yugal, hasta tal punto que producía decúbitos a nivel de molares superiores del maxilar, dificultad para la apertura bucal y modificación de la oclusión intermaxilar con aumento de volumen de la hemifacies derecha, obstrucción nasal y rinofaríngea que determinaban dificultades respiratorias, sólo en dos ocasiones epistaxis de poca entidad. Su extirpación se hizo en bloque y su peso exangüe fue de 130 gramos. Lo publicamos con detalle a continuación, dado que considero que la técnica tiene otras aplicaciones y así he podido extenderme someramente sobre la misma.

- 8.— Esta técnica quirúrgica no trata de sustituir a las técnicas tradicionales de manera absoluta, sólo pretende el autor que el cirujano la recuerde para los casos selectivos en que el tamaño exagerado del tumor y/o su localización lo hagan poco o nada accesible por los medios tradicionales, si no es a costa de producir graves mutilaciones.
- 9.— La fácil exposición de las regiones a las que me he referido, permite enuclear no sólo con más facilidad tumores tapados por las estructuras fundamentalmente maxilares, sino el hacerlo con mayores garantías de exéresis completa, como es el caso de los angiofibromas de cavum, sin duda uno de sus mayores problemas, asociado a la posibilidad de graves hemorragias que hasta ahora eran difíciles de controlar. Al hacerse la exéresis bajo visión directa, esta situación es más fácil no sólo de controlar, sino incluso de que se produzca, ya que no nos vemos precisados a trocear el tumor de forma intempestiva. La identificación de las estructuras retromaxilares, septales, esfenoidales, etc., es ahora fácil.
- 10.— Los distintos especialistas y las diferentes patologías irán dando con algunas modificaciones que el cirujano haga a nuestra técnica, el que sus posibilidades se vayan haciendo día a día más numerosas. Casi pretendemos más que exponer una nueva técnica quirúrgica, el desarrollar una nueva vía quirúrgica, que pudiéramos llamar vía maxilopterigoidea, que tal vez lleve a una nueva concepción quirúrgica.

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### Transfacial Access to the Retromaxillary Area

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### Introduction

There are territories which are quite difficult to reach by conventional surgical techniques. The consequences are mutilation of or damage to adjacent structures. This is especially true for the retromaxillary, pterygoid and ethmoidal spaces, the rhinopharynx, the sphenoidal sinus, the clivus and other regions at the base of the skull. With our technique of temporary disarticulation of the maxilla these regions can be reached a lot more easily and no irreparable mutilations are caused.

### Technique

Nasotracheal intubation or tracheostomy is used depending on the location of the pathology. Temporary tarsorrhapy is advocated. The incision extends from the vermilion of the upper lip vertically along the philtral crest of the side to be operated on, around the nose upwards to the inner canthus, preserving it, becoming horizontal then and passing laterally to the outer canthus and curving slightly downwards over the zygomatic process (Fig. 1). A vertical incision is placed in the vestibular sulcus. A palatal flap extending from the retrotuberosity area of the side to be operated on

### Summary

A case of angiofibroma of large proportions is presented which was manifest in various regions difficult of access. Using conventional techniques marked mutilation would have been expected. Consequently the technique of temporary disarticulation of the maxilla attached to the cheek with a transfacial access to the retromaxillary area was applied and will be described.

### Key-Words

Transfacial access - Retromaxillary tumour - Angiofibroma

to the contralateral biscuspid area is raised. Then the subjacent osseous structures are exposed, including the upper part of the zygoma, the lower half of the orbital rim including the orbital floor but respecting the lacrimal system, the piriform aperture with detachment of the nasal mucosa as far as possible and the alveolar process in the paramedian area. The osteotomies are done in the following order: a vertical cut at the level of the temporo-zygomatic junction, another detaching the frontal process of the zygoma, then the orbital walls behind the orbital rim, crossing to the highest point of the piriform aperture again preserving the lacrimal system (Fig. 2). On the orbital floor the infraorbital nerve has been identified and marked, because it has to be sectioned. A vertical incision is then placed in the alveolus between central and lateral incisor which is continued sagittally on the palate to the posterior edge. The palatine artery is freed from its bony channel using a chisel. This way the arterial pedical of the palatal flap is conserved. Finally the pterygo-maxillary junction is cut with the chisel inserted medially (Fig. 3) the maxilla is now mobilized, remaining pedicled on the cheek and rotating around the osteotomy in the zygomatic arch (Fig. 4).

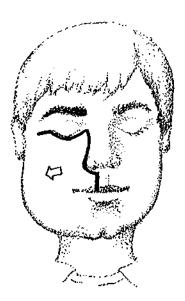


Fig. 1 Incision for unilateral epproach.

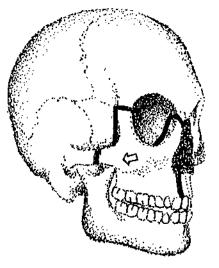


Fig. 2 Osteotomy of the maxillo-zygomatic bloc.

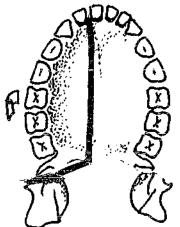


Fig. 3 Palatal approach.

Osteotomy of the palatal shelf.

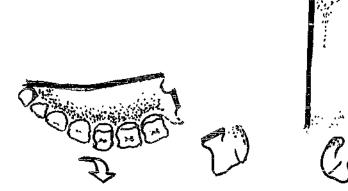
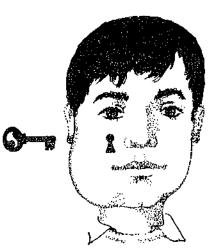


Fig. 3 b Mobilization of the maxilla.



Flg. 4a

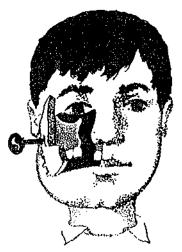


Fig. 4b



Fig. 4 c

Fig. 4a, b, c The retromaxillary and pharyngeal spaces have to be opened.

The mobilized bloc is protected and fixed by moistened, gauze.

In this way easy access is obtained to the pterygomandibular and retromaxillary areas, the rhinopharynx, the nasal fossa, the sphenoid sinus, the ethmoids, the suborbital and subtemporal regions. It is also easy to reach the base of the skull in the area of the foramina and fissures through which the important vessels and nerves pass.

### Case Report

In the following a case of enormous juvenile angiofibroma of the post nasal space will be presented, which due to its large dimensions had to be operated on by this technique in order to prevent severe mutilation.

A 14 year old male presented with a history of only minor epistaxis on the right side which was treated twice by the ENT specialist by means of cauterization. He was then sent to the Dept. of Oral and Maxillo-facial Surgery by his stomatologist because of a swelling in the right parotideomasseteric area and recurrent inflamation developing over the last five months and becoming more and more frequent.

On examination an increased volume of the right parotidomasseteric and angle region was noted, the function of the parotid gland could not be evaluated (Fig. 5 a). Submandibular lymph nodes were present. On nasal inspection the problem quickly became apparent: there was practically total obstruction of both nasal cavities, more par-





Fig. 5 a

Fig. 5 a, b Preoperative appearance.

Fig. 5 b

**Fig. 6** The maxilla is mobilized and remains pedicled on the cheek. The tumour is expected.

ticularly on the right side. However, the patient could still breath a little through the nose intermittently.

There was difficulty in chewing, ulceration of the soft tissues of the cheek, which caused pain and progressive trismus was seen. The mass in the postnasal space and nasal cavity was not uniform in appearance probably due to the inflammatory process.

Panoramic X-ray study was not conclusive except that a radio-opacity at the maxillary level was seen and that the dento-alveolar structures were intact. The tomographic study also showed extensive radiopacity with loss of transparency of the sphenoidal sinus and the right ethmoid, the maxillary sinus, the nasal cavity and the postnasal space. Facial thermography showed a gradient of 1.5 degrees more on the affected side compared with the left side and an increase in the vascular network. It was the CT scanner (Avellaneda 1979, Legent et al. 1981) which demonstrated the true size and situation of the tumour. The mass occupied the pterygo- and retro-maxillary regions, the zygoma, the nasal cavities, the ethmoids, the floor of the orbit, the post nasal space, the rhinopharyux, the sphenoidal sinus, the jugular, parotid and temporal regions. The nasal septum was pushed to the left (Fig. 5 b). The arteriographic study (Seldinger 1953) of the right internal and external carotids gave the following information: tumour vascularized by the transverse facial, ascending palatine and internal maxillary arteries. Further vascularization was found arising from the ophthalmic artery and intracavernous branches. All in all, the tumour was highly vascularized.

At the beginning, the diagnosis was not easy to make. First of all because an ENT specialist had examined the nasal cavity a few days earlier without suspecting any kind of tumour and secondly because the pathology was more apparent in the cheek and temporal areas. Biopsies were first taken from the cheek and temporal region, which made us suspect a vascular process. The progressive nasal obstruction and the radiographic appearances led to a biopsy in the post nasal space which resulted in the pathologists' reports of angiofibroma.

With this diagnosis, hormonal preoperative treatment

under the guidance of the endocrinologist was commenced and testoviron was administered for two weeks. No remission was noted. On the contrary the clinical appearance became even more dramatic.

Given the connections of the tumour with both the external and internal carotids on the right side, the possibility of arterial embolization was discussed with the Neurosurgical Department. Although this preoperative measure is recommended (*Berkstein* et al. 1981) it was not accepted because of the risks involved and the little technical benefit which would probably be achieved.

With no other options remaining the Dept. of Oral and Maxillo-facial Surgery decided to operate, Twelve units of blood were made available before commencement of the operation. The procedure started with oral intubation followed by tracheostomy. Then the control of the right common carotid artery as well as internal and external carotids separately was carried out (Riche et al. 1980). Next the mobilization of the maxilla was performed as described (Fig. 6). When the maxilla was turned back it could be seen that the tumour was easily distinguishable from the rest of the structures. It had a firm consistency and rested in a typical teat-shape, around, above, in and among the retro-maxillary, pterygomaxillary and ethmoidal regions, the post nasal space, the sphenoidal sinus, the right nasal cavity, the rhinopharynx, the floor of the orbit, the temporal region, the pterygomandibular and premasseteric regions. The tumour was easily separated from the adjacent structures although in some areas it was attached quite firmly, especially in the rhinopharynx and the choanal space. Eventually it had a bloodless weight of 150 grammes. Inspection showed that the tumour was completely removed. Since the sphenoidal sinus was opened it was curetted, also removing some fragments (Piquet et al. 1979). A moderate haemorrhage occurred only in the pterygomaxillary region, this was easily controlled by local means.

The reconstruction included packing of the sphenoidal sinus, right nasal cavity and maxillary sinus, re-suturing of the infraorbital nerve at the time the maxilla was repositioned and fixed with osteosynthetisis wires. Then an

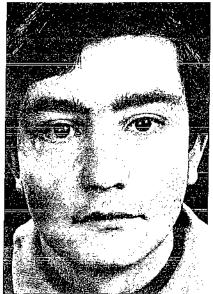




Fig. 7 c Intraoral appearance

Fig. 7 Postoperative appearance.



Fig. 7 d Computed tomography

intermaxillary splint was placed and the soft tissues were sutured.

Postoperatively the patient was sent to the ICU. He developed at electasis in the left lung which was treated in a conventional manner. Tracheostomy and feeding by a nasogastric tube were continued for 10 days. During this time the packs were removed. Intermaxillary fixation was maintained for six weeks.

The histological report confirmed the diagnosis of angiofibroma with no signs of malignancy. The postoperative X-ray follow up as well as clinical observation did not produce any significant information. There were no signs of disturbed healing and/or recurrence of the tumour. Function and aesthetics are satisfactory, only a degree of ectropion of the lower eye-lid is visible. Postoperative thermography showed equal temperatures of both halves of the face (Fig. 7).

#### Discussion

The case presented forced the author to consider a transfacial access to the retromaxillary region (Hernandez Altemir 1982, 1983). It rose from a fundamental need not only to obtain an appropriate operating field but to cause as little mutilation as possible. The technique developed has various advantages.

The incision does not sacrifice any structure which is practically not recoverable and is not important from the functional or aesthetic points of view.

In contrast to transmaxillary techniques which resect parts of the maxilla, no dental structures are sacrificed, there is no risk of necrosis of the maxilla and no second stage reconstruction is necessary. Excellent access is achieved to all the fore-mentioned areas which, without this technique, would not be possible without mutilation except if highly

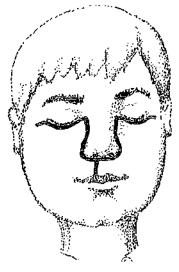


Fig. 8 Incision for bilateral approach

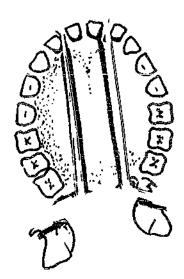


Fig. 9 a Osleotomy

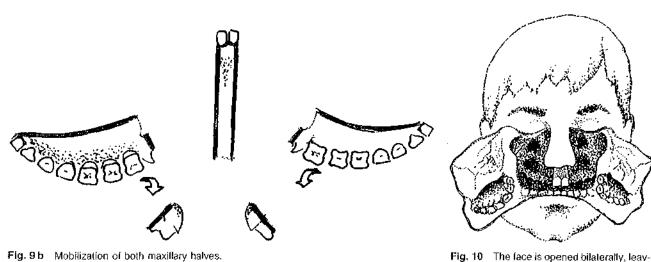


Fig. 9 b Mobilization of both maxillary halves.

Fig. 9 Bilateral palatal approach

sophisticated and complex techniques such as microsurgery were used, which even then often result in operating fields of limited access and difficult manipulation (Martinez Asensio et al. 1975, Alfranca Bouthelier et al. 1977, Prades and Bosch 1977, Gobbo 1979). With our technique even the foramina and fissures of the base of the skull are easily accessible. The easy display of the regions referred to above gives a greater guarantee of complete removal of tumours and reduces considerably the risk of serious haemorrhage (Garcia Soto et al. 1979, Altamar Rios 1980, Bey et al. 1981). This is further improved by the fact that the tumour can be removed en bloc without dividing it. Another important aspect is that this technique can be carried out simultaneously on both halves of the maxilla, opening the face like a book (Fig. 8-10). However, the need for such an

extensive approach will be extremely rare. The vasculariza-

tion of the pedicle on which the maxilla is based is mainly secured by the facial and transverse facial arteries, As explained we try to respect the arterial pedicle of the palatal flap. Our experience shows however that it could be sacrificed without any great risk.

ing a median strut.

Ligature of the external carotid artery has not influenced the vitality of our flap in any tangible way. The next time we will consider exclusive temporary arterial control without ligature. Also, since the operation is carried out under direct vision, perhaps it is not even necessary to control the large arteries prior to exposure and removal of such tumours.

From our first case we learned that we should leave the tarsorraphy in place for some time in order to prevent ectropion.

There is no doubt that different modifications of our techni-

que will be introduced (*Curioni* et al. 1984, *Martinez-Lage* et al. 1984). We expect that this will lead to a new surgical concept which could be used not only in tumour surgery but also in facial osteotomies.

This surgical technique does not try to replace the traditional one in any way. The author only hopes that the surgeon will remember it for selected cases in which the exaggerated size of the tumour and/or its location makes it difficult or impossible to reach it in the traditional way, without mutilation (Oliveras and Mexia 1976, Sierra and Vázquez 1980). It is a good alternative to the temporal approach (Obivegeser 1985) for more medially and anteriorly situated tumours.

#### Conclusion

The technique of temporary mobilization of the maxilla pedicled on the cheek is simple and straightforward. It gives an excellent access to many regions which are difficult to reach and has been very useful in the specific case of an enormous juvenile angiofibroma of the post nasal space. The main advantage lies in the absence of need to sacrifice any maxillary or dental structures and the ease with which any small sequellae which may occur can be dealt with.

#### Acknowledgement

The author thanks the Anaesthesiology and Intensive Services, with Doctors Temino and F. Pardo, Head, without whose collaboration the Oral and Maxillofacial Surgery would not have achieved the assistence, teaching and investigation-level which I consider it has at the present time. My thanks also to the rest of the Services and personnel of the Institution, without exception.

Collaborators in the clinical case:

Dr. Bandrés, Resident Doctor of the Maxillofacial and Oral Surgery Service at the "Miguel Servet" Hospital in Zaragoza. Dr. Contin, Clinical Head of the ORL of the Children's Hospital attached to the Miguel Servet Hospital in Zaragoza. (Head Dr. Alba).

Dr. Dehesa, Clinical Head of the Maxillofacial and Oral Surgery Service of the Miguel Servet Hospital in Zaragoza.

Dr. Ferrández, Clínical Head of Endocrinology of the Paediatric Department of the Children's Hospital (Head Dr. Bonet), of Miguel Servet's Hospital.

Dr. Gómez Perún, Assistant Doctor of the Neurosurgery Service of Miguel Servet's Hospital in Zaragoza.

Dr. Martinez Tello, Clinical Head of the Pathological Anatomy Service (Head Dr. García Julián).

Dr. Rived, Assistant Doctor of the Maxillofacial and Oral Surgery Service of Miguel Server's Hospital in Zaragoza.

Dr. Ucar, Head of the Neurosurgery Service.

Dr. Valero, Clinical Head of Neuroradiology of the Radioelectrology Department (Head Prof. Solsona).

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Dr. Francisco Hernández Altemir, M.D. Stomatologist Oral and Maxillofacial Surgeon Head of the Maxillofacial and Oral Surgery Service "Mignel Servet" Hospital, Zaragoza, Spain D. Enrique Aznar García, Jefe del Departamento de Cirugía de la Ciudad Sanitaria José Antonio de Zaragoza

### CERTIFICA:

Que el Dr. Francisco Hernández Altemir, Jefe del Servicio de Cirugía Oral y Maxilofacial de esta Institución, ha desa rrollado en el seno de este Departamento su técnica de Desarticulación temporal pediculada a mejilla del maxilar superior (es) como vía de abordaje transfacial a las regiones fundamentalmente retromaxilares y para otras indicaciones, una nueva técnica, aportación de un caso clínico, interviniendo con fecha 26-3-1982 un caso clínico de Angiofibroma gigante juvenil de Cavun, con resultados muy satisfactorios.

Zaragoza, 15 de Julio de 1982

shuar!

Fdo.: Enrique Aznar García Jefe del Departamento de Cirugía

WI.BO.

II DIRECTOR MEDIC

TE LA CIUDAD SANIMERIA

LOW - SEIGHTH BOS

### DR. ELISARDO PARDOS BAULUZ

ORTODONCIA EXCLUSIVAMENTE

La 12emta Estoma, el tralojo del Doctor Herrander Blumr any titul frante de com , intermido por la teomico de desorhantocio temporal pede loca a nepllo de monitor

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JERE GEL SERVICIO DE CIRUGIA MAXILOFACIAL DE LA CIUDAD BANIFARIA "JOSE ANTONIO PRIMO DE RIVERA"

Residencial Bueneviste Frey Luis Amigó, S Edificio Zafiro, planta C, letre B. Teléfono 270719 ZARAGOZA - 6

Capping of 1047

Zaragoza 28 de abril de 1982

Real Academia de Medicina de Zaragoza

Profesor Don Fernando Orensanz Gutiérrez

(Sección Cirugía)

Plaza de Basilio Paraiso.1

Secretaria actuals Nueva Facultad de Medicipa. Domingo Miral e, Zaragoza

Distinguido emigo y compañerot

Según musica conversación, to savio el Título de la Comunicación que me gustaría desarrollar en el seno de esa Real Academia de Medicina,
si es que consideras, que la misma reune los merecimientos necesarios para tal
honor: DESARTICULACIÓN TEMPORAL PEDICULADA A MEJILLA DEL MAXILAR(ES) SUPERIOR(E
COMO VIA DE ABORDAJE TRANSFACIAL A LAS REGIONES FUNDAMENTALMENTE RETROMAXILARES
Y PARA OTRAS INDICACIONES. UNA NUEVA TECNICA.

Atentamente.

F.Hernández





# MINISTERIO DE SANIDAD Y CONSUMO INSTITUTO NACIONAL DE LA SALUD CENTRO ESPECIAL "RAMON Y CAJAL"

El Dr. Hernandez Altemir, presentó en el XII Congreso Nacional de la Sociedad Española de Cabezay Cuello una Comunicación Libre sobre: " Un caso de angio\_fibroma juvenil gigante de Cavum, intervenido por la técnica de desarticulación tempo\_ral pediculada a mejillo de maxilar superior ".

Para los efectos oportunos, firmo el presente documento a 11 de Diciem\_

bre de 1.982.

dole Die De V.M. Sada

Presidente del Congreso



# VII CONGRESO NACIONAL DE LA SOCIEDAD ESPAÑOLA DE CIRUGIA ORAL Y MAXILOFACIAL

OVIEDO, del 2 al 5 de Junio de 1982

Secretaria: ESCUELA DE ESTOMATOLOGIA / Facultad de Medicina Julián Claveria, s/n - Telétono (985) 25 19 00 - OVIEDO (España)

D. Luis Antuña Zapico, Secretario del VII Congreso de la Sociedad Española de Cirugia Oral y Maxilofacial - celebrado en Oviedo los dias del 1 al 4 de Junio de 1.982

#### CERTIFICA :

Oviedo, 15 de Junio de 1.982

Fdo. Dr. Luis Antuña Zapico

# AVISO A LOS SEÑORES CONGRESISTAS

Durante los días 9, 10 y 11 de Diciembre y coincidiendo con las horas de Comunicaciones libres, se proyectaran una serie de peli\_culas y video-films en el Aula de la planta 6ª Centro del Departamen\_to de Cirugía Maxilofacial, cuyos títulos se exponen a continuación.

- " Disección posterior del cuello " (Dr. Die Goyanes )
- " Tumor maligno de maxilar superior " ( Dr. Castillo Escandon )
- " Osteotomias en el tratamiento de la dimensión vertical (Dr. V. Sac
- Maxilectomia y Craniectomia frontal por Carcinoma Epidermoide "
  ( Dr. Navarro Vila )
- Hemimandibulectomia, Hemiglosectomia y resección de suelo de boca. Reconstrucción con colgajo miocutaneo de pectoral mayor<sup>11</sup>
   (Dr. Navarro Vila)
- " Reconstrucción con colgajo miocutaneo trapecial en cirugía oncolo\_
  gica de cabeza y cuello." (Dr. Navarro Vila)
- "Reconstrucción con colgajo osteomiocutaneo trapecial en cirugía oncológica de cabeza y cuello" (Dr. Navarro Vila)
- " Osteoma frontal. Tratamiento y reconstrucción " ( Dr. Martinez Vi
- Parotidectomia total con conservación del nervio facial " (Dr. Di GOyanes)
- " Resección del hueso temporal " (Dr. Die Goyanes )

NOTA: El día 11 a las 10, el Dr. HERNANDEZ ALTEMIR, presentará en e Salon de Actos una comunicación Libre sobre " un caso de angiofibro juvenil de Cavum intervenido por la técnica de desarticulación tempo pediculada a mejilla de maxilar superior."



Georg Thleme Verlag Stuttgart · New York

# Journal of Maxillofacial Surgery

Nijmegen, July 3rd, 1984

Dr. Francesco Hernandes Altemir Head of the Maxillofacial and Dral Surgery Service Hospital "Miguel Servet"

<u>Zaragoza</u> Spanje Editor-in-Chief
Prof. H. P. Freiholer, M. D., D. M. D.
Afdeling Mond- en Kaakchlrurgie
Heelkundige Klinleken
Geert Grooteplein zuld 14
Postbus 9101
NL-6500 HB Nijmegen

Dear Dr. Hernandez Altemir,

I received the answer of the Editorial Board concerning your manuscript. It is basically accepted.

I therefore ask you kindly to reshape it according to the suggestions I made in my letter of May 8th.

We will then together polish it in order to have it published as soon as possible.

Yours sincerely,

Prof.Dr. H.P. Freihofer Editor-in-Chief

Se envió el trabajo para su publicación en este Journal el 27 de abril de 1984



Georg Thleme Verlag Stuttgart - New York

# Journal of Maxillofacial Surgery

Nijmegen, July 3rd, 1984

Dr. Francesco Hernandes Altemir Head of the Maxillofacial and Dral Surgery Service Hospital "Miguel Servet"

<u>Zaragoza</u> Spanje Editor-in-Chief Prof. H. P. Freihoter, M. D., D. M. D. Afdeling Mond- en Kaakchlrurgle Heelkundige Klinleken Geert Grooteplein zuid 14 Postbus 9101 NL-6500 HB Nijmegen

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Prof.Dr. H.P. Freihofer Editor-in-Chief

Se envió el trabajo para su publicación en este Journal el 27 de abril de 1984

# Journal of Oral and Maxillofacial Surgery

DANIEL LASKIN, D.D.S., M.S. Editor-in-Chief

Department of Oral and Maxillofacial Surgery Medical College of Virginia PO Box 566, MCV Station Richmond, Virginia 23298 (804) 786-0602

December 10, 1984

Francisco Hernandez Altermir Head of the Maxillofacial and Oral Surgery Service of the Hospital "Miguel Servet" Zaragoza SPAIN

Dear Dr. Altermir:

Thank you for submitting your paper entitled "Temporary Pedicellated Disarticulation to the Cheek of the Upper Maxillary(ies) as a Way of Transfacial Access to the Mainly Retromaxillary Regions and in Other Directions (Maxillopterygoid way) a new technique" for publication in the JOURNAL OF ORAL AND MAXILLOFACIAL SURGERY.

It has been reviewed by our Consultant Staff and in their opinion it should be considered for publication. However, it is first necessary that the paper be rewritten since it is currently not in proper English. I have attempted to do this but find it too difficult to decifer some of the statements. I would suggest that the paper be reviewed by someone very familiar with the English language so that it can be put into more acceptable form prior to resubmission.

Please return the original edited copy with the revised manuscript.

Sincerely yours,

Daniel M. Laskin, D.D.S., M.S.

Editor-in-Chief

DML/jhm

Enclosure



Se envió el trabajo para su publicación en este Journal el 27 de abril de 1984.

EDWIN W. COCKE, JR., M.D. OTOLARYNGOLOGY HEAD AND NECK SURGERY EDWIN W. COCKE, JR., M.D.
PRACTICE LIMITED TO EAR. NOSE AND THROAT
920 MADISON AVENUE, SUITE 1030-N
MEMPHIS, TN 38103

June 26, 1995

Dr. Francisco Hernandez Altemir Residencial Buena Vista Fray Luis Amigo, 8 Edificio Zafiro-Planta O, Letra B

Dear Dr. Altemir,

I have not corresponded with you in some time and I am very interested in receiving from you another brochure concerning your work with regard to Manipulation of the Facial Bones. You may recall that I have been primarily interested in surgical exposure of the skull base through the facial bones and you were good enough to send me your brochure at one time.

i would appreciate receiving another brochure of similar nature from you. I am in the process of attempting to review the world literature in regard to this subject and certainly would like to include your work. I still think that it would be nice if you could become a member of one of our organizations here in the states with regard to skull base work. If you would like for me to put you in contact with one of the executives involved with the Society of Skull Base Surgery, I would be happy to.

Thank you in advance for your favor.

Sincerely.

Shuir liche.) Edwin W. Cocke, Jr. M. D.

EWCjr/dka



Dr. Francisco Hernandez Alterior Residencial Buenainste Frag Luis Amego 8 Edificio Zafiro Plantos O Letra B Zaragoza Spain 50006

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920 MADISON AVENUE, SUITE 1030 EN

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Francisco Hernández Altemir

JEFE DEL SERVICIO DE CIRUGIA ORAL Y MAXILOPACIAL DE LA CIUDAD SANITARIA "MIGUEL SERVET" Residencial Buenavista
EDIFICIO 2AFIRO. PLANTA 0 LETRA 8
Teléfono 976/27 02 19
50006 - KARAGOKA

Zaragoza 9th August 1995

Edwin W. Cocke, Jr., M.D. 920 Madison Av., Suite 1030-N MEMPHIS, TN 38103

Dear Dr. Cocke,

With regard to your letter of June, 26th, 1995, that I received some days ago, I enclose the paper "Transfacial access to the retromaxillary area and some technical modifications".

I presented this paper in the 8th Congress of the European Association for Maxillofacial Surgery, that was held in Madrid (Spain) in September 1986, 15th-19th. Later on I reviewed and updated this study for the "Symposium: Dismantling and Reassembly of the facial skeleton -state of the art-". Castellanza (VA)(Italy), November 26th, 1994; under the patronage of the European Association for Craniomaxillofacial Surgery, European Skull Base and Italian Society for Maxillofacial Surgery. An issue of the paper was given to each participant to the Symposium.

You will notice that it includes techniques and modifications of the endotracheal intubation that are useful in the skull base surgery and in some other aspects of the head and neck surgery.

I also enclose photocopies of the posters presented in the "XIII Congreso Nacional de la Sociedad Española de Cirugía Oral y Maxilofacial", held in Pamplona and San Sebastián in May 29th-June 3rd,1995 expecting that you will find them useful. At that congress, I presented what, in my opinion, is the new concept: "Pediculated craniofacial surgery" (it is included in the Congress official summary). You will see different incissions and ostheotomies to be performed for this new concept, in the same line of the "Transfacial access to the retromaxillary area and skull base, published in Estoma 3 (1982) 75.

# Francisco Hernández Altemir

JEFB DEL SERVICIO DE CIRUGIA ORAL Y MAXILOFACIAL DE LA CIUDAD SANITARIA "HIGUEL SERVET"

Residencial Buenavista

EDIFICIO ZAPIRO. PLANTA 0 LETRA 8 Teléfono 976/27 02 19 50006 - ZARAGOZA

It would be an honour to me belonging to the Society of Skull Base Surgery, if it were not too expensive, because you can suppose how dear it is to prepare papers, posters, etc. with no monetary help at all.

I would like to thank you for your interest in my papers, and, if you still consider it possible, you can include them in your review. I would like to know your opinion about the subjects sent to you and receive some news about your revision.

Thank you in advance for your kindness.

Yours faithfully,

Francisco Hernández Altemir, M.D.



L PERCONDUMINA

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Secretaria técnica de la SECOMi

Cursos - ACCESO A LA BASE DEL CRANEO.1-2-3 de Marzo de 2006. ZARAGOZA.

Fecha

1 de marzo de 2006

Inicio

3 de marzo de 2006

E-Mail

Fecha Fin

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UNIVERSIDAD DE ZARAGOZA

FACULTAD DE MEDICINA DEPARTAMENTO DE CIRUGÍA, OBSTETRICIA Y GINECOLOGIA

Director: Profesor Dr. Lozano Mantecón

CURSO DEL DOCTORADO 1-2-3 de Marzo de 2006

ACCESO A LA BASE DEL CRANEO

Director del Curso

Profesor Asociado Dr. D. Francisco Hernández Altemir Jefe del Servicio de Cirugía Oral y Maxilofacial del Hospital Universitario Miguel Servet

Miércoles día 1: Aula 10

MAÑANA

9 a 10 h. Introducción al Curso Prof. Dr D. F. Hernández Altemir

10 a 11 h. Accesos Neuroquirúrgicos a la Base del Cráneo Prof. Emérito Dr. D. Vicente Calatayud Maldonado

Jueves día 2:

MAÑANA

9 A 11 h. Cirugía sobre la base del cráneo lateral.

Dr. D. Jesús Fraile Rodrigo

FEA del Servicio de Otorrinolaringología del H.U. Miguel Servet

Aula 12

TARDE

16 A 18 h. Imágenes multimedia de las Cirugía de la base del cráneo.

Prof. Dr. F. Hernández Altemir

Viernes día 3:

Aula 12

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**ANAÑANA** 

9 a 11 h. Metodología transfacial y de la cirugía craneofacial pediculada para el.

acceso a las estructuras retromaxilares, parafaringeas y de la base del

cráneo.

Prof. Dr. D. F. Hernández Altemir

11 h. en adelante Continuación presentación de Imágenes multimedia de la Cirugia de la base de cráneo.

, Prof. Dr. D, F, Hernández Altemir.

El Curso del Doctorado para el ACCESO A LA CIRUGIA DE LA BASE DEL CRANEO, está abierto a Estudiantes de Medicina de últimos Cursos y a Facultativos y Especialistas Médicos con interés en la cirugía y patología craneofacial y de la base del cráneo. No se entregaran certificados ni documentos de asistencia.



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# UNIVERSIDAD DE ZARAGOZA- FACULTAD DE MEDICINA-

Departamento de Cirugla, Ginecología y Obstetricia (Director Prof. Dr. D. V. Calatayud)

CURSO DOCTORADO

Director del Curso: Prof. A. Dr. D. Francisco Hernández Altemir (Hospital Universitario Miguel Servet de Zaragoza- Jefe del Servicio de Cirugía Oral y Maxilofacial)

### ACCESO A LA BASE DEL CRANEO

Días 1, 2, 3 de marzo del 2004, Aula 10 (Facultad de Medicina)

Profesores Invitados:

Profesor Dr. Don Vicente Calatayud Maldonado -Neurocirugía-Profesor Dr. René Sarrat Torreguitart -Ciencias Morfológicas-Dr. Don Gregorio Sánchez Aniceto - Cirujano Oral y Maxilofacial

Horario:

Lunes 1 de marzo del 2004

9h.: Profesor Dr. D. René Sarrat Torreguitar Recuerdo de la embriología y anatomía de la base del cráneo

10h. a 12 h. Profesor Dr. D. Vicente Calatayud Maldonado
Patología Clínica y quirúrgica de la base del cráneo (presentación de casos
Clínicos)

Martes 2 de marzo del 2004

17h.: Prof. A. Dr. D. Francisco Hernández Altemir

Recuerdo histórico de las técnicas transfaciales para el acceso a estructuras de

la base del cráneo y regiones adyacentes

18 h. a 20 h. Dr. Don Gregorio Sánchez Aniceto

Patología quirúrgica de la cirugía de la base del cráneo resueltas a través de técnicas extraordinarias

Miércoles 3 de marzo del 2004

9h. a 12 horas : Dr. Don Gregorio Sanchez Aniceto

Continuación del tema: Patología quirúrgica de la cirugía de la base del

craneo a través de técnicas extraordinarias

12h. a 14 horas, Prof. A., Dr. Don Francisco Hernández Altemir

Nuestra metodología transfacial y su evolución hacia el empleo del arco de

tracción craneofacial y de la cirugía craneofacial pediculada

Interpretación de la Universidad de Liverpool a nuestra técnica de acceso

medio facial a la base del cráneo y estructuras con ella relacionadas

Cirugía craneofacial pediculada

El acceso al Curso es libre para estudiantes de medicina y facultativos especialistas interesados en el tema, así como para los MIR en formación de especialidades a fines: (Cirugía Oral y Maxilofacial, Otorrinolaringología, Neurocirugía, etc.)



DE LA
UNIVERSIDAD DE ZARAGOZA
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Teléfono Decanato 976 76 16 65 Fax Decanato 976 76 17 45 e-mail: dirmediz@posta.unizar.es 50009 ZARAGOZA

D° DOLORES SERRAT MORE, Profesora Titular y Decana de la Facultad de Medicina de la Universidad de Zaragoza,

INFORMA: Que vista la nominación a favor del Dr. D. Francisco Hernández Altemir al Premio "Rey Jaime I" 2003 efectuada por la Dirección Gerencia del Hospital Universitario Miguel Servet de Zaragoza, la Facultad de Medicina y dada la calidad de los temas "Técnicas transfaciales y sus modificaciones" e "Intubación endotraqueal por vía submental" la Facultad de Medicina de la Universidad de Zaragoza se adhiere a dicha nominación.

y, para que conste, a los efectos oportunos, expido el presente informe, en Zaragoza a dieciseis de mayo de dos mil tres.

LA DECANA en funciones,

Fdo.: Dolores Serrat Moré



Bajo el patronazgo y presidencia de honor de S.M. El Rey

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Valencia, 24 de febrero de 2003

Estimado Dr. Hernández

Me complace informarle que <u>ha sido nominado para el Premio "Rey Jaime I"</u> 2003 a la Medicina Clínica. Como sabe, nadie conoce mejor la propia labor que uno mismo. Por este motivo, le agradeceré que me envie la siguiente información en los impresos adjuntos en - español e inglés- y que a continuación le indice:

- -Resumen de su Curriculum Vitae-300 a 500 palabras-
- -Resumen -300 a 500 palabras- de su labor científica, en la que se especifique sus principales contribuciones.
- -Una lista de las 10 publicaciones suyas que considere más importantes y una copia de cada una de ellas.

Según las normas que rigen los "Premios Rey Jaime I", le comunico que la documentación enviada por los candidatos, excepto libros, permanecerá en los archivos de la Fundación Premios "Rey Jaime I".

Le ruego remita esta documentación antes del día 30 de Marzo de 2003.

Reciba un cordial saludo,

Soutiogo Grisolia

Santiago Grisolia





Dear sirs,

I am enclosing copies of some of our most recent studies, which have appeared in the international bibliography, on the subject of our "submental endotracheal intubation" techniques and other transfacial techniques permitting access to the base of the cranium and adjacent areas (Maxillary swing approach and others).

The historical evolution and the advantages of the "submental endotracheal intubation" technique are summarised in the article and bibliography "Indications for and technical refinements of submental intubation in oral and maxillofacial surgery". The advantages of this technique over the tracheoctomy in patients who do not require long term endotracheal intubations are that it is less traumatic and, with reference to the area of surgery, it avoids complications such as endocranial intubation in fractures at the base of the cranium whether or not associated with panfacial fractures – Journal of Cranio-Maxillofacial Surgery (2003) 31.383-388.

With reference to "Transfacial Techniques for access to the base of the cranium" (Maxillary Swing approach, etc), I would like to bring to the attention of the jury that in the Journal of Cranio-Maxillofacial Surgery Volume No 1, February 2004, pages 19-20, "Coronoidectomy in maxillary swing for reducing the incidence and severity of trismus – a reminder", the renowned authors, Yoav P Talmi et al. attribute the authorship of the transfacial techniques to Hernández Altemir. The authors acknowledge that prior to the description and development of these techniques, access to certain areas at the base of the cranium and to retromaxillary regions, the clivus etc. required extremely aggressive and complex surgery that neither surgeons nor patients were always able to sustain.

In the light of this, I consider that both procedures; submental intubation in its various forms and transfacial access, should be carefully considered by the Jury for the Rey Jaime I (King James I) awards, in the clinical medicine section, as they represent notable advances in Oral and Maxillofacial surgery, in Otorinolaringology, in Neurosurgery, in Anaesthetology and in Intensive Medicine. These techniques have provided a meeting point for various specialist fields and have also benefited both medical practice and research.

Yours faithfully,

Francisco Hernández Altemir







Secretario General Perpetuo Carlos Cuchí de la Cuesta

CARLOS CUCHÍ DE LA CUESTA, ACADÉMICO DE NUMERO Y SECRETARIO GENERAL PERPETUO DE LA REAL ACADEMIA DE MEDICINA DE ZARAGOZA

# CERTIFICA QUE:

El Dr. D. Francisco Hernández Altemir, dictó la conferencia titulada "Algunas consideraciones sobre la interpretación que hace la universidad de Liverpool a nuestra metodología transfacial y de la cirugía craneofacial pediculada, derivada de la misma" el pasado día 5 de febrero de 2004, la cual se publicará en los Anales de esta Corporación el próximo año.

Zaragoza, 2 de septiembre de 2004

# Maxillary Swing Approach for Resection of Tumors In and Around the Nasopharynx

William I. Wei, MS, DLO, FRCSE, FACS; Chiu M. Ho, FRCSE, FRACS; Po W. Yuen, DLO, FRCSE; Ching F. Fung, FRCSE; Jonathan S. T. Sham, DMRT, FRCR; Kam H. Lam, MS, FRCSE, FRACS

he efficacy of the anterolateral approach to the nasopharynx and its vicinity was evaluated. Using this maxillary swing approach, we have removed tumors in and around the nasopharyngeal region in 26 patients. Among them, 18 suffered from recurrent primary nasopharyngeal carcinoma after external radiotherapy, three patients had chordoma, two had schwannoma, one had adenocarcinoma of the nasopharynx, and one had malignant fibrous histiocytoma. The last patient had a recurrent deep-lobe parotid gland tumor localized in the paranasopharyngeal space. The facial wounds in all 26 patients healed primarily with no evidence of necrosis of the maxilla. Seven patients developed palatal fistula, five of them subsequently healed, whereas one patient required surgical closure and one had to wear a dental plate. This group of patients was followed up from 4 to 42 months (median, 15 months). Among the 18 patients with recurrent nasopharyngeal carcinoma, five had local recurrence, four died of other conditions, and nine of them are still alive with no evidence of disease. This gives an actuarial control of tumor in the nasopharynx of 42% at 3.5 years. In the eight patients remaining, one died of recurrent chordoma, two are alive with recurrent disease, and five are free of disease. Exposure of the nasopharynx and the paranasopharyngeal space is possible using the anterolateral approach. (Arch Otolaryngol Head Neck Surg. 1995;121:638-642) The associated morbidity is low.

The nasopharynx and its adjacent area and the paranasopharyngeal space are located in the center of the head. This region is difficult to approach, and it is even more challenging to obtain an adequate exposure for an oncologic surgical procedure.

This problem was presented by Wilson in 1950.¹ Over the years, many surgical approaches have been designed to provide access to the nasopharynx. The primary objective of most of these procedures was for the extirpation of tumors in the maxilloethmoidal area, but they have also been used for removal of benign and malignant tumors in and around the nasopharynx.² However, most of these approaches did not adequately expose the nasopharynx and the paranasopharyngeal space to permit an oncologic procedure to

From the Departments of Surgery (Drs Wei, Ho, Yuen, Fung, and Lam) and Radiation Oncology (Dr Sham), The University of Hong Kong, Queen Mary Hospital. be performed. We have previously described the maxillary swing approach to this region.<sup>3</sup> The present series is a review of our experience in resecting tumors in and around the nasopharynx using this approach.

#### RESULTS

All 26 patients survived the operations and were able to tolerate an oral diet on the third postoperative day. The facial wounds in all 26 patients healed primarily, and there was no necrosis of the maxilla. On removing the dental plates, a palatal fistula was detected in seven patients (27%). These fistulas were treated conservatively with a dental plate, and five of the

See Patients and Methods on next page

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# PATIENTS AND METHODS

#### **PATIENTS**

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From February 1989 through December 1993, in the Otorhinolaryngology Unit, Department of Surgery, The University of Hong Kong, Queen Mary Hospital, we used the maxillary swing approach in the resection of tumors in and around the nasopharyngeal area in 26 patients. Among them, 18 suffered from recurrent primary nasopharyngeal carcinoma following external radiotherapy.

These patients (17 men and one woman) underwent surgical resection of the recurrent nasopharyngeal carcinoma. The patients' ages ranged from 33 to 74 years (median, 50 years). Informed consent was obtained from all patients before operation.

All patients received radical doses of external radiotherapy, ranging from 59 to 70 Gy (median, 63 Gy). The preradiotherapy staging according to Ho revealed the following: stage 1 (n=2), stage 11 (n=5), stage III (n=6), and stage IV disease (n=2). Three patients received their radiation treatment elsewhere, and their preradiotherapy clinical stage was not known.

Computed tomographic scans were performed in the 18 patients before surgical resection. In nine patients, it was apparent that the tumor was localized in the nasopharynx, whereas in the other nine patients, the tumor had extended to involve the paranasopharyngeal space. Biopsy specimens obtained from the nasopharynxes in 18 patients revealed anaplastic carcinoma in 17 and nonkeratinizing squamous cell carcinoma in the remaining patient. In two of the 18 patients, the recurrence detected after external radiotherapy was initially successfully treated with brachytherapy in the form of a split-palate gold-grain implantation. Unfortunately, the tumor recurred in both patients. This recurrence was treated with surgical resection. The disease-free interval between the last radiation treatment and the present recurrence in these 18 patients ranged from 6 to 26 months (median, 17 months). The follow-up period ranged from 7 to 42 months (median, 15 months).

In the remaining eight patients, one patient had recurrent adenocarcinoma of the nasopharynx after surgical resection via a split-palate approach followed by postoperative external radiotherapy. Three patients suffered from chordoma presenting in the nasopharyngeal region, and two had extensive schwannoma extending from the paranasopharyngeal region to the parapharyngeal space. The seventh patient suffered from a recurrent pleomorphic adenoma localized in the deep lobe of the parotid gland. The last patient had a malignant fibrous histiocytoma of the infratemporal fossa. This histiocytoma was resected with the maxillary swing approach combined with a mandibular swing.

#### OPERATIVE TECHNIQUE

We used an anterolateral approach to the nasopharynx and its vicinity (**Figure 1**). The maxillary antrum with the hard palate attached to the anterior cheek flap is turned laterally as an osteocutaneous flap (**Figure 2**). This surgical approach has been reported previously.<sup>3</sup>

With this approach, the cartilaginous portion of the eustachian tube on the side of the lesion and the soft tissue of the whole nasopharynx can be resected under direct vision. The posterior part of the nasal septum is removed to offer a better exposure of the contralateral nasopharynx. When the recurrent tumor has extended laterally beyond the nasopharynx, tissue in the paranasopharyngeal space can be removed together with the tumor. After the resection is completed, the maxilla is returned and fixed to the facial skeleton with miniplates and screws. A dental plate is fitted in all patients to achieve additional stability. Myringotomy and insertion of a grommet are necessary at the end of the operation to prevent the development of serous otitis media.

In four patients, the resection margin was close to the tumor. To increase the chance of eradicating the tumor, hollow nylon tubes were placed and long metal needles were accurately inserted in the tumor bed before the maxilla was swung back in place. This allowed the insertion of iridium wires as afterloading brachytherapy.

In the last patient, a 16-year-old girl, with a malignant fibrous histiocytoma, the tumor extended downward into the parapharyngeal space. A concomitant mandibular swing was necessary to expose the tumor for complete removal.

seven fistulas healed within a few months, whereas two posterior fistulas persisted. One patient wore a dental plate, and there was no functional problem. In the last patient, the fistula was closed surgically with a palatal flap.

All patients developed a certain degree of trismus during the first few months after the operation. This invariably responded partially to conservative management, and there was no functional disability.

At the time of resection, in two of the 18 patients with recurrent nasopharyngeal carcinoma, the tumor was found to be infiltrating the skull base extensively; only palliative resection was performed. In the other 16 patients, the size of the recurrent tumor ranged from 1 to 3 cm; in nine patients, the paranasopharyngeal space was affected. They all underwent curative resection, and the resection margins were negative for tumor at the time of surgery. As the tumor margins were close in four of the

patients, hollow nylon tubes were inserted for postoperative afterloading brachytherapy. These patients were followed up from 7 to 42 months (median, 15 months). There was no evidence of necrosis of the maxilla in all patients.

Among the 16 patients who had curative resection, three patients developed local recurrence, whereas 13 were free from local disease. Two of the 13 patients with local tumor control developed regional metastasis and died, while two developed bleeding from the internal carotid artery. These two patients with bleeding were among the four who had afterloading brachytherapy following the resection. One patient died of the bleeding, whereas the other survived after ligation of the internal carotid artery. He, however, died of bronchopneumonia 8 months later. The other nine patients are still alive, with no evidence of local disease. The actuarial control of disease

Figure 1. Computed tomographic scan of the nasopharynx. Top, Dashed lines indicate the osteotomies. Bottom, The nasopharynx was exposed with the maxilla swung laterally while remaining attached to the anterior cheek flap.

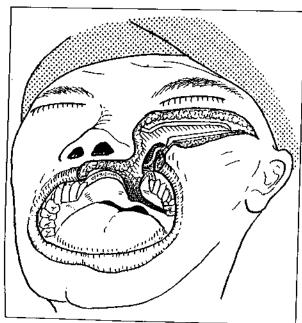


Figure 2. The maxilla is separated from the facial skeleton but remained attached to the anterior cheek flap.

in the nasopharynx was 42% at 3.5 years (**Figure 3**), and the actuarial survival of this group of patients was 36% at 3.5 years (**Figure 4**).

In one of the three patients who suffered from chordoma, the tumor was extensive and only a palliative debulking procedure was performed. There was a rapid recurrence postoperatively, and the patient died of cachexia 4 months later. The other two patients with chordoma subsequently underwent a secondary neurosurgical procedure for complete eradication of tumor.

For the patient with recurrent adenocarcinoma of the nasopharynx, the tumor at the time of surgery was found to be 3 cm in diameter and extended into the nasal cavity. To achieve adequate tumor clearance, a part of the hard and soft palate was removed en bloc with the main tumor. The tumor recurred locally 8 months later.

The remaining four patients were followed up from 4 to 30 months postoperatively (median, 14 months). In all of them, there was no evidence of locally recurrent disease or necrosis of the maxilla.

#### COMMENT

As nasopharyngeal carcinoma is radiosensitive, the primary treatment modality for this tumor is radiotherapy. When the tumor recurs in the nasopharynx after external radiotherapy, the prognosis is gloomy. Further courses of external radiotherapy can be given, and this may still eradicate the tumor in some patients. For the second course of radiotherapy to be effective, the radiation dose has to exceed the first dose. The dosage of the second course of radiation is limited by the tolerance of the surrounding tissues. The long-term effects of radiation on tissue is not negligible, and, with a second course, the resultant damage to nearby tissue is expected to be high. 5-7

Brachytherapy allows the delivery of a tumoricidal dose to the tumor site while sparing the normal tissue. This is effective in the treatment of small recurrent tumors. In our department, we have used the split-palate approach to expose the recurrent tumor in the nasopharynx for accurate implantation of the radioactive gold grains (gold 198).8 Our experience revealed that this is an effective way of eradicating small recurrent tumors with no operative mortality and acceptable morbidity.9 The limitation of this form of brachytherapy is that the radiation range of the gold grains is only about 0.5 cm. It is not effective in treating large recurrent tumors or those tumors that have extended to affect the paranasopharyngeal space. Under these circumstances, surgical resection may be offered. Similarly, when the tumor recurs after gold-grain implantation, surgical resection should be used to provide salvage.

A number of approaches has been described in the past for resection of lesions in the nasopharynx and its vicinity. These included the lateral approach via the infratemporal fossa<sup>10</sup> and the superior approach.<sup>11</sup> These surgical approaches are not easy to perform, and they carry significant morbidity.<sup>12</sup>

Transpalatal approaches have been used for a long time to gain access to the nasopharynx.<sup>13</sup> Resection of chordomas<sup>14</sup> and nasopharyngeal carcinoma through the transpalatal route has been reported.<sup>15,16</sup> The limitation

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of this inferior approach is that when the tumor extends beyond the nasopharynx into the paranasopharyngeal space, en bloc resection is difficult.

The various anterior approaches to the nasopharynx through the transnasal or the transantral route, as described by Wilson, <sup>17</sup> did not provide an exposure for performing an oncologic surgical procedure. <sup>17</sup> Recently, there were reports on gaining exposure to the nasopharynx by downward fracturing of the entire palate after a transverse maxillary osteotomy. <sup>18</sup> Exposure of the nasopharynx is claimed to be adequate, <sup>19</sup> but resection of pathologic tissues in the lateral wall of the nasopharynx and in the paranasopharyngeal space is not entirely satisfactory. Exposure of the nasopharynx with the anterior approach can be increased with subtotal maxillectomy or extended maxillotomy. Under this circumstance, the defect resulting from the partial maxillectomy requires reconstruction. <sup>20</sup>

After total maxillectomy, the nasopharynx and the paranasopharyngeal space are usually widely exposed. For resection of tumor in this region, the maxilla can be removed for access and it was possible to reinsert it as a free graft. Although there is no evidence of bone resorption at 15 months, application of this technique in patients following radiotherapy requires further consideration.

eration.

The anterolateral approach to the nasopharynx with the maxilla swung laterally provides exposure of the nasopharynx, and, with removal of the posterior half of the nasal septum, the whole nasopharynx is exposed. The paranasopharyngeal space on the side of the swing would also be adequately exposed without moving the orbital floor 22 Malignant tumors or large benign tumors in this region can be removed en bloc as in the present review.

The results of salvage resection of recurrent carcinoma in the nasopharynx with the lateral approach showed that six of the 13 patients were alive after 2 to 5

years.23

The transpalatal approach has also been used in the resection of recurrent nasopharyngeal carcinoma after radical radiation therapy. In one center, resection was cartied out for nine patients and the 5-year survival rate of this group of patients was reported as 44% (4/9). 15

The largest series in the literature reported the results of surgical resection of recurrent nasopharyngeal carcinoma in 15 patients using the transpalatal, transmaxillary, and transcervical routes. <sup>24</sup> Seven patients were followed up for more than 3 years, and the other six for less than 3 years. The overall control of local disease was 31% (4/13).

The anterolateral route to the nasopharynx with the maxillary swing approach offers a wide exposure of the whole nasopharynx and the paranasopharyngeal space for an oncologic surgical procedure. Although the follow-up period was short, wide resection of the nasopharynx and the surrounding soft tissue provides control of local disease of 42% of the patients at 42 months postoperatively. The operative procedure is not difficult and the associated morbidity is acceptable. With this wide exposure, a brachytherapy source can be accurately placed at the appropriate positions to give additional treatment to a close resection margin. This was done in four pa-

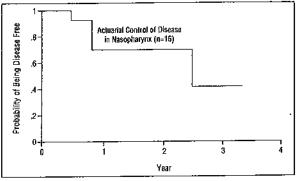


Figure 3. The actuarial control of disease in the nasopharynx after resection with the maxillary swing approach.

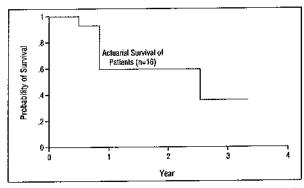


Figure 4. The actuarial survival of patients who underwent resection of the nasopharynx with the maxillary swing approach.

tients in the present group; three of them subsequently developed vascular problems. Although one patient was successfully salvaged, this additional procedure should be performed in selected patients only.

The wide exposure achieved with the anterolateral approach also allowed digital palpation of the internal carotid artery during the dissection and resection of tumor in the nasopharynx and paranasopharyngeal region. Any inadvertent injury to the vessel could be repaired under direct vision.

Many surgical approaches for the removal of chordoma have been described. 25,26 These approaches were either associated with significant morbidity or did not permit complete removal of the chordoma, especially around the nasopharyngeal area. With the maxillary swing approach, adequate exposure of the chordoma around the nasopharynx is possible and the chordoma in this region can either be adequately removed or significant debulking can be performed as shown here.

Surgical removal of recurrent pleomorphic adenomas in the parotid gland carries with it a high risk of injury to the facial nerve. It is more so when the recurrent tumor is localized in the deep lobe of the parotid gland. For the patient in this series, it was not possible to remove the tumor through the previous facial incision as the main tumor bulk was behind the ascending rami of the mandible and the facial nerve was in the way. With the maxillary swing approach, the deeplobe tumor could be completely removed from inside without disturbing the facial nerve, thus preserving its function.

For the patient with recurrent adenocarcinoma of the nasopharynx and advanced schwannoma, the maxillary swing approach offers wide exposure for tumor removal.

When the tumor extended from the base of the skull to the neck, then the maxillary swing approach could be combined with the mandibular swing to increase the exposure as shown in the last patient reported herein. The morbidity was not increased significantly and en bloc tumor removal was possible.

The anterolateral route to the nasopharynx with the maxillary swing approach offers wide exposure of the whole nasopharynx and the paranasopharyngeal space for performing an oncologic surgical procedure. The reassembly of the osseous and soft tissue is not difficult and the associated morbidity is acceptable.

Accepted for publication November 30, 1994.

This study was supported by the following research grants from The University of Hong Kong: Committee on Research and Conference Grants (grant No. 335/048/0040); Sun Yat Sen Foundation Fund (grant No. 378/048/123); and Simon K. Y. Lee Fund (grant No. 357/048/7206).

Presented at the 36th Annual Meeting of the Combined Otolaryngological Spring Meetings Section of the American Society for Head and Neck Surgery, Palm Beach, Fla, May 11, 1994.

Reprint requests to Department of Surgery, The University of Hong Kong, Queen Mary Hospital, Hong Kong (Dr Wei).

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# Coronoidectomy in maxillary swing for reducing the incidence and severity of trismus – a reminder

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SUMMARY. Purpose: The maxillary swing approach is a proven method for access to the nasopharynx. However, often, trismus is incurred postoperatively, hampering adequate oral care and follow-up and affecting patients' quality of life. Case reports: Coronoidectomy was performed in four patients undergoing maxillary swing. Minimal trismus was seen in one patient undergoing repeat irradiation and chemotherapy. After a 1-month period no trismus was observed in the other three patients. Conclusion: Coronoidectomy, usually performed in maxillectomy for reducing trismus is a useful adjunct in the maxillary swing procedure. © 2003 European Association for Cranio-Maxillofacial Surgery.

Keywords: Maxilla; Maxillary swing; Coronoidectomy; Trismus; Nasopharynx; Quality of life

#### INTRODUCTION

The maxillary swing approach is a proven method for access to the nasopharynx with good exposure and acceptable morbidity, first described by *Hernandez Altemir* (1986). Wei et al. (1991) popularized this procedure initially used for resection of recurrent nasopharyngeal carcinoma (Wei et al., 1995; King et al., 2000; Shu et al., 2000) and later for other tumours in and around the nasopharynx (Wei et al., 1995).

Recognized direct surgical complications are palatal fistula, nasal regurgitation, otitis media with effusion and trismus (King et al., 2000). Yet, while trismus was documented to a degree in all patients following surgery, it invariably responded to conservative management and there was no functional disability (Wei et al., 1995). In another series of nine patients undergoing maxillary swing, six (67%) developed trismus (King et al., 2000).

Otitis media with effusion may be overcome by prophylactically introducing a ventilation tube (*Talmi* et al., 1998) whereas the majority of palatal fistula eventually close.

Coronoidectomy as performed routinely in maxillectomy is proposed in cases of maxillary swing in order to eliminate or reduce the incidence and severity of trismus.

#### SURGICAL PROCEDURE

The maxillary swing approach was modified from *Wei* et al. (1991) allowing the maxillary antrum with the hard palate attached to the anterior cheek flap turned laterally as an osteocutaneous flap (*Wei* et al., 1995).

Through a Weber-Fergusson incision (Osborne et al. 1987), the horizontal limb was extended to the zygoma. The vertical limb of the incision extended to the inner surface of the upper lip and continued on to the hard palate between the two central incisors. The midline palatal incision was carried to the junction between the hard and soft palates, and turned laterally to run behind the maxillary tuberosity. The soft tissue of the hard palate was incised 1 cm lateral to the midline bony cut thus obviating an overlapped closure of the defect. Three miniplates and screws were temporarily applied to the zygoma, the frontal process of the maxilla, and the opposite premaxilla. Using an oscillating saw, an osteotomy was performed from the zygoma, the anterior and posterior maxillary wall of the inferior orbital region, and the midline of the premaxilla and hard palate. The final osteotomy was done to separate the maxillary tuberosity from the pterygoid plates by using a curved osteotome. The whole freed maxilla is swung laterally while attached to the masseter and the cheek flap. The tumour in the nasopharynx was dissected under direct vision. The bony surface was drilled and the posterior septum and ethmoid sinuses were also removed if necessary.

Margins were verified by frozen-sections and the mucosal flap of the removed inferior turbinate was grafted on the raw surface.

Prior to closure, a coronoidectomy was performed with detachment of the temporalis muscle from the mandible. Plating was applied, packing inserted and the skin closed. A pre-prepared dental plate may be applied to enhance healing.



Fig. 1 - Patient with angiofibroma. No trismus occurred and the small palatal fistula eventually healed completely.

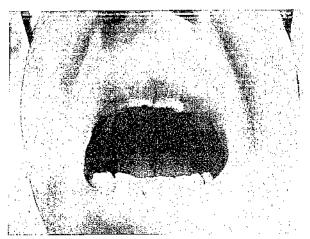


Fig. 2 - Patient with recurrent nasopharyngeal carcinoma 8 years following treatment. Following wide local resection via the maxillary swing approach, the patient was treated by chemoradiation. This patient had not performed physical therapy and some mild trismus eventually developed.

#### **PATIENTS**

Four patients underwent maxillary swing with coronoidectomy for benign or malignant disease. Three had juvenile angiofibroma and one had recurrent nasopharyngeal cancer. Only this latter patient was retreated by chemoradiation while none of the others was treated this way. None of the non-irradiated patients had any trismus while mild trismus was seen in the patient who was irradiated. Two representative cases are portrayed: In a case of angiofibroma via the maxillary swing approach, no trismus occurred and the small palatal fistula eventually healed completely (Fig. 1). Another patient with recurrent nasopharyngeal carcinoma, 8 years following treatment, had wide local resection followed by chemoradiation. This patient had not performed physical therapy and some trismus eventually developed (Fig. 2).

#### DISCUSSION

Coronoidectomy is a time-honored method for treating refractory trismus due to scarring (Nitzan et al.,

1992; Fujioka et al., 2000). Coronoidectomy was performed routinely in all cases of total maxillectomy as a preventive measure followed by extensive physical therapy exercising the temporomandibular joint. A degree of trismus may seem as a reasonable price to pay for resection of recurrent tumour in such a difficult to access location as the nasopharynx. Yet, although Wei et al. (1995) reported that all cases of trismus eventually improved, it was still a problem affecting up to 2/3 of the patient population of King et al. (2000). It should be remembered that following this approach, the patient may undergo repeat chemoradiation treatment, further inducing scarring and fibrosis with subsequent trismus. With the advent of fiberoptic endoscopy, trismus does not preclude examination of the nasopharynx but affects patient well-being and quality of life.

#### CONCLUSION

Coronoidectomy is a valuable adjunct to the maxillary swing approach. This procedure is not time consuming, is easy to perform with the wide exposure provided by the technique and minimizes trismus. Further studies on larger patient groups may provide further insight on the benefit of the procedure.

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# & MAXILLOFACIAL SURGERY

# The transfacial approach to the postnasal space and retromaxillary structures

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SUMMARY. Various surgical approaches to the region are discussed, and the procedure according to Hernandez Altemir (1986) described in detail. Six cases are presented to illustrate how this versatile osteoplastic technique may be adapted for individual patients.

#### INTRODUCTION

The surgical approach to the postnasal space and the retromaxillary structures poses a challenge because of the anatomical inaccessibility of these sites. This inaccessibility has in the past unjustly consigned many tumours to inoperability, has led to the unnecessary mutilation of many patients in order to establish sufficiently radical surgery and has resulted in inadequately radical surgery in the attempt to avoid such mutilation. A multitude of operations has been described, some of which are noted below, but all of these have drawbacks which have hampered their widespread adoption.

The quest for an approach to this region is not new. Drommer (1986) cites two illustrations of Kocher's osteoplastic technique from the 19th and early 20th centuries. The Le Fort I downfracture osteotomy has been described as an approach to the postnasal space by Stell & Wood (1983), and must be the most cosmetic of all the approaches described, as it involves only an intraoral incision, but it lacks the versatility of the procedure to be described later, and gives poor access for dealing with malignant lesions in dentate individuals.

The temporal approach also provides an excellent cosmetic result and has been described as an approach for maxillectomy (Attenborough, 1980), and for access to the orbit, retromaxillary and infracranial regions (Obwegeser, 1985). In our experience, this approach renders access that is too limited for comfort and safety. The extended anterolateral approach (Shaheen, 1982) is a major operation with an unpleasant scar yet still gives somewhat limited access. The cervical approach (Attia et al., 1984) has gained considerable popularity, but involves a lower lip splitting incision, which yields a poor cosmetic result, and an extensive dissection.

The zygomatic osteoplastic technique described by Crockett (1963) may be seen as a forerunner of the transfacial approach to be described below, although it involves an unpleasant horizontal cheek scar and gives far less access, because only the zygoma is osteotomised. The technique to be advocated below was simultaneously described by Curioni and Hernandez Altemir, but only published by the latter (Hernandez Altemir, 1986).

### THE TRANSFACIAL APPROACH: TECHNIQUE

The fundamental elements of the technique are illustrated in the diagrams (Figs 1 & 2) and may also be followed by reference to Figures 3A to 3E, which illustrate the various stages of the procedure utilised in the treatment of a juvenile angiofibroma of the postnasal space. The incision is based on the standard maxillectomy approach, incorporating an extended pre-orbicularis blepharoplasty incision (Figs 1 & 3A). The soft tissues are reflected only far enough to permit the osteotomy cuts to be performed, miniplates to be preformed, and their holes drilled prior to osteotomy (Fig. 3B). These points are important to the success of the technique. This is an osteoplastic osteotomy of the maxilla, malar, and palate, deriving its blood supply from the cheek flap, so excessive tissue stripping may threaten the viability of the osteotomised structures. The preforming and drilling for the miniplates makes an accurate facial reconstruction with perfect dental occlusion easy to achieve. Intraorally, soft and hard tissue incisions are 'stepped' so that they are not coincident, so as to facilitate reliable healing. Intraoral bone cuts divide the palate in the paramedian plane, with this cut being extended through the maxillary alveolus normally between the first and second incisor teeth, and into the floor of the

The facial bone cuts divide the zygomatic arch at its junction with the body of the malar, the lateral orbital rim inferiorly, the orbital floor just posterior to the orbital rim but normally staying lateral to the lacrimal apparatus, and the nasal process of the maxilla in an oblique line extending from the most medial extent of the orbital floor cut to the piriform margin of the nose inferior to the inferior meatus.

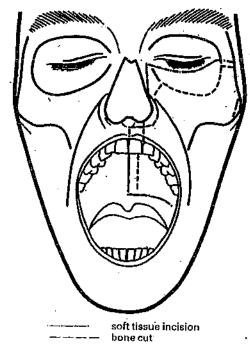


Fig. 1 - The fundamental technique: basic hard and soft tissue

The nasolacrimal duct is thus unaffected. To complete the osteotomy, the lateral nasal wall is divided horizontally below the inferior meatus after submucoperiosteal dissection, and the pterygoid plates, if uninvolved by tumour, are separated with a curved chisel through a small buccal incision, as for any conventional midface osteotomy. Normally, the hard and soft palates are divided at their junction, and the infraorbital nerve divided and tagged to facilitate repair later. The osteotomised fragment is outfractured and folded laterally, to be protected within a saline soaked swab. The required access is now effected (Figs 2 & 3C). Final reassembly is by replacing the osteotomised fragment to its former position and by miniplating. Formal microsurgical repair of the infraorbital nerve should be attempted if access permits, but otherwise simple realignment of the nerve aided with one or two fine perineural sutures has, in our experience, resulted in excellent and rapid return of infraorbital sensation. As stated by Hernandez Altemir (1986) in his original description, the procedure may be performed bilaterally should still wider access be desired. In this event, the only static structures of the midface are the nasal soft tissues, the upper nasal bony skeleton and septum and the attached midline strip of hard palate. Our experience is that healing is just as reliable as in the unilateral case. In all our cases, palatal healing and function has been excellent (Fig. 3D), and the facial scar has rapidly become inconspicuous (Fig. 3E). The Table summarises the details of the first six cases performed using this technique, the results of which are described below, and which illustrate how the basic technique may be adapted to individual patients.

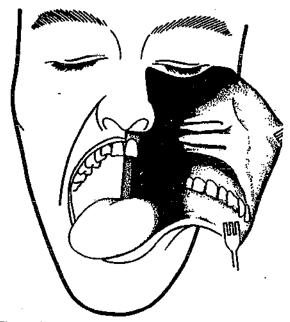


Fig. 2-The fundamental technique: the outfracture.

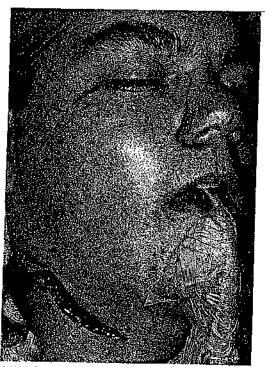


Fig. 3 (A) - Case 5. The classical incision planned for a 16-year-old boy with a juvenile angiofibroma of the postnasal space. The submandibular incision was purely to secure proximal arterial control should it have proved necessary.

### Case reports

Case 1: Adenocarcinoma ex-pleomorphic adenoma of the soft palate and parapharyngeal space

The ENT surgeon who referred the case had received the patient from his general practitioner with a diagnosis of quinsy. This 60-year-old man had a large tumour which



Fig. 3 (B) — Case 5. Miniplates are always formed and the holes drilled before outfracture.



Fig. 3 (C) = Case 5. After outfracture, the typical excellent exposure of the postnasal space is obtained.

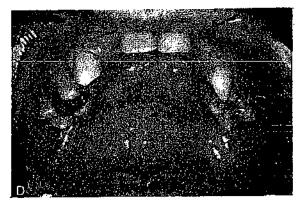


Fig. 3 (D) - Case 5. Postoperatively, the palate has healed very well, and functions perfectly.

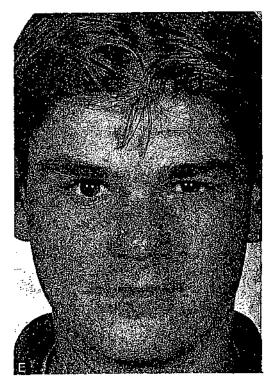


Fig. 3 (E) — Case 5. The facial scars became relatively inconspicuous within a few weeks.

was ultimately shown to be a pleomorphic adenoma partly replaced by adenocarcinoma. Computerised tomography demonstrated an extensive lesion involving the parapharyngeal space, pharynx, soft palate, and postnasal space up to the skull base. This was the first time that we had used the technique and the excellence of the exposure that it would provide was underestimated and a lower lip splitting incision and mandibulotomy were also performed. The mandibular swing, however, contributed little to the exposure, which was highly effective with the whole tumour easily accessible. The tumour was safely excised and the soft palate defect closed with a pharyngeal flap and a buccal fat pad flap. The functional result of this repair was excellent and the only conspicuous scar is that of the redundant lower lip splitting incision. This was the

Table .									
Case	Age (year:	s)Sex	Anatomical site	Pathology	Procedure	Dental status	Infraorbital nerve repair	Infraorbital nerve recovery	Complications
1 .	60	М	Soft palate/ parapharyngeal space/skull base	Adenocarcinoma ex-pleomorphic adenoma	Unilateral complete swing	Edentulous	Microsurgical	Complete	Poor lower lip scar**
2	18	F	Soft palate/ postnasal space/ infratemporal fossa/skull base	Malignant schwannoma	Unilateral complete swing	Dențale	Microsurgical	Complete	None
3	49	М	Posterior hard palate	Adenoid cystic carcinoma	Unilateral anterior swing	Partially dentate	Epineural* approximation	· Complete	None
4	39	M	Ethmoid air cells	Giant compact osteoma	Unilateral extended swing	Partially dentate	Epineural* approximation	Complete	None
5	16	M	Postnasal space	Juvėnile anglofibroma	Unilateral complete swing	Dentate	Epineural* approximation	Partial at 6 weeks postoperatively	Slight palatal wound breakdown
5	55	М	Soft palate and nasopharynx	carcinoma	Bilateral complete swing	Edentulous .	Epineural* approximation	Complete	Died: no local tumour present at death

<sup>\* &#</sup>x27;Epineural approximation' means that the cut ends of the nerve were simply approximated with one or two epineural sutures, without magnification.
\*\* This scar was from a mandibulotomy lip split incision, and was unnecessary.

only case for which tracheostomy was performed. In this early case, wire osteosynthesis was used, but miniplates are now employed.

#### Case 2: Malignant schwannoma of the soft palate, postnasal space, and infratemporal fossa

This 18-year-old girl was referred by an ENT surgeon who had carried out an incomplete transoral excision of a low grade nerve sheath tumour from the soft palate 2 years previously. The residual tumour had begun to grow more aggressively, having become a malignant schwannoma, and then occupied most of the postnasal space up to the skull base, and extended into the infratemporal fossa. After planning the osteotomy cuts and preforming the miniplates, the osteotomy was performed and allowed unimpeded dissection posteriorly into the infratemporal fossa and superiorly on to the cribiform plate and skull base, permitting delivery of the tumour. Most of the inferior surface of the soft palate could be preserved with the nasal layer being repaired with a buccal fat pad flap. The buccal fat pad is readily accessible following this osteotomy, and is easily routed into the operation site, making it an ideal choice as a reconstructive flap.

#### Case 3: Adenoid cystic carcinoma of the posterior hard palate

This 49-year-old man consulted a general dental practitioner as a casual patient with a mass in the posterior part of the left palate. A central biopsy was performed which yielded a diagnosis of adenoid cystic carcinoma, and the lesion was obviously overlying the greater palatine foramen (Fig. 4A). In order to achieve the most effective surgical clearance, excision of the posterior hard palate and adjacent soft palate was planned, with section of the pterygoid plates and greater palatine neurovascular

bundle at the skull base. The transfacial approach was modified by including only the anterior maxilla in the osteoplastic flap and this permitted easy, unobstructed and clean dissection of the posterior maxilla and ptyerygoid region under direct vision from in front and above (Fig. 4B). Skeletal repair was with miniplates, and reconstruction was effected by raising a temporalis muscle flap to obturate the defect. The photographs taken 5 weeks postoperatively (Figs 4C & D) demonstrate the excellent cosmetic and functional results obtained using this technique.

#### Case 4: Giant compact osteoma of the ethmoid air cells This 39-year-old man was referred by a general surgeon to whom he had been sent for excision of his right preauricular epidermoid cyst. At presentation (Fig. 5A) he was noted

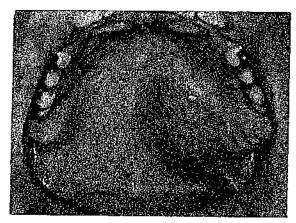


Fig. 4 (A) - Case 3. Pre-operative view showing the swelling of the left palate.



Fig. 4 (B) – Case 3. The transfacial approach was modified to include only the anterior maxilla in the flap, allowing clean dissection, under direct vision, of the posterior maxilla and pterygoid region.



Fig. 4 (C) - Case 3. Shows the excellent repair at only 5 weeks postoperatively.

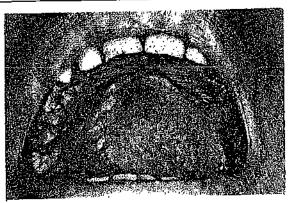


Fig. 4 (D) – Case 3. A fully functional repair of the hard and soft palate was obtained.

to have an obvious right exophthalamos, and was found to have impaired medial rectus activity resulting in diplopia. On fundoscopy, the right optic disc was hyperaemic with blurred margins. Axial computerised tomography (Fig. 5B) revealed the problem to be a large mass with the density of cortical bone and occupying the right ethmoid air cells, having destroyed the medial orbital wall and involving the optic canal. The lesion was approached using a modification of the transfacial approach in conjunction with a bicoronal flap. The latter was used in case a frontal craniotomy became necessary. This did not prove necessary, but this flap facilitated the upper nasal osteotomy and reconstruction. The epidermoid cyst was excised via an inferior extension of the bicoronal incision.

In this case, the paranasal incision was extended superomedially toward the glabella, and the osteotomy included the right side of the bony nasal skeleton. This necessitated division of the right nasolacrimal duct superiorly, and the right medial canthal ligament. The osteotomy exposed the ethmoid mass (a giant compact



Fig. 5 (A) - Case 4. Patient at presentation, showing right exophthalmos. The globe is displaced anteriorly and laterally.

osteoma) which was easily removed (Fig. 5C), laying open the resultant cavity for unimpeded exploration, exposing the involved optic canal. The medial orbital wall was reconstructed with an iliac crest corticocancellous graft and the osteotomies repaired with miniplates (Fig. 5D). Anastomosis of the nasolacrimal duct was reinforced by a silicone nasolacrimal tube, the infraorbital nerve anastomosed, and the medial canthal ligament re-attached with monofilament sutures. Eleven weeks postoperatively, the cosmetic result was excellent (Fig. 5E). The diplopia had resolved and the optic disc had reverted to normal.

# Case 5: Juvenile angiofibroma of the postnasal space

This 16-year-old boy presented with a history of epistaxis. Digital subtraction angiography demonstrated the classical vascular 'blush' of a juvenile angiofibroma of the postnasal space. The classical incision was planned (Fig. 3A), and a cervical incision added to facilitate proximal arterial control should this have proved necessary. As always, miniplates were preformed and their holes drilled before

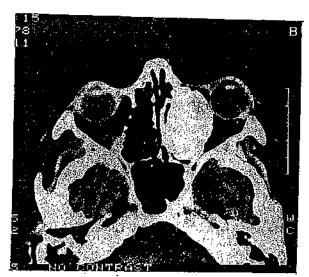


Fig. 5 (B) - Case 4. Axial computerised tomography revealed a bony mass having replaced the right ethmoid air cells and destroyed the medial orbital wall, encroaching on the optic canal.



Fig. 5 (C) - Case 4. After the outfracture, the ethmoid mass was easily removed.



Fig. 5(D) - Case 4. Reconstruction using miniplates also facilitates the reattachment of the medial canthal ligament. The nasolacrimal duct was anastomosed and supported by a transnasal silicone

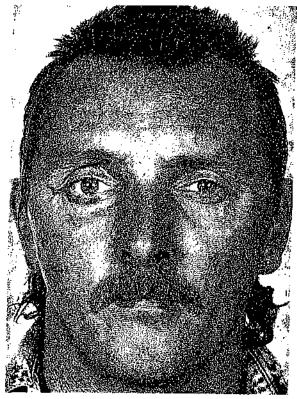


Fig. 5 (E) - Case 4. Postoperatively, the globe had returned to its normal position and the diplopia had resolved.

performing the osteotomies (Fig. 3B). After outfracture, excellent exposure of the postnasal space was obtained (Fig. 3C) and the tumour was delivered without haemorrhage. The palate has healed well (and functions excellently), and the facial scars became relatively inconspicuous within a few weeks (Figs 3D & E).

Case 6: Extensive bilateral squamous cell carcinoma of the soft palate and nasopharynx

This last case is mentioned briefly only because it required the bilateral use of the transfacial approach. The tumour at presentation was too extensive to enable adequate clearance to be obtained through a unilateral exposure. Healing was rapid with very little increase in morbidity, but the patient died of disseminated disease only a few months later. At post-mortem examination, there was no evidence of any local residual tumour.

# DISCUSSION

This procedure utilises the techniques learnt in orthognathic surgery to facilitate safe and radical oncological surgery in this difficult region, with minimal morbidity and excellent cosmetic results. One of its main advantages is its adaptability which allows modifications to be made to overcome the problems posed by any particular patient. For example, in cases three and four, when the loction of the disease dictated that the posterior maxilla be incorporated in the resection, then only the anterior part needed to be included in the osteotomy, yet on the other hand, when the bony nasal skeleton needed to be included in the facial swing, then this was accomplished by dividing the medial canthal ligament and nasolacrimal duct, and later repairing these structures with no morbidity. In extreme cases, both sides of the face may be swung clear without adding significantly to the morbidity. This straightforward operation serves to 'unlock' this difficult anatomical region and may be commended to surgeons with experience in surgical oncology and modern maxillofacial techniques.

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# Letters to the Editor

# THE TRANSFACIAL APPROACH TO THE POSTNASAL SPACE AND RETROMAXILLARY STRUCTURES

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R. J. M. Gray BDS, MDS Lecturer in Oral Surgery

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F. Gordon Hardman FDSRCS, MB, CLB Colwyn Bay Clwyd

# LETTER TO THE EDITOR

# MAXILLARY SWING APPROACH TO THE NASOPHARYNX

#### TO THE EDITOR:

It is always difficult to know who should receive the recognition for describing a particular surgical technique, and there are few who can claim to have a truly original idea since we all build on what we have learned from others. Thus, I was not surprised when we wrote an article on a "new" operation to find it described by other authors shortly afterward. Indeed it is not unlikely that many so-called new operative techniques are simply redescriptions or modifications of methods published long before but which are now lost in the depths of obscure scientific journals. It was the Guy's Hospital surgeon Sir Heneage Ogilvie who said, more than 50 years ago, "All that is recent is not necessarily an advance, and all advances are not necessarily recent."

My reason for writing is to comment on the article by Wei et al<sup>3</sup> on the maxillary swing approach. This is an excellent means of gaining access to the nasopharynx and retromaxillary region which I have found most useful for tumors in this area. Nevertheless, it is not exactly new. The technique first came to my notice when presented at the 7th Congress of the European Association for Maxillofacial Surgery in 1984. An English language paper was subsequently published by Altemir in 1986. It is clear on rending this that he first described the technique in the Spanish literature in 1982, and I feel he should be given some credit for this elegant approach. This is always assuming that, as is surprisingly often the case with maxillofacial operations, it was not actually described in the German literature of the last century!

A. E. Brown, FRCS, FDSRCS

Queen Victoria Hospital East Grinstead Sussex, United Kingdom

 Brown AE, Obeid G. A simplified method for the internal fixation of fractures of the mandibular condyle, Brit J Oral Maxillofac Surg 1984;22:145-150.

- Wennogle CF, Delo RI. A pin-in-groove technique for reduction of displaced subcondylar fractures of the mandible. J Oral Maxillofuc Surg 1985;43:659-665.
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- Curioni C, Padula E, Toscanoo P, Marragia A. The maxillo check flap. Presented at 7th Congress of the European Association for Maxillofacial Surgery, Paris, 1984.
- 5. Martinez-Lage JL, Acero J, Lorenzo F, Temporary maxillectomy. Presented at 7th Congress of the European Association for Maxillofacial Surgery, Paris, 1984.
- Altemir FH. Transfacial access to the retromaxillary area. J Maxillofac Surg 1986;14:165-170.

# REPLY:

I cannot agree more with the sentiment expressed by Mr. Brown, that uncertainty often surrounds the claim to originality of new surgical procedures. Indeed, "there is nothing new under the sun" (Ecclesiastes, chapter 1, verse 9). We developed our maxillary swing approach initially for access to the orbit,1 in which the blood supply to the mobilized maxillary wall depended on the masseter muscle. This technique, conceived in 1986 independently of the description of an approach to the retromaxillary area by Altemir,2 was employed for resection of benign tumours lying close to or arising from the floor of the orbit. Our success prompted us to move a larger piece of bone on the muscle in the treatment of a postradiotherapy recurrent soft palate tumour. Partial avascular necrosis of the bone suggested that blood supply after radiotherapy was marginal and should be increased by way of the cheek flap as the carrier.

Faced with the problem of postradiotherapy recurrent nasopharyngeal carcinoma, we extended the maxillary swing approach, made certain modifications, and applied it in the salvage surgical treatment of this disease. All our patients have had a radical course of irradiation. At the same time, resection often entailed removal of infratemporal fossa contents, thereby dividing the internal maxillary artery. Maintenance of blood supply is, therefore, highly dependent

on attachment of the bone to the cheek flap, and an intact facial artery. This vessel has to be preserved when a synchronous neck dissection is carried out, or the neck dissection should be done on a separate occa-

One major difference between the procedure of Dr. Altemir and ours is the site of osteotomy on the maxilla. To approach the nasopharynx, in contrast to approaching the orbit, the orbital walls do not need to be violated, even temporarily. The osteotomy on the anterior wall of the maxilla lies below the orbital rim. Exposure of the nasopharynx and the parapharyngeal space is quite adequate, and potential ocular complications are avoided. We also believe that modifications of this technique will develop when varied situations

William I. Wei, MS, FRCSE, DLO University of Hong Kong Department of Surgery Queen Mary Hospital Hong Kong

- Lam KH, Lau WF, Yue CP, Wei Wl. Maxillary swing approach to the orbit. Head Neck 1991;13:107-113.
   Altemir FH. Transfacial access to the retromaxillary area. J Max-Fac Surg 1986;14:165-170.
   Wei Wl, Lam KH, Sham JST. New approach to the national content of the process.
- sopharynx; the maxillary swing approach. Head Neck 1991;13:200-207.

HEAD & NECK January/February 1992

MA:9201

(We do not have this journal.)

AU: Brown AM; Lavery KN; Millar BG AD: West Midlands Regional Plastic and Jaw Surgery Unit, Wordsley Hospital TI: The transfacial approach to the postnasal space and retromaxillary structures [see comments] SO: Br J Oral Maxillofac Surg. 1991 Aug. 29(4). P 230-6. CY:SCOTLAND 15:0266-4356 PT:JOURNAL ARTICLE JC: AZR : SB:M D MM: Face: \*SU. Head and Neck Neoplasms: \*SU. Maxilla: \*SU. Nose: \*SU. Pharynx: \*SU. Adenocarcinoma: SU. Adenoma, Pleomorphic: SU. Carcinoma, Adenoid Cystic: SU. Carcinoma, Squamous Cell: SU. Dermatofibroma: SU. Ethmoid Bone: PA. Neoplasms, Multiple Primary: Neurllemmoma: SU. Nose Neoplasms: SU. Osteoma: SU. Osteotomy: Palatal Neoplasms: SU. Skull Neoplasms: SU. Check Tags: Adolescence, Adult. Case Report, Female, Middle Age. AB: Various surgical approaches to the region are discussed, and the procedure according to Hernandez Altemir (1986) described in detail. Six cases are presented to illustrate how this versatile osteoplastiarepsilontechnique may be adapted for individual patients. CM: Comment in: Br J Oral Maxillofac Surg 1991 Dec; 29(6): 424 FR: 920608 FA:93 NF:92001902

# COMPREHENSIVE MEDLINE EN Registro completo

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# MAXILLOFACIAL SURGER

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F. Gordon Hardman FDSRCS, MB, CLB Colwyn Bay Clwyd



Laligam N. Sekhar, Ivo P. Janecka. eds. Surgery of cranial base tumors. Raven Press. New York. 892 páginas. Precio: \$281.50.

Este libro de texto de multiautores (70) acerca de la nueva subespecialidad de cirugía de la base del cráneo ha sido editado por dos cirujanos muy respetados. Sekhar, antiguo profesor de Neurocirugía de la Universidad de Pittsburgh y ahora establecido en Washington, y Janeka, profesor asociado de garganta, nariz y oído de Pittsburgh.

El libro es largo, 870 páginas, y está dividido en seis secciones: principios generales, anatomía quirúrgica, técnicas operatorias, reconstrucción, tratamiento de tumores específicos y rehabilitación y complicaciones. El libro está ampliamente ilustrado tanto con dibujos como con fotografías intraoperatorias y tomografías. En mi opinión las fotografías intraoperatorias son las menos útiles, porque se han tomado a través de un microscopio y son terriblemente difíciles de interpretar, incluso contando con la ayuda del pie de foto.

Hay poca duda de que el texto presenta los últimos extremos de la tarea quirúrgica en ese difícil área y uno se llena de admiración hacia la formación técnica de aquellos cirujanos que son capaces de realizar una resección de un tumor en las profundidades del seno cavernoso, a menudo con resección y reconstrucción de la arteria carotidea. Existe, sin embargo, un considerable debate dentro del mundo de la neurocirugía acerca de la eficacia de dicha cirugía. El libro es amplio en extremo: de hecho, una crítica del libro sería que hay excesiva repetición de abordajes quirúrgicos con poca evaluación crítica acerca de dichos abordajes.

Como neurocirujano que forma parte de un equipo craniofacial, creo que existe una cierta falta de terminación en el libro, ya que muchos de los abordajes anteriores, laterales y transorales han sido ejecutados por cirujanos que están poco familiarizados con las corrientes actuales de la realizan así, especialidad У nuestra práctica de procedimientos de un modo que es menos que ideal. particularmente sorprendido por la falta de referencias a nuestra literatura, y el abordaje transfacial de Altemir era notable por su ausencia. Me opongo vigorosamente al abordaje de translocación facial de la nasofaringe, clivus y fosa infratemporal, porque es innecesaria y hay otros métodos preferibles. Una de las principales razones del desarrollo

espectacular de esta subespecialidad quirúrgica es la habilidad para prevenir la salida de líquido cefaloraquídeo y su consiguiente meningitis. Esto se debe, en no pequeña parte, al uso de colgajos libres locales o microvasculares y me desilusionó un poco el hecho de que no se aconsejara el uso de colgajos de fascia libres procedentes de la arteria radial para sellar defectos óseos o de la dura.

Este libro es un excelente texto de referencia para cualquiera interesado en cirugía de la base del cráneo y debería estar rápidamente a disposición de aquellos que se atrevan a extender las fronteras de la cirugía a la intercara de la base del cráneo y de la cara.

E.D. Waughan

· 综述: 最新研究进展 ·

# 上颌骨翻转术在鼻咽部和其周围肿瘤切除中的 运用

朱瑾 韦霖 韩德民

摘要 鼻咽部、鼻咽旁间隙及其毗邻区域位于头颅的正中部位,后面即脑干和颈椎的上段。因此以上部位的手术,只能考虑采用头颅的上、侧、下方和前面进路。本文总结曾经采用的手术 进路的优缺点,并对从前外侧进路到达鼻咽部和咽旁间隙的上颌骨翻转术的进展、手术步骤、可能的并发症及其防治方法进行介绍与回顾。

关键词 上领骨 (Maxilla); 鼻咽肿瘤 (Nasopharyngeal Neoplasms)

鼻咽、鼻咽旁间隙其毗邻区域位于头颅正中。 在解剖学上,其后是脑干和颈椎的上段,因此,难 以采用从其后面进路到达该部位。曾有人[1]采用 从上经颅底进路到达鼻咽部以切除该部位肿瘤,但 这样的进路需暴露蛛网膜下腔,使之易于被鼻腔、 鼻咽部病原菌污染从而可能出现脑膜炎、脑膨出等 并发症,增加患者死亡率。采用侧面进路[2,3],首 先必须实施根治性的乳突切除术,游离三叉神经的 下颌缘支、切断颧弓、中颅窝底骨质以及下颌骨。 此外,还需要暴露并游离颈内动脉从中耳到颅底 段、切断脑膜中动脉使颈内动脉有足够的活动度, 方能更好地进入鼻咽腔。该术式能较好地暴露鼻咽 旁间隙, 但手术难度和创伤大, 相应并发症发生率 高,并且手术对侧鼻咽腔暴露差。从下面进路暴露 鼻咽部包括经硬腭进路<sup>[4,5]</sup>和经颈进路<sup>[6]</sup>。经硬腭 进路手术较简单, 创面易于修复, 相应并发症和死 亡率都较低,但其暴露的视野局限,不能在直视下 切除鼻咽侧壁和鼻咽旁间隙的肿瘤,增加了术中损 伤颈内动脉的可能。此外,该术式也不适用于放疗 后张口受限的患者。鼻咽及其周围区域的肿瘤也可 采用经颈下颌骨翻开进路予以切除。沿下颌骨下缘 行颈部弧形切口,游离并离断下颌骨,牵拉后暴露 鼻咽部。由于鼻咽部的位置较深,局部牵引张力较 大, 因此也可去除部分下颌骨以及上颌骨后部达到 充分暴露鼻咽部的目的[7]。在术中可通过颈部切 口寻找到颈内动脉并对其进行追踪至颅底,从而减 少术中损害颈内动脉的几率。该术式创伤大,相应

【上颌骨翻转术的进展】 由于鼻咽部及其旁间隙位于头颅正中,被颈椎、上颌骨等骨性结构包绕,并与颈内动脉、迷走神经等重要的血管神经眦邻,因此,不断有学者致力于寻找创伤小、暴露好的手术进路。1986 年 Hernandez [13]报道一种经面进路暴露上颌骨后区域的术式。该术式将上颌窦上、内、外壁从其附着处游离并使之旋向外侧,但保留了硬腭的完整,从而使鼻咽上侧壁的暴露欠住。韦霖教授在此基础上进行改良,于1991 年率先报道一种暴露鼻咽部的新术式,并将之命名为上颌骨翻转术。该术式将游离的上颌窦、硬腭连同其

并发症发生率也较高。从前面到达鼻咽部的手术入 路包括不同方式的经鼻或鼻窦进路[8.9],这类术式 均难以充分暴露鼻咽部。联合硬腭和上颌骨牙槽突 切除、或上颌骨次全切除、或扩大范围的上颌骨切 开术[10]有助于术野的暴露,但手术较复杂,且切 除上颌骨后的局部缺损仍需进一步的修复。同时, 该术式所暴露的术野也难以完整切除侵犯到鼻咽侧 壁或鼻咽旁间隙的肿瘤。由香港大学医学中心玛丽 医院韦霖教授改进并推广的上颌骨翻转术 (maxillary swing approach)[11,12], 通过从前外侧进路到达 鼻咽腔,可相对充分地暴露鼻咽后壁、顶壁、侧壁 及咽旁间隙的肿瘤,便于手术器械进入术野操作, 有利于其彻底的根治性切除。同时,该术式对患者 鼻面部功能及外观的影响较小。笔者通过在玛丽医 院的临床进修,深刻认识到上颌骨翻转术的临床运 用将增加大范围的鼻咽和其周围组织病变的手术机 会,有必要推广使之成为临床鼻咽部手术的可选术 式之一。为此,本文将对上颌骨翻转术的进展、手 术步骤、可能的并发症及其防治方法进行介绍与 回顾。

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前面附着的皮肤、肌肉形成骨皮瓣、并旋向外侧, 从而可充分暴露鼻咽腔和鼻咽旁间隙,使该部位的 病变可在直视下彻底切除。目前,该术式在香港玛 丽医院耳鼻咽喉/整形与修复/头颈外科广泛运用于 临床复发性鼻咽癌以及其它一些鼻咽部良、恶性肿 瘤的手术切除。据报道[14,15], 1989 年 2 月 ~ 2002 年6月期间该科室采用上颌骨翻转术对109例放疗 后的持续性和复发性鼻咽癌进行了挽救性手术。其 中,82 例因手术切沿组织冰冻切片显示无肿瘤细 胞残留而被称之为治愈组。通过平均37个月的随 访、局部肿瘤的5年控制率为68%;治愈组5年 精确存活率为54%。由此可见,上颌骨翻转术使 挽救性切除放疗后持续性或复发性鼻咽肿瘤成为可 能,并在合适的病人中取得了满意的疗效。该术式 通过前外侧进路较为充分地暴露鼻咽腔和鼻咽旁间 隙,从而有助于彻底切除鼻咽及其周围的肿瘤。笔 者在玛丽医院进修期间,上颌骨翻转术除运用于复 发性鼻咽癌的挽救性手术外,还运用于2例鼻咽部 复发性腮腺深叶恶性肿瘤和1例鼻咽部脊索瘤的手 术切除,术中切沿组织冰冻切片报告显示这三例肿 瘤均完整切除。理论上,该术式可选择性运用于范 围较广的鼻咽纤维血管瘤、鼻咽部脊索瘤、神经纤 维瘤等良性肿瘤以及复发性鼻咽癌[16,17]和其它一 些侵入鼻咽部的恶性肿瘤如腮腺深叶恶性肿瘤的根 治性切除,特别是当这些肿瘤侵犯翼腭宽、颞下窝 或肿瘤向后靠近颈内动脉时。手术的疗效取决于病 变的范围以及肿瘤的性质。

患者仰卧位,在手术对侧经鼻 【手术步骤】 气管插管, 施行全麻。用美蓝行皮肤划线和针刺定 位标记后,行延长的 Weber Ferguson 切口:沿上唇 正中向上达鼻底,绕鼻翼向上达内眦,在下睑下缘 约 5 mm 处由内向外至颧弓;延长上唇正中切口, 在两中切牙间切开上齿龈内外侧, 经硬腭距齿缘 5 mm 处向外弧形切开硬腭至术侧上颌结节处。稍分 离上颌骨前壁皮下组织至上颌骨骨面暴露有足够的 切割面、标记并切断眶下神经。为确保翻转后的上 颌骨能准确复位,切割前在上颌骨颧突和颧骨之间 将 3 孔小钛板用螺钉定位;在上颌骨左右交界的正 中将5孔小钛板用螺钉定位。取出钛板和螺钉后, 用瀕片电震荡锯切割上颌窦前壁、后壁、和硬腭, 并用骨凿将上颌结节与翼板分开。将上颌骨的骨性 连接分离后,整个上颌骨仅与其前附着的颊部皮 肤、肌肉瓣相连,后者是其血供来源。此时,整个

上颌骨骨皮瓣可翻转至外侧,从而暴露鼻咽腔和鼻咽旁间隙(图1)。



图 1 上颌骨翻转术切除腮腺深叶多形性腺瘤的手术示意图, 虚线表示上颌骨切割范围

为更好地暴露术野,可根据需要去除鼻中隔后份、蝶窦前壁和翼突内板。彻底清除病变后,取带蒂颊部脂肪填入鼻咽部术腔,切除术侧下鼻甲,将下鼻甲粘膜作为游离移植物覆盖在鼻咽部术区并用止血棉固定,以促进鼻咽部粘膜愈合。将翻转的上颌骨复位,并暂时用术前备好的齿板固定于硬腭。在颧弓和上颌骨正中的标记位点分别用螺钉固定钛板。取下齿板,缝合硬腭切口;按美蓝标记点对位后逐层缝合面部切口。固定齿板。在术侧耳行鼓膜切开术。

曾有学者采用前臂游离皮瓣修复鼻咽部刨面<sup>[18]</sup>。Shu 等<sup>[17]</sup>认为鼻咽部刨面不必采用皮片或黏膜覆盖。笔者通过对采用下鼻甲黏膜覆盖鼻咽部刨面的患者术后随访,发现术后所有患者鼻咽部黏膜上皮化良好。因此可见,采用下鼻甲黏膜作为游离移植物覆盖在鼻咽部术区可达到促进鼻咽部黏膜愈合的目的,同时,该方法具有创伤小、简便易行的优点。

【手术并发症和防治措施】 据报道<sup>[19]</sup>,上颌骨翻转术的手术并发症包括硬腭瘘、鼻涕倒流、分泌性中耳炎和张口受限。其中,以不同程度的张口受限较多见,尤其多见于术后进一步放疗的患者。术后可让患者早期进行咀嚼运动以预防该并发症的发生。如已发生张口受限,可通过面部肌肉伸展疗法获得足够的齿龈间距。硬腭瘘是另一较常见并发症,与术前放疗密切相关。由于目前已改变了硬腭切口的位置,从最初的硬腭正中切口改良为硬

腭齿缘切口,硬腭瘘发生率明显降低。在笔者进修 期间,有1例术后出现硬腭瘘的患者,经硬腭瓣修 补后痊愈。术中预防性鼓膜切开可显著降低分泌性 中耳炎的发生率。随着术者手术技能的提高,使对 鼻腔黏膜保护的增加、鼻中隔后部切除几率的减 少,鼻涕倒流的发病率亦明显减少。鼻咽部较好的 暴露使术者易于通过触摸颈内动脉的搏动确定其位 置,从而防止颈内动脉的损伤。上颌骨翻转术的其 它一些并发症源于面部伤口愈合不良所致,包括下 眼睑瘢痕挛缩、局部肉芽形成等。这些并发症发生 率低,并可通过再次手术治愈。

【总结】 鼻咽部由于其解剖位置的特殊性使手术进入鼻咽和其周围部位的难度较大。目前在不同的手术进路中,采用上颌骨翻转术从前外侧进路到达鼻咽腔,可较好地暴露鼻咽和其旁间隙,从而可选择性运用于鼻咽和其旁间隙良、恶性肿瘤的手术切除。该术式经过十余年的临床实践得以不断完善。对有经验的医生而言,其术后并发症程度轻、发生率低。

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(收稿日期: 2004-12-03)



# European Association for Maxillo-Facial Surgery (E.A.M.F.S.)

President Prof. ALONSO DEL HOYO

SERVICIO DE CIRUGIA MAXILOFACIAL HOSPITAL DE LA PRINCESA Diego de Léón, 62 - 28006 MADRID (SPAIN)

Dr. Francisco Hernandez Altemir Fray Luis Amigo 8, 8º A Edificio Zafiro ZARAGOZA

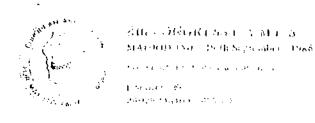
Madrid, 30 de Septiembre de 1986.

Estimado colega,

El Comité Organizador del 8º Congreso de la "European Association for Maxillo-Facial Surgery", quiere al terminar el Congreso, agradecerle su valiosa colaboración en el mismo y su contribución al éxito del Congreso.

Quedando los miembros del Comité Organizador a su disposición y reiterándole nuestro agradecimiento reciba un cordial saludo,

Prof. J.R. Alonso del Hoyo Presidente



PROF/ J.R. ALONSO DEL HOYO, PRESIDENT OF THE EUROPEAN ASSOCIATION FOR MAXILLO FACTAL SURGERY AND OF THE 8TH CONGRESS OF THE E.A.M.F.S., CERTIFIES HEREWITH THAT DR. FRANCISCO HERNANDEZ ALTEMIR HAS PRESENTED AT THE CONGRESS THE FOLLOWING PAPERS FOR POSTER..........

- 1. A modification of the radical partial parotidectomy with preservation pf the superior facial associated with suprabyoid evidement.
- 2.
- 2. A technical modification of the cervical submaxillectomy
- 3. A modification of the total parotidectomy with hemiman-dibulectomy and suprahyoid evidement.
- 4. A modification of the total parotidectomy with sacrifice of the peripheric facial.
- 5. A technical modification of the total parotidectomy with sacrifice of the peripheric facial associated with hemimandibulectomy and radical evidement.

6.Exeresis of the auricular pavilion and the cutaneoparotid structures associated with hemimandibulectomy and radical dissection of the neck.

- 7. A technical modification of the superficial of total parotidectomy associated with dissection of the peripheric facial.
- 8. A modification of the total parotidectomy with sacrifice of the peripheric facial associated with suprahyoid evidement.
- 9. A modification of the total parotidectomy with sacrifice of the peripheric facial associated with hemimandibulectomy or o ostectomy.
- 10. A technical modification of the parotidectomy with the sacr fice of the peripheric facial associated with cervical radical evidement.
- 11. A modification in the technique of the radical dissection of the neck.



# 8th CONGRESS E.A.M.F.S. MADRID 35th - 19 th September - 1986

President Prof. Alonso del Hoyo

Londres 39 22075 Madrid (SPAIN)

PROF. J.R. ALONSO DEL HOYO, PRESIDENTE DE LA EUROPEAN ASSOCIATION FOR MAXILLO FACIAL SURGERY Y DEL 8º CONGRESO DE LA E.A.M.F.S.

# CERTIFICA:

QUE EL DR. F. HERNANDEZ ALTEMIR

HA PRESENTADO AL CONGRESO LOS SIGUIENTES TRABAJOS:

- 1.- A NEW TECHNIQUE TO CONTROL THE TRACHEOSTOMA.
- 2.- A NEW TECHNIQUE FOR MOUTH RESPIRATION
- 3.- PERICRANEAL FIXATION OF THE NASOTRACHEAL TUBE
- 4.- CATETERISMO ARTERIAL TEMPOROCAROTIDEO (INNOVACIONES)
- 5.- FISTULA ARTERIOVENOSA CAROTIDEO YUGULAR POR ARMA DE FUEGO
- 6.- TRANSFACIAL ACCES TO THE RETROMAXILLARY AREA AND SOME TECHNICAL MODIFICATIONS

MADRID, 19th SEPTEMBER 1986

I SUR COMOREDO FIAMESE



8th CONGRESS E.A.M.F.S MADRID 15th - 19 th September 1986

President Prof. Amosc det blovo

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- 12. A modification of McFee's technique for simple radical dissection of the neck.
- 13. Cuadernillo explicativo de transfacial. Access to the retromacillary area and some technical modifications.
- 14 Transfacial access to the retromaxillary area
- 15. Una nueva técnica de intubación submental.
- 16. Colaboración de los médicos residentes del servicio de Cirugía Oral y Maxilofacial del Hospital Miguel Servet de Zaragoza, en el Poster:

"Quimioterapia arterial, cancer cervical:" del Instituto Provincial de Oncología. Hospital Provincial de Madrid/Dr. Ga Yanes Santos y Dr. Chamorro Pons.

CONTROL OF BURNESS ELAMARIS.

Madrid, 19th September, 1986

# 1987 YEAR BOOK OF

# OTOLARYNGOLOGY-HEAD AND NECK SURGERY

Transfacial Access to the Retromaxillary Area

PAPARELLA BAILEY

# Factors Influencing Parathyroid Alfotransplantation in Rats

Michael Friedman (Univ. of Illinois at Chicago) Laryngoscope 98(Suppl. 39):1-16, September 1986

8-8

Parathyroid transplantation could be a solution to the problem of permanent hypoparathyroidism or hypocalcemia, but immune rejection has caused allograft failures. Parathyroid tissue is not immunologically privileged. An attempt was made to create a predictable model of parathyroid allotransplantation using newborn and fetal tissue without immunosuppression of the host. Studies, done in rats, were based on the successful use of cyclosporine in renal and cardiac transplantation. Cyclosporine was given orogastrically in a dose of 20 mg/kg daily. Some animals received long-term immunosuppression after implantation of fetal thyroparathyroid complexes.

Maintenance of a serum calcium level above 8 mg daily was taken as biochemical evidence of graft function. The return of pregraft hypocalcemia after excision of the graft site also indicated successful function, as did histologic evidence of normal parathyroid tissue at the graft site. The serum calcium level rose transiently after allografting from newborn rats and after fetal parathyroid allografting. A 1-week course of cyclosporine was associated with a more rapid and persistent rise in the serum calcium level; levels-remained elevated for 2 weeks after cessation of cyclosporine therapy. Long-term graft survival was achieved in animals given cyclosporine continuously for 40–90 days after fetal parathyroid allografting.

The ability of a fetal parathyroid allotransplant to suppress specific T cell activity and survive in a potentially hostile setting is enhanced by cyclosporine therapy. The agent is not yet ready, however, for wide clinical use.

▶ This article is the outstanding candidate's thesis by Friedman that was the recipient of this year's Fowler Award. It deals with the effort to transplant parathyroid gland tissue into a histoincompatible host without systemic immunosuppression.

Previous reports in this field have been confusing and contradictory. There have been numerous reports of failure on the basis of immunologic rejection and occasional reports of success (probably because of random and rare instances of histocompatibility). Some authors reported that either adult or fetal parathyroid tissue is immunologically "privileged." Others described wide differences in survival based on the anatomical site of surgical implantation.

Although not providing a definitive set of answers to these complex questions, this work has given us important new information that should be helpful in the progress toward resolution of this problem. Cyclosporine or one of its pharmacologic descendants would seem to be required as a long-term immunosuppressant for sustaining viable and functional parathyroid allografts.—B.J. Bailey, M.D.

Transfacial Access to the Retromaxillary Area

Francisco J. Maxillo

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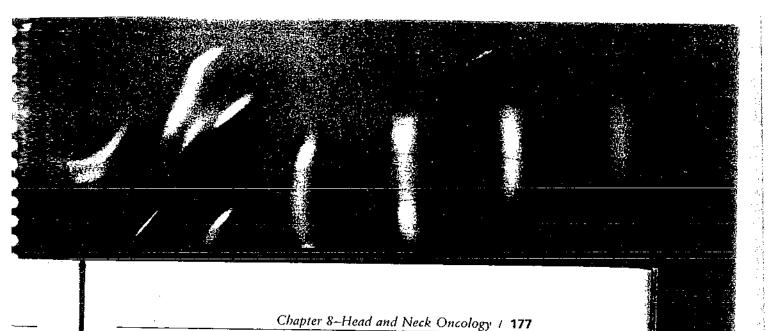
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Craniofacial Sinuses Anthony D. ( Throat, Nose and Otology, Head Neck Si



Francisco Hernandez Alternir (Hospital "Miguel Servet," Zaragoza, Spain) J. Maxillofac, Surg. 14:165–170, June 1986

Temporary disarticulation of the maxilla via a transfacial approach can provide access to the retromaxillary, pterygoid, and ethmoidal spaces, as well as the rhinopharynx, the sphenoid sinus, and the clivus, without mutilating surgery.

TECHNIQUE.—The incision extends from the upper lip around the nose to the inner canthus and continues horizontally to the outer canthus and over the zygomatic process. A vertical incision is made in the vestibular sulcus, and a palatal flap is raised to expose the osseous structures. Osteotomies are done vertically first at the temporozygomatic junction, then to detach the frontal process of the zygoma, and then along the orbital walls behind the orbital rim, crossing to the peak of the piriform aperture, thus preserving the lacrimal system. A vertical incision is then made in the alveolus. The pterygomaxillary junction is cut and the maxilla mobilized while remaining pedicled on the cheek.

This approach does not sacrifice any important structure that is not recoverable. No dental structures are lost, and no second-stage reconstruction is necessary. The foramina and fissures of the skull base are readily accessible. The technique may be used simultaneously on both halves of the maxilla. Ligation of the external carotid artery has not compromised flap vitality, but temporary arterial control without ligation is a possibility.

This approach is useful in selected patients when the size and/or location of a tumor makes it difficult or impossible to reach by a conventional approach without mutilation. Functionally important maxillary and dental structures are preserved.

▶ Although this article from Spain is only a case report, it describes an important, innovative approach to an extremely difficult surgical access problem. The retromaxillary region, sphenoid sinus, nasopharynx, clivus, and base of the skull can be reached by temporary mobilization of the maxilla pedicled on a cheek flap with its major blood supply.

Hernandez Altemir reported this work in Europe in 1982, and it has taken 4 years to reach the English language literature. Whereas the technique is likely to have limited usefulness in the practice of most otolaryngologists, it is an innovation that may prove to be of great importance in a small number of situations. The beauty of this approach is that it preserves important skeletal, dental, and sinus structures while providing wider exposure of and improved access to the region of surgical interest.—B.J. Bailey, M.D.

# Craniofacial Resection for Tumors of the Nasal Cavity and Paranasal Sinuses

Anthony D. Cheesman, Valerie J. Lund, and David J. Howard (Royal Nati. Throat, Nose and Ear Hosp., Charing Cross Hosp., and Inst. of Laryngology and Otology, London)

Head Neck Surg. 8:429-435, July-August 1986

# International Journal A second of the secon

October 1991 · Volume 20 · No. 5



MUNKSGAARID GOPENHAGEN

# Transfacial access for neurosurgical procedures: an extended role for the maxillofacial surgeon

I. The upper cervical spine and clivus

P. D. Grime, R. Haskell, I. Robertson, R. Gullan: Transfacial access for neurosurgical procedures; an extended role for the maxillofacial surgeon. I. The upper cervical spine and clivus. Int. J. Oral Maxillofac. Surg. 1991; 20: 285-290.

Abstract. A variety of osteoplastic flaps have been devised for transoral or extraoral access to the base of skull and the upper anterior cervical spine. Part I of this two-part review will describe access to the clivus and upper anterior cervical spine. Part II will describe access to the middle cranial fossa, the infratemporal fossa and the pterygoid (retromaxillary) "space".

Peter David Grime<sup>1</sup>, Richard Haskell<sup>1</sup>, Iain Robertson<sup>2</sup>, Richard Gullan<sup>2</sup>

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Key words: transfacial access; osteotomy; neurosurgical procedures; skull base; cervical spine.

Accepted for publication 2 May 1991

As a consequence not only of improved anaesthesia and intensive care, but operative techniques, neurosurgical procedures once considered to have unacceptable morbidity and mortality are now contemplated with increasing regularity. The maxillofacial surgeon, by nature of training and expertise, is in an advantageous position to assist in the management of patients by providing surgical access to the clivus, the upper anterior cervical spine, the middle cranial fossa, the infratemporal fossa and the pterygoid (retromaxillary) "space".

The purpose of this review, published in two parts, is to present and discuss techniques for transfacial access to these regions, stimulating further interest in a relatively unexplored theatre of operation for both maxillofacial and neurosurgeons.

The text is primarily directed towards, the management of benign lesions, although with appropriate modification the techniques may be utilised during resection of malignant neoplasms.

All methods of transfacial access to be described involve the reflection of osteoplastic flaps: trans-oral routes to the central base of skull and upper cervical spine utilise parasagittal mandibulotomy, maxillotomy or hemi-maxillotomy flaps. Extra-oral osteotomies of the zygomatic bone, the maxilla and the

proximal mandible give access to the lateral base of skull and the middle cranial fossa.

The fact that such a variety of techniques have been described, not only illustrates the difficulty in achieving optimal exposure but reflects the expertise of interested surgeons within different specialties.

# Review of surgical anatomy

Selection of the appropriate technique is dependent on the anatomical location, rather than the nature of the pathology to be treated. This involves an understanding of the surgical anatomy at the base of skull. If more than one method appears suitable the chosen technique should have the least morbidity, the objective being preservation of function with minimal visible scarring and deformity.

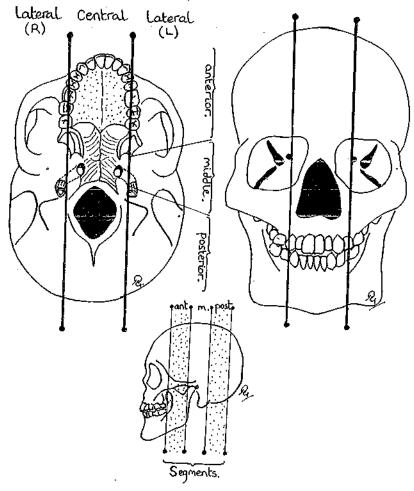
For convenience, the base of skull can be divided into right lateral, left lateral and central compartments by the internal carotid arteries as they traverse the temporal bone (Fig. 1).

The central compartment contains the sphenoid body, clivus and upper cervical spine whilst the lateral compartments are composed of a portion of the greater wing of sphenoid, the inferior surface of the petrous temporal bone (the infratemporal fossa) and the posterior cranial fossa. The lateral compartments can be further subdivided into anterior, middle and posterior segments<sup>12</sup> (Fig. 1).

The anterior segment extends from the anterior middle cranial fossa to the anterior edge of the petrous temporal bone within which are found several foramina; rotundum containing the maxillary nerve; ovale, containing the mandibular nerve; lacerum, containing the internal carotid artery as it enters the cranial cavity, and spinosum with the middle meningeal artery.

The infratemporal fossa and pterygoid (retromaxillary) "space" are separated from the central compartment by the lateral pterygoid plate, tensor palati, superior constrictor and the contents of the parapharyngeal space, and bounded laterally by the temporalis and masseter muscles, the ascending mandibular ramus and the deep lobe of the parotid gland.

The middle segment is the petrous bone itself, containing the internal acoustic meatus and canal for the internal carotid artery. The posterior segment contains the jugular foramen, internal jugular vein and the foramen magnum. These 2 segments are not accessed transfacially and will not be discussed.



 $Fig.\ l.$  Central and lateral compartments of the skull base. The lateral compartment is divided into anterior, middle and posterior segments.

The central compartment is accessed transorally and the anterior segment of the lateral compartment extra-orally.

A wide range of lesions can be treated including aneurysms of the posterior cerebral circulation<sup>2</sup>; craniospinal malformations<sup>8</sup>; degenerative disease of the upper cervical spine and dislocation or fracture dislocation of the upper cervical vertebrae<sup>9</sup>; benign and malignant tumours, e.g. chordomas, meningiomas, neurofibromas, gliomas<sup>19</sup>.

Imaginative combinations of the techniques to be described could allow resection of large base of skull tumours, with neck dissection as required, and still leave patients with acceptable function and aesthetics.

These transfacial approaches have become practicable due to the development of small plates for rigid reconstitution of the skeleton ("osteosynthesis") following the various osteotomies. These allow rapid, rigid fixation of any part of the facial skeleton which dra-

matically reduces post-operative morbidity and entirely eliminates the need for maxillo-mandibular fixation.

Part I of this review will describe access to the clivus and upper cervical spine within the central compartment. Part II will present and discuss access to the middle cranial fossa, the infratemporal fossa and the pterygoid (retromaxillary) "space", the anterior segment of the lateral compartment.

# Access to the central compartment - clivus and upper cervical spine

Access to the clivus through a normal oral cavity is possible but impractical <sup>10</sup>. Access to the anterior cervical spine from Cl to C4 may be achieved utilising the approach popularised by CROCK-ARD<sup>8</sup>, but there is no doubt that surgical access is improved by mandibulotomy. The volume of the oral cavity is increased temporarily by splaying apart the divided bone and soft tissue and

by depressing the tongue and floor of mouth into the space created. The advantage of improved access far outweighs the disadvantage of a surprisingly small increased morbidity. As an alternative the oral cavity can be opened into the nose or nasopharynx.

There are essentially four facial osteoplastic flaps designed to have this effect:

Transmandibular

Parasagittal mandibulotomy (labiomandibulotomy).

Transmaxillary

- 2) Le Fort I maxillotomy,
- 3) Hemimaxillotomy; palatal mucosal pedicle.
- 4) Hemimaxillotomy: cheek pedicle.

# Techniques Transmandibular

Parasagittal mandibulotomy4,13-15,20

A midline, full thickness lip-split is performed utilising a notch to aid relocation at the vermillion border and the incision carried around the chin, in a line of relaxed skin tension, over the lower border of the mandible to the level of the hyoid bone where it deviates laterally (Fig. 2). A sub, deep fascial flap is developed with protection of the mandibular and cervical branches of the VIIth nerve. The submandibular gland and the muscles of the floor of the mouth are exposed.

The mandible is divided in the anterior region dependent on the position of the lower incisor tooth roots, following reflection of a mucoperiosteal flap (Fig. 3). Removal of a tooth to facilitate access is unnecessary. Two small plates are fixed in situ over the stepped or oblique osteotomy site and then removed prior to sectioning with burs and osteotomes (Fig. 4). This manoeuvre ensures rapid, accurate relocation and post-operative stability.

The floor of the mouth is then divided lateral to the submandibular duct and medial to the submandibular gland. Care must be taken to ensure the preservation of the lingual nerve which can be identified running

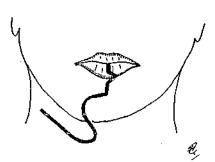


Fig. 2. Typical lip-splitting incision incorporating notch at vermilion border to aid relocation.

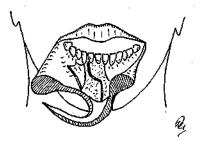


Fig. 3. Parasagittal mandibulotomy stepped to aid post-operative stability.

from lateral to medial across the incision in the molar region.

The soft palate is divided either in the midline or with a "lazy S" incision to one side of the uvula. The latter incision reduces the risk of post-operative shortening of the soft palate leading to velopharyngeal incompetence. At this point the mandible can be widely separated (Fig. 5). The insertion of a Cloward's retractor allows excellent access to the posterior pharyngeal wall which is divided either in the midline or as an inferiorly based flap.

The posterior pharyngeal mucosa, with the underlying constrictor muscles, may be elevated as far laterally as the tori tubarius after incising the posterior wall of the pharynx, in the midline, from the posterior border of the vomer to the level of the arytenoid cartilages.

The prevertebral fascia and muscles may also be reflected laterally after midline division. The periosteum is reflected from the clivus no further laterally than the "paraclival gutters". This ensures preservation of the internal carotid arteries and associated cranial nerves.

If additional exposure of the clivus is required, laterally based mucoperiosteal flaps are reflected from the hard palate, and the posterior bony palate is removed with preservation of the nasal soft tissue floor (Fig. 6).

At this point control is handed to the neurosurgeons.

On completion of the planned neurosurgical procedure, the wounds are closed in standard fashion without the use of surgical drains. A soft, fine-bore nasogastric feeding tube may be inserted to aid post-operative nourishment. As an alternative, cervico-oesophagostomy<sup>21</sup> or percutaneous endoscopic gastrotomy can be provided.

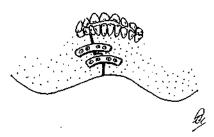


Fig. 4. Two small plates fitted then removed prior to completion of osteotomy.

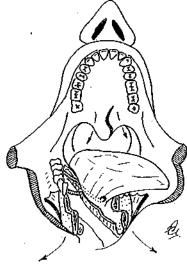


Fig. 5. Mandibulotomy completed prior to division of soft palate. Care must be taken to identify and preserve the lingual and hypoglossal nerves when dividing the floor of the mouth.

As a general rule, tube feeding is maintained for 3 to 5 days and attention is paid to oral hygiene. The routine use of an antiemetic helps prevent vomiting, reducing the chance of wound disruption.

All patients receive prophylactic peri-operative antimicrobial treatment and a reducing dose of Dexamethasone. Providing careful closure of the mucoperiosteal flap over the small plates takes place, the risk of post-operative infection is low. Post-operative shortening of the soft palate may occur, particularly if a midline split is performed, leading to velopharyngeal incompetence.

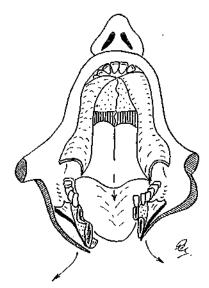


Fig. 6. For improved access to the clivus, the soft tissue of the palate is reflected laterally and the posterior bony palate removed.

Speech therapy, in our experience, has corrected the functional deficit satisfactorily.

## Transmaxillary

There are three potential transmaxillary approaches. The first is a modification of the maxillary osteotomy at Le Fort 1 level. The other two methods involve hemimaxillotomy flaps, pedicled either on the palatal mucosa or the cheek.

Le Fort I maxillatomy<sup>2,3,22</sup>, Following the injection of approximately 10 ml of 1:200,000 Adrenalin in 0.9% saline into the operative site, an incision is made above the mucogingival reflection from one first molar tooth to a similar point on the contralateral side. The nasal mucosa is elevated from the lateral nasal wall and floor, the soft tissues are reflected over the maxilla and, following identification of the infraorbital nerves, two small plates are adapted on each side for post-operative fixation. The maxilla is then divided with a reciprocating or oscillating saw or alternatively with dental burs, above the tooth apices. (Figs. 7, 8). The cuts pass posteriorly from the piriform aperture through the zygomatic buttresses and the tuberosities to reach the pterygoid plates. The nasal septum and the lateral nasal walls are divided with osteotomes and, finally, the pterygoid plates are separated from the maxilla by means of a curved Obwegeser chisel.

The maxilla is "downfractured" and remains pedicled on the palatal mucosa and the faucial pillars. The nasal mucosa is removed bilaterally to expose the nasal septum. The inferior turbinates are excised with heavy scissors and the vomer removed piecemeal to expose the roof of the nasopharynx and the clivus. A Cloward retractor or a modified Dingman gag is inserted to keep the maxilla displaced downwards and a large box-like space is created. (Fig. 9). The posterior pharyngeal wall is then divided appropriately either by midline incision or as an inferiorly based flap. The clivus becomes accessible from the middle ethmoid sinuses to the for-

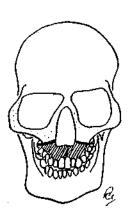


Fig. 7. Maxilla cut at Le Fort I level. Anterior

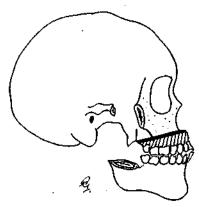


Fig. 8. Maxilla cut at Le Fort I level. Lateral

amen magnum and the anterior arch of the atlas.

For improved access to the lower clivus, a midline palatal split is performed through bone and soft tissue, including the soft palate. The divided maxilla retains its faucial blood supply and can be separated by a self-retaining retractor. With this modification, removal of the nasal septum or the turbinates is unnecessary. Post-operative healing does not appear to be compromised by this manoeuvre originally performed by KOCHER and described by LANZ in 1893.1.

Hemimaxillotomy: palatal mucosal pedicle<sup>7</sup>. This is, essentially, a high, hemi Le Fort I osteotomy (Fig. 10). The hemimaxilla is exposed via a Weber-Ferguson incision with preservation of the infraorbital nerve and an incision above the mucogingival reflection on the ipsilateral side from the midline to the maxillary tuberosity. The skin, subcutaneous tissues, periosteum and mucoperiosteum of the maxilla are elevated to expose the anterior and lateral walls of the maxilla, nasal bone, piriform aperture of the nose, zygomatic bone and masseter muscle.

The anterior attachment of masseter to the zygomatic arch is divided,

The nasal mucosa is reflected unilaterally as for a Le Fort I osteotomy. The fibromuscular attachment of the soft palate to the pterygoid plates and the hard palate is divided to expose the nasopharynx.

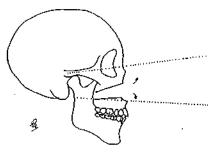


Fig. 9. Large box-like space created by downfractured maxilla.

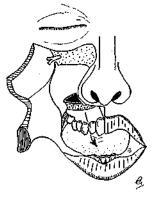


Fig. 10. Hemimaxilla pedicled on palatal mucosa and displaced inferiorly.

Coronoidectomy is then performed following division of the temporalis muscle attachment. The pterygoid muscles are divided with cutting diathermy until the lateral pterygoid plate is exposed. The maxillary artery may be mobilised, clipped and divided near the pterygoid plate.

The maxilla is then divided as for the Le Fort 1 osteotomy, ipsilaterally, to include the lateral pterygoid plate as high as possible. The nasal floor is then divided to the ipsilateral side of the midline without damaging the palatal mucosa. The maxilla is mobilised and hinged medially on the palatal mucosa retaining its faucial blood supply, and the pharyngeal mucosa can then be divided.

Additional exposure can be achieved by removal of:

- a) zygomatic bone to the level of the inferior orbital rim;
- b) the middle and superior turbinates;
- c) ethmoid sinuses;
- d) the posterior nasal septum and the pterygold plates.

Hemimaxillotomy: cheek pedicle. A Weber-Ferguson skin incision is followed by the elevation of a palatal mucosal flap from the ipsilateral tuberosity to the contralateral premolars (Fig. 11). The palatine artery is freed

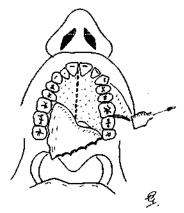


Fig. 11. Palatal flap reflected prior to division of bony palate, just lateral to nasal septum. Vertical mucosal incision placed in region of zygomatic buttress.

from its channel by a chisel. A vertical mucosal incision is placed in the region of the ipsilateral zygomatic buttress. The soft tissues of the cheek, orbital floor and palate are elevated sufficiently to allow access for surgical division of bone with an oscillating saw. "Tunnelling" behind the buttress gains access for separation of the pterygoid plates and through which the posterior maxilla and buttress can be divided. The nasal mucosa is reflected from the lateral nasal wall and floor. Bone cuts are made between the upper incisor teeth into and through the hard palate just to the operative side of the nasal septum. The bone is divided from the lateral nasal wall through the inferior orbital rim towards the infraorbital nerve canal. The canal is "deroofed", the nerve identified, and divided with a scalpel blade. The bone cut then continues anterolaterally back over the rim and through the buttress; this is completed intraorally, the posterior maxilla divided and the pterygoid plates separated from the maxilla by an osteotome.

The lateral nasal wall is divided with an osteotome and the hemimaxilla, pedicled on the cheek, is outfractured laterally. (Fig. 12). The pharyngeal wall can then be divided appropriately.

# Wound closure

Following completion of the neurosurgical procedure, the pharyngeal wall is closed in layers, the maxilla or hemimaxilla returned to the preoperative position and fixed in situ by the precontoured, prepositioned, small plates. The wounds are closed in the standard fashion. A method of postoperative feeding is provided as discussed previously.

# Discussion

The first stage in selecting the most appropriate access osteotomy is to determine the location of the tumour or other lesion using appropriate endoscopic and radiological techniques. Where possible the nature of the lesion is ascertained.

For access to lesions confined within the central compartment, the Le Fort I

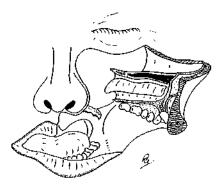


Fig. 12. Hemimaxilla pedicled on cheek and displaced laterally.

maxillotomy gives good access to the upper and middle clivus, (access to the lower clivus may be poor), maxillary, ethmoidal and sphenoidal sinuses, the nasal and pterygopalatine fossae and the medial portion of the infratemporal fossa<sup>2</sup>. Although removal of the nasal septum and turbinates is necessary, this does not appear to cause long-term problems.

It is a technique which lends itself to the clipping of distal-vertebral and Basilar artery aneurysms or removal of small clival chordomas and is extremely useful for removal of nasopharyngeal tumours.

Dividing the downfractured maxilla in the midline, gives excellent access to the entire clivus, taking the neurosurgeon closer to the operative site than is possible with the transmandibular approach. In this situation, pre-operative nasal architecture is retained. Access can be further enhanced by an incision splitting the upper lip in the midline and by extending this incision around the nasal alae (a "tulip" incision). SANDOR et al. 18, describe this approach in conjunction with a parasagittal mandibulotomy but, in our opinion, this does not add to the access already achieved. Midpalatal splitting of the downfractured maxilla will almost certainly become the definitive approach to the clivus,

The main advantage of both techniques is a low morbidity with absence of facial scarring. The risks of cranial nerve or vertebro-basilar vascular damage and aphasia or epilepsy as a result of brain retraction following transcranial approaches to the upper clivus are avoided. Complications are uncommon but include subcutaneous emphysema and IIIrd or VIth nerve palsies<sup>5</sup>.

Exposure from the upper, middle clivus to the level of C4 may be achieved by parasagittal mandibulotomy alone, or in combination with a Le Fort I maxillotomy with midline palatal division. Alternatively, hemimaxillotomy or hemimaxillectomy could achieve similar access. For lesions confined to this region, hemimaxillotomy may be preferred to parasagittal mandibulotomy, having the advantage of reduced morbidity with a shorter time for exposure and closure. Hemimaxillotomy pedicled on the palatal mucosa is technically more difficult to perform than when using a cheek pedicle, and for access to the central compartment only has no distinct advantages. Unlike the Le Fort

I maxillotomies, hemimaxillotomy precludes a midline approach which neurosurgeons may find disadvantageous.

The loss of sensation over the cheek as a consequence of infraorbital nerve division with the cheek pedicle is a small price to pay for the excellent access offered by this technique. Hemimaxillotomy is preferred to hemimaxillectomy as bone and teeth are preserved and reconstruction, either by a temporalis muscle flap or an obturator, is avoided.

Access to the clivus can be achieved through a lateral rhinotomy or by bone removal following a midfacial degloving 6,16,17 the latter approach avoiding facial scars.

The major disadvantages of these techniques, however, are the potential loss of bone (in young people this may be replaced as a free graft) and a lateral rather than midline approach.

For access to lesions which extend beyond the central compartment into the lateral compartment, parasagittal mandibulotomy is to be recommended for its versatility. Extension of the cervical incision and further dissection in the neck allows access to the infratemporal fossa, particularly if this is combined with horizontal sectioning of the vertical mandibular ramus above the lingula and superolateral reflection of the hemimandible and cheek.

Extension intraorally gives access to the parapharyngeal space. Although access to the lateral compartment can be achieved by intraoral extension of hemimaxillectomy and hemimaxillotomy techniques, a major disadvantage is the lack of control over major neurovascular structures of the neck and skull base. A palatally pedicled hemimaxillotomy flap in this situation would have a distinct advantage.

With all transoral procedures, there is a potential risk of post-operative wound infection and meningitis. This risk is minimised by the prophylactic intravenous administration of appropriate broad spectrum antibiotics, for example, a Cephalosporin plus Metronidazole beginning peri-operatively and continuing for 72 h. There are no reported cases of meningitis or wound infection associated with the techniques described. The use of systemic steroids and oral or intramuscular non-steroidal anti-inflammatory drugs, for example Diclofenac, reduce postoperative oedema with good pain control. As an alternative to the difficult insertion of sutures for closure of the pharyngeal wall,

human derived fibrin adhesives provide rapid and watertight, albeit expensive, closure.

Intermaxillary fixation is unnecessary with bone plating techniques and, providing soft tissue closure over the plates is achieved, the risk of infection and malunion is low. Krespi & Sisson<sup>13</sup> report one incident of malunion when utilising transosseous wires instead of small plates for fixation after mandibulotomy. In the absence of intermaxillary fixation, transosseous wires do not provide adequate stability at the osteotomy site.

Extensive parasagittal mandibulotomy techniques may give rise to postoperative dysphagia as a consequence of pharyngeal and tongue retraction. This usually recovers within 2 months. If the hypoglossal nerve is damaged, recovery may take longer. Serous otitis media leading to deafness occurs if the Eustachian tube is divided but is easily remedied by the insertion of a middle-ear ventilating tube. Should extensive dissection be anticipated in the neck or if midline glossotomy is to be performed, a preliminary tracheostomy is advisable to protect the airway from extensive post-operative oedema. Oral intubation rarely gives rise to restricted surgical access, whilst nasal intubation may be inappropriate with some techniques. However, when intubation of the trachea could be expected to hinder surgical access then elective tracheostomy is also necessary.

In general, these techniques have acceptable morbidity, result in minimal scarring and preserve satisfactory post-operative function.

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# Transfacial access for neurosurgical procedures: an extended role for the maxillofacial surgeon

II. Middle cranial fossa, infratemporal fossa and pterygoid space

P. D. Grime, P. Haskell, I. Robertson, R. Gullan: Transfacial access for neurosurgical procedures. Int. J. Oral Maxillofac. Surg. 1991; 20: 291-295.

Abstract. A variety of osteoplastic flaps have been devised for transoral or extraoral access to the base of skull and the upper anterior cervical spine. Part I of this two-part review describes access to the clivus and upper anterior cervical spine. Part II will describe access to the middle cranial fossa, the infratemporal fossa and the pterygoid (retromaxillary) "space".

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Key words: translacial access; osteotomy; neurosurgical procedures; middle cranial fossa; infratemporal fossa; pterygoid space.

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Part I of this two-part review discussed transfacial access to the upper anterior cervical spine and clivus within the central compartment at the base of the skull. In Part II, access to the middle cranial fossa, the infratemporal fossa and the pterygoid (retromaxillary) "space" within the lateral base of skull compartment will be described. Transfacial access is achieved utilising an extraoral osteotomy of the zygomatic bone, or by extension of the versatile parasagittal mandibulotomy.

# Techniques Access to the lateral compariment

The middle crapial fossa6-8

The standard zygomaticotemporal approach to the middle cranial fossa utilises a full bicoronal scalp flap extended into the preauricular region on the ipsilateral side, the hair having been shaved according to personal preferences. The scalp flap extends from a point just above the lateral corner of the contralateral eye within the normal hair-bearing area, continues across the scalp, contoured to allow accurate relocation, and sweeps around the attachment of temporalis. The incision then follows the curvature of the helix to the most caudal point of the inner aspect of the tragus. The incision is deepened to the epicranial aponeurosis over the scalp and to the temporalis fascia over the temple. In the preauricular area, blunt dissection in the avascular plane anterior to the cartilage of the external meatus is sufficient to reach the root of the zyromatic arch.

After the scalp flap is turned back to a line joining the supraorbital rim and the line of the zygomatic arch, and incision is deepened between these points through the superficial layer of the temporalis fascia. The upper branches of the facial nerve lie lateral to this layer and are thus preserved.

The pericranium is incised across the forehead and around the temporal muscle to the suprameatal crest and hence to the posterior zygomatic root. The supraorbital nerve is freed from its foramen and the lax skin between the eyebrow and lid is freed from its periosteal attachments to allow inferior traction of the skin flap (Fig. 1).

The temporalis muscle is elevated from its origin down to the infratemporal crest, elevating the periosteum from the lateral orbital wall.

The zygomatic bone is divided in three places with dental burs after drilling holes to take osteosynthesis wires or, if preferred, small or micro plates. The cuts are made as follows: 1) Across the supraorbital rim 1 cm above the zygomaticofrontal suture with the bur directed towards the inferior orbital fissure thus producing an oblique cut;

2) From the inferolateral corner of the orbital rim traversing the body of the zygoma parallel with, and directed towards, the anterior border of the masseter muscle; 3) A bone cut obliquely bisecting the eminentia articularis of the zygomatic arch (Fig. 2). The zygoma is outfractured with osteotomes and pedicled on the masseter muscle displaced inferiorly (Fig. 3). Access to the middle cranial fossa is then achieved with craniotomy (Fig. 4).

# The infratemporal fossa and pterygoid (retromaxillary) "space"

A variety of surgical techniques may be utilised in the approach to the infratemporal fossa and retromaxillary regions, which are acknowledged to be amongst the most difficult to access<sup>1,2,4,9,10,12,13</sup>.

1) The preliminary stages of the standard

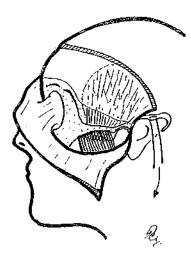


Fig. 1. Bicoronal flap retracted exposing lateral orbit and zygomatic arch with attached masseter muscle.

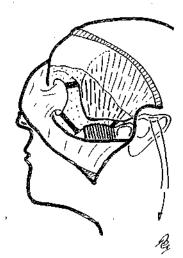


Fig. 2. Osteolomy cuts outlined.

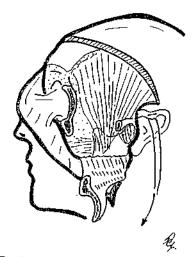
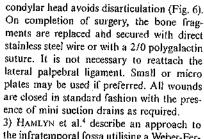


Fig. 3. Zygoma pedicled on masseter muscle and displaced inferiorly.

zygomaticotemporal approach are completed but the temporalis muscle is not detached from above. The ascending ramus of the mandible is approached intra-orally and the coronoid process cut. The coronoid process can then be delivered upward and the temporalis muscle elevated from the infratemporal crest. This gives access to the fossa.

2) Alternatively, the bicoronal flap is extended on the contralateral side? By more extensive subperiosteal dissection in the nasal and orbital region, and by careful dissection close to the superficial surface of the masseter muscle, the flap may be mobilised to a greater degree and reflected, allowing access to the mandibular ramus and the coronoid process extra-orally. The latter structure is divided and turned superiorly (Fig. 5).

Alternatively, the mandibular ramus can be sectioned horizontally above the lingula, the temporomandibular joint distracted after capsular division and the upper ramus displaced superiorly pedicled on the temporalis muscle. A further osteotomy just below the



3) HAMLYN et al. describe an approach to the infratemporal fossa utilising a Weber-Ferguson incision and division of the zygomatic bone with lateral reflection on the zygomatic arch and preservation of the infraorbital nerve,

4) For a wider approach a combination of the zygomaticotemporal technique in combination with a hemimaxillotomy is ideal. This requires a Weber-Ferguson incision extended laterally over the orbital margin and continued superiorly encircling the temporalis muscle origin and extending inferiorly across the route of the zygoma (Fig. 7). This incision is similar to that of the original zygomaticotemporal approach described by Nett-Dwyer et al. 8, if the Weber-Ferguson component was removed. Unfortunately, the terminal branches of the superior division of the facial nerve are sacrificed.

The zygoma is cut as described previously and a cheek pedicled hemimaxillotomy performed. Alternatively, both the maxilla and the zygomatic bone can be removed in one piece as described by McGurk & Lello?. Both these methods are variations of a technique first described by Crockett? and later modified by Worthington<sup>13</sup>.

5) It is also possible to use a transoral, cervical approach. This proceeds as a standard parasagittal mandibulotomy but the floor of mouth incision is extended backwards and

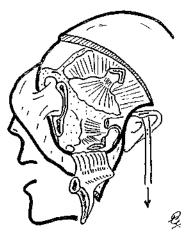


Fig. 5. Coronoid fragment pedicled on temporalis and reflected superiorly exposing retromaxillary region.

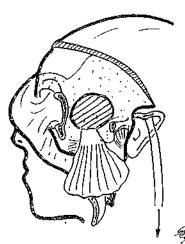


Fig. 4. Temporalis muscle detached and reflected inferiorly prior to craniotomy.

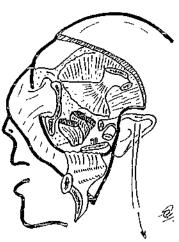


Fig. 6. Alternative ostcotomy - pterygoid muscles divided.

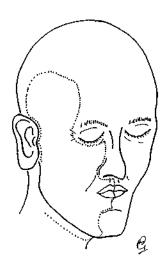


Fig. 7. Skin incision for combined zygomaticotemporal/hemimaxillotomy technique combined with labiomandibulotomy and neck incision for extended access.

upwards behind the maxillary tuberosity (Fig. 8). By further extension into the maxillary sulcus, the maxillary antrum, pterygopalatine fossa and infratemporal fossa are exposed. The coronoid process of the mandible can be resected to improve access to the infratemporal fossa and the temporal muscle retracts superiorly. The resected bone retracts automatically and a traction wire placed through its base aids recovery at the end of the procedure.

The disadvantage with a pure transoral approach to the infratemporal fossa is the lack of control over major neurovascular structures at the base of skull and the limited exposure. To combat this difficulty, the cervical incision is extended to the mastoid process.

Following development of a subfascial flap, the digastric and stylohyoid muscles are released from the hyoid and reflected superiorly with the submandibular gland. The mylohyoid muscle is divided from its posterior border parallel with the lower border of the mandible to the midline. The sternocleidomastoid muscle is retracted posteriorly and the carotid sheath dissected to the base of skull with identification of the carotid bifurcation and the cranial nerves X, XI and XII.

At this stage, further lateral movement of the hemimandible is prevented by the presence of the external carotid artery. This may be divided at the level of the facial artery. If necessary, the stylohyoid ligament, styloglossus and stylopharangeus muscles are separated from their styloid attachment. This allows dissection of the internal carotid artery to the base of the skull.

The intraoral mucosal incision does not extend into the buccal sulcus but extends from the maxillary tuberosity on to the hard palate, continuing as a mucoperiosteal incision I cm from the gingival margin to the midline. A posterior-based palatal flap is de-

Fig. 8.Intra-oral incision extended lateral to the maxillary tuberosity.

veloped with division of the long sphenopalatine vessels and nerve.

The posterior bony palate is resected and the nasal mucosa elevated from the medial pterygoid plate. The lingual nerve is followed superiorly lying on the medial pterygoid muscle which is divided from its insertion into the lateral pterygoid plate. Complete access to the infratemporal fossa is thus provided with full control of major nerves and vessels.

This technique can be modified further if access to the central compartment is not required! Parasagittal mandibulotomy and the skin incisions are as above. In this situation, it is not necessary to divide the attachments of digastric or stylohyoid, or reflect the submandibular gland. The carotid sheath is exposed by retraction of the digastric and sternomastoid muscles and the external carotid transected at the level of the bifurcation (Fig. 9). The facial artery and vein are identified at the lower border of the mandible. These are divided and reflected superiorly with the fascial flap protecting the lower divisions of the facial nerve. (Fig. 10).

The intraoral mucosal incision is also modified. This extends from the base of the coronoid process running inferomedially to the retromolar area then anteromedially into the gingival sulcus and is carried down to bone. This incision extends to the midline. A full thickness mucoperiosteal flap is reflected from the lingual side of the mandible and extended inferiorly to the attachment of mylohyoid and posteriorly to detach the pterygomandibular raphe and superior constrictor.

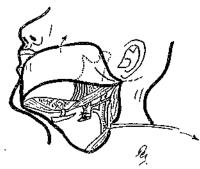


Fig. 9. External carotid artery divided at level of bifurcation.

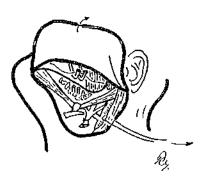


Fig. 10. Mandibular branches of facial nerve identified and protected.

The mucoperiosteum is also reflected from the medial aspect of the rannus above the lingula and from the anterior border of the ramus to the coronoid tip.

Following parasagittal mandibulotomy, the periosteum of the lower border is divided and the remaining soft tissue reflected from the medial aspect of the mandible and a horizontal osteotomy of the ramus above the lingula performed intraorally. The neurovascular bundle is preserved and the mandibular fragment reflected superolaterally with its attached soft tissue with excellent access to the pterygomaxillary fossa and the parapharyngeal space (Fig. 11). Unfortunately, access to the infratemporal fossa is limited and is best achieved extra-orally as described previously.

#### Discussion

One of the great advantages of the zygomatico-temporal approach to both the middle cranial fossa and the lateral compartment in general is the simplicity of the surgery and the preservation of the facial nerve without recourse to parotidectomy, as described in earlier accounts of a preauricular approach 10,12. If control of the carotid arteries or neck dissection is required, simple cervical extension of the preauricular incision provides the necessary access, and avoidance of the oral route reduces the risk of contamination and subsequent wound infection. Facial aesthetics are maintained and the incision is cosmetically acceptable. UTTLEY et al.11 have reported a series of 54 cases utilising the approach described by Neil-Dwyer et al.8 with minimal (4%) mortality and morbidity. Complications are rare but fixation of the zygoma may present a problem in children.

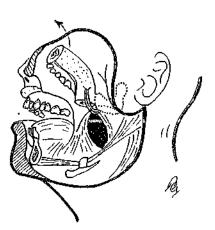


Fig. 11. Mandibular fragment pedicled on the cheek flap, reflected superolaterally to expose the retromaxillary area and the pterygoid "space".

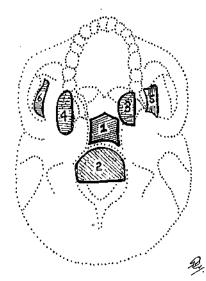


Fig. 12. Zones at the base of skull. 1. Clivus. 2. Upper cervical spine. 3. Pterygoid "space"/retromaxillary region: medial. 4. Pterygoid "space"/retromaxillary region: lateral. 5. Infratemporal fossa. 6. Middle cranial fossa.

The alternative methods of achieving access to the infratemporal fossa and pterygoid (retromaxillary) "space", as described by CROCKETT<sup>2</sup> and modified by both WORTHINGTON<sup>13</sup> and HAMLYN et al.<sup>4</sup> using similar osteoplastic flaps, have the disadvantage of an anterior approach with reduced access and an increased risk of permanent damage to the facial nerve. The end result is cosmetically inferior,

The difficulty with the bicoronal approach<sup>8,9</sup>, despite bilateral preauricular extensions, is in adequately mobilising the flap for sectioning the mandibular ramus and gaining access to the retromaxillary area without causing a traction palsy.

On balance this is preferable to the combined zygomaticotemporal and hemimaxillotomy approach? which sacrifices the terminal branches of the upper division of the facial nerve, and is cosmetically inferior. The main disadvantage of the zygomaticotemporal ap-

proach is the difficulty in following the internal carotic artery through the bone of the skull base.

Should this be necessary, the postauricular approach as described by FISCH<sup>3</sup> may be used, but this technique involves the resection of the mandibular condyle and coronoid processes and division of the mandibular division of the trigeminal nerve which compromises a return to full mandibular function. With this technique there is also loss of ipsilateral lower lip sensation. The zygomaticotemporal approach preserves the temporomandibular joint, allows resumation of normal function and preserves lower lip sensation. The approach described by Fisch is more appropriate to those with an otolaryngological training.

When access to both central and lateral compartments is required, a parasagittal mandibulotomy approach offers the best technique with wide exposure.

By extension of the cervical incision to include the preauricular and temporal approach, the middle cranial fossa may be accessed but the external carotid artery must not be ligated or blood supply to the temporal flap may be compromised. As an alternative, the combined zygomaticotemporal maxillotomy approach also gives good access to both compartments albeit with poor control over major neurovascular structures. Cervical extension in these circumstances could compromise flap blood supply.

A palatally pedicled hemimaxillotomy flap allows access to both compartments with exception of the middle cranial fossa.

An alternative approach to the infratemporal fossa and retromaxillary area devised by MANN et al.<sup>5</sup> has not been described in detail here as it is unnecessarily complex involving the combination of both lower and upper lip splitting incisions and temporary removal of the zygomatic complex.

Access is achieved by removing the

coronoid process of the mandible and dividing the pterygoid muscles before removing the posterior wall of the maxilla, the pterygoid plates and the lateral nasal wall.

The zygomatic complex is replaced as a free graft and wired in situ at the end of the procedure. Loss of ipsilateral cheek and both upper and lower lip sensation occurs and facial scarring is unacceptable in comparison with alternative techniques. It can no longer be recommended,

Table 1 summarises the osteotomy most likely to be appropriate for a particular region (Fig. 12), accepting that specific circumstances may dictate alternative choice.

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Table 1

Procedure	Compartment	Zone
Le Fort I osteotomy	С	1 [2]
Le Fort I osteotomy with midline palatal split	С	1 2
Hemimaxillotomy	CILI	1 2 [3] [4] [5]
Parasagittal mandibulotomy	c'	1 2 3
Zygomaticotemporal	Ł	[3] 4 5 6
Zygomaticotemporal with hemimaxillotomy	CL	1 2 3 4 5 6
Parasagittal mandibulotomy with cervical extension	C [L]	1 2 3 4 [5]

Key: C=central; L=lateral; []=access possible but not recommended.

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# Pathology

# Transoral approach for large pituitary adenoma using Le Fort I osteotomy with mandibulotomy

A case report

Y. Myoken, T. Sugata, T. Kiriyama, K. Kiya: Transoral approach for large pituitary adenoma using Le Fort I osteotomy with mandibulotomy. A case report. Int. J. Oral Maxillofac. Surg. 2000; 29: 128-130. © Munksgaard, 2000

Abstract. A patient is presented with a large pituitary adenoma that was successfully treated with a Le Fort I osteotomy in combination with mandibulotomy.

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Key words: Le Fort I osteotomy; mandibulotomy; neurosurgical procedure; skull base neoplasm.

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Various approaches have been described to reach the centrally placed clivus and midline cranial base tumors, which are technically difficult to access and expose. For example, lateral approaches have been used, but all involve prolonged, and at times excessive, retraction on the brain stem and cranial nerves, which may cause postoperative neurological deficits<sup>5,7</sup>. Alternatively, anterior approaches through the nasopharynx or oropharynx with either palatal, maxillary or mandibular splitting may provide direct access and reduce the risk of postoperative neuro-logical deficits<sup>1-4,6,10,12</sup>. Archer et al. described a transclival approach for the treatment of basilar artery aneurysms using a Le Fort I osteotomy, which provided unprecedented access to the region of the clivus in its entirety and did not cause problems such as soft tissue retraction2. The same approach allows partial or total resection of midline skull base tumors12. This technique

along with a mandibular split to treat a large pituitary adenoma is described.

# Case Report

A 54-year-old woman presented with acute onset of headache, associated with slight visual disturbances. Computed tomography of the head revealed a tumor mass involving the clivus. A transmaxillary biopsy was performed and the histopathologic diagnosis was invasive nonfunctioning pituitary adenoma. Her neurological examination was normal and studies revealed normal levels of growth hormone, luteinizing hormone, prolactin, follicle-stimulating hormone and thyroxine. She chose not to undergo surgical treatment but was followed for several months until a year later, when she complained of severe headache and diplopia. Magnetic resonance imaging (MRI) of the head revealed an extremely large, diffuse mass at the cranial base, involving the entire region of the sella and sphenoid sinus, with bilateral extension into the cavernous sinus. Suprasellar extension into the region of the hypothalamus was observed (Fig. 1).

Surgery was now thought to be necessary. Anesthesia was administered via oral intubation because she refused a tracheotomy. A midline mandibulotomy was first performed to prepare space for an oral endotracheal tube (Fig. 2). A Le Fort I osteotomy was performed to displace the maxilla downwards. The downwards displaced maxilla allowed optimal access to the clivus. The inferior turbinates were excised and the nasal septum was removed piecemeal to expose the roof of the nasopharynx and the clivus. Self-retaining retractors were inserted to keep the maxilla displaced downwards and a large box-like space was created (Fig. 2). The tumor was then resected by the neurosurgeons, after which the maxilla and mandible were repositioned and fixed with miniplates applied. A nasogastric tube was inserted for postopera-

Postoperatively, the patient's headache and diplopia resolved and her wounds healed satisfactorily without CSF leakage or meningitis. She had no other neurological deficits. The cosmetic result was excellent and there were no significant problems related to malocclusion. MRI of the head showed semitotal removal of the tumor (Fig. 3). The patient

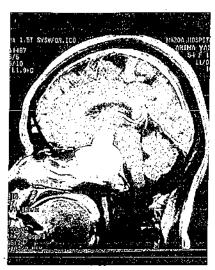


Fig. 1. Preoperative coronal MRI demonstrates large midline tumor invading clivus with suprasellar extension.

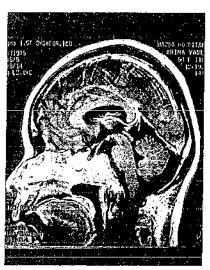


Fig. 3. Postoperative coronal MRI reveals semitotal resection of tumor.

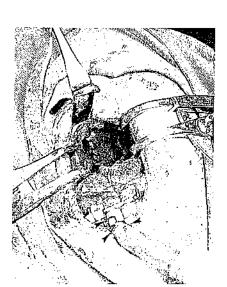


Fig. 2. Midline mandibulotomy provides space for an oral endotracheal tube (arrowheads). Self-retaining retractors are inserted to keep the maxilla displaced downwards and a large box-like space is created.

received postoperative local radiation therapy (46 Gy in total). At present, three years postoperatively, she is in good condition.

# Discussion

Surgery is the treatment of choice for giant invasive pituitary adenomas which involve the sella and parasellar regions, along with superior suprasellar extension and inferior invasion of the clivus<sup>1,1,2</sup>. The object is to achieve maximal turnor resection but to preserve function with minimal visible scarring

and deformity. There are essentially three potential transoral approaches for midline skull base tumors6. The first is a transmandibular approach using a parasagittal labiomandibulotomy, which provides access to the anterior spine from C1 to C4, but leaves visible external scarring3. If additional exposure of the clivus is required, the mandibulotomy should be combined with midline palatal division, which may cause velopharyngeal incompetence6. The second is a transmaxillary approach using a hemimaxillotomy which allows good exposure of the middle compartment of the skull base from the roof of the sphenoid to C5, but leaves facial scarring4. This technique, however, precludes a midline approach which neurosurgeons may find disadvantageous6. Thirdly, a transmaxillary approach using a Le Fort I osteotomy is possible, which provides excellent access extending from the sella to the arch of the atlas and to the lateral recesses on either side without soft tissue retraction<sup>12</sup>. The major drawback with the Le Fort I osteotomy, however, is the necessity of turbinectomy and damage to the nasal septum.

Selection of an appropriate access technique depends on the anatomical location of the skull base tumour. Since the large midline pituitary adenoma involved the entire clivus and extended suprasellarly, a Le Fort I osteotomy was chosen. Although this technique was originally described to provide good access to the entire clivus, it has been re-

ported that single fragment maxillotomy does not always allow adequate access to the clivus, especially to the lower clivus<sup>6,8</sup>. The use of a mandibulotomy, however, provided sufficient space for an oral endotracheal tube and allowed sufficient displacement of the maxilla11. The surgical access extended from the pituitary fossa to the arch of the atlas and provided good exposure of the large pituitary adenoma. The technique described may avoid palatal dysfunction resulting in a nasality of the voice, dysphagia, nasal regurgitation and oronasal fistulas, as compared to the midpalatal splitting of the downfractured maxilla which may also provide good access to the entire clivus<sup>6,8,9</sup>.

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- Ch. Lindquist, Stockholm
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- D. M. Long, Baltimore
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- I. Nyáry, Budapest
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#### Craniofacial Osteotomies for Skull Base Access

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#### Summary

During a five year period 150 craniofacial access osteotomies for skull base access have been performed allowing direct exposure of pathology in difficult anatomical acreas with minimal complications. These approaches have been developed by considering the craniofacial skeleton as a single osteoplastic structure. Bone segments are mobilised and replaced using rigid fixation. In this way osteotomies can be planned which significantly improve access and preserve form and function in the complex region of the skull base.

Keywords: Craniofacial osteotomies; skull base; surgical access; multidisciplinary management.

#### Introduction

Skull base surgery, until recently an area of limited surgical interest, has become a rapidly expanding field. The basis for its success is the conceptual evolution that most skull base lesions are extra cerebral and should be removed avoiding interference with the neural axis. The obvious access is therefore via the facial structures. In this respect transnasal surgery for the pituitary has pioneered the trend. However, recently the craniofacial skeleton has been recognised as a single osteoplastic structure and bony segments can be mobilised either as free or pedicled modules<sup>13, 21, 28, 32</sup>.

A variety of approaches may be used to reach an anatomical site on the skull base but there has been a tendency to couple a particular osteotomy with access to a defined skull base region, a view which we regard as being too restrictive. A sound anatomical knowledge of the craniofacial skeleton and the preoperative definition of the nature, site and extent of the pathology are the basis for a flexible, multi disciplinary approach<sup>4, 8, 21, 23–25, 27, 31, 36, 43</sup>

In the last 5 years the authors have performed 150 craniofacial osteotomies for surgery in and around the

skull base. We describe 7 cases in order to highlight the need for a flexible approach.

#### Method and Patients

For convenience the surgical approaches may be divided into anterior and lateral; the anterior approaches are those involving the cranium, midface and mandible.

#### Anterior Cranial Approaches

The anterior cranial approaches involve the frontal bone, i.e., vault, superior orbital margins/glabella and orbital roof. Of necessity these bone segments are usually mobilised as free bone segments. The nasal bones and zygoma may be incorporated as necessary<sup>5, 15, 20, 21</sup>.

This approach may be unilateral or bilateral providing access to extra and intracranial pathology. We have used this approach for pathology in the orbit, ethmoid and sphenoid sinuses, clivus, anterior cranial fossa, cavernous sinus, suprasellar region and anterior circulation aneurysms.

#### Case 1, Superior Orbital Osteotomy

A 54 year old female nurse was admitted following a subarachnoid haemorrhage. There was no neurological deficit. A C.T. scan and cerebral angiography were performed (Fig. 1).

The plan was to reach the anterior communicating artery aneurysm "from below" with minimal brain retraction via a superior orbitotomy. A bifrontal skin flap and a small right osteoplastic frontal craniotomy were performed. The right superior orbital margin, orbital roof and the superior aspect of the lateral orbital wall were removed en bloc. Access was further improved by retracting on the globe rather than the brain. The aneurysm was clipped. Following dural closure the bone segment was replaced and rigidly fixed with mini plates.

At 3 years post operation the patient had made a good recovery. There was a small area of reduced sensation above the right supraorbital margin.

#### Case 2, Bilateral Superior Orbital Osteotomies

A 65 year old female patient presented with a 3 year history of progressive apathy and hypersomnia associated with weight gain and vomiting. Bilateral anosmia was present on neurological test-

ing. A C.T. scan was performed (Fig. 2). The pre-operative diagnosis was an olfactory groove meningioma.

The aim of the approach was to gain access to the anterior cranial fossa as far back as the lesser wing of the sphenoid bilaterally with minimal brain retraction. In order to reduce the vascularity of the tumour early access to the anterior and posterior ethmoidal vessels bilaterally was required.

A bifrontal craniotomy, ligation of the anterior and posterior ethmoidal arteries and removal of the orbitofrontal bandeau was performed. The bone segment mobilised consisted of the supraorbital ridges, glabella and medial portions of the orbital roofs bilaterally. The frontal sinus was cranialised and the frontonasal ducts obliterated. The tumour was completely excised. The supraorbital bone fragment was replaced and rigidly fixed. The mini-plates had been placed prior to mobilisation to ensure accurate relocation.

Two years postoperatively the patient remains well her only complaint being anosmia.

The advantages of this approach are direct access to the pathology from a variety of different angles and a basal exposure which requires minimal brain retraction. Sensation to the forehead is maintained by preserving the supraorbital nerves and rigid fixation of the bone segments ensures a satisfactory cosmetic result.

This approach has been used in 36 cases as illustrated in Table 1.



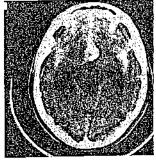


Table 1. Superior Orbital Access. Age range 3/12-71 years

Pathology	Number of cases
Meningioma	12
Vascular	11
Orbifal	8
Other tumours	5
Total	36

Superior orbital access osteotomies were used in the removal of 6 sphenoid wing meningiomas, 5 suprasellar meningiomas and an olfactory groove meningioma. Of the 11 vascular cases there were 6 anterior communicating artery aneurysms, 3 ophthalmic artery aneurysms and 2 arteriovenous malformations. The orbital pathology included a meningioma, osteomas (2), fibrous tumours (3) an encephalocoele, and an optic pathway tumour. Other indications for superior orbital access included optic nerve decompression for benign intracranial hypertension (1), a hypothalamic glioma, pituitary tumour (3).

#### Midface Approaches

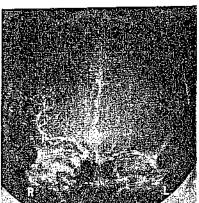
We have found it helpful to group these into the "transfacial" and the "transoral" approaches.

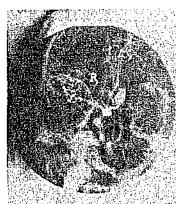
#### Transfacial Approaches

The term 'transfacial' is used to describe any procedure that mobilises the midfacial skeleton through a facial (skin) incision irrespective of the extent of midface disassembly employed.

The nasal bones, maxilla, and zygoma may be mobilised alone or in combination, unilaterally or bilaterally and either pedicled to the soft tissues or as free bone fragments.

These approaches allow access to the anterior and middle cranial fossae, cavemous sinus, craniovertebral junction, the upper cervical vertebrae (to the level of C 4), infra-temporal, and pterygo palatine fossae, nasopharynx, clivus, paranasal sinuses, and the orbit<sup>2, 8, 11–13, 21, 23–25, 28, 32, 34, 43</sup>





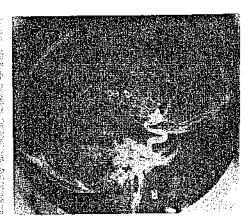


Fig. 1. (a) CT scan showing interhemispheric blood and blood throughout the basal cisterns. (b) Cerebral angiography demonstrates a large anterior communicating aneurysm

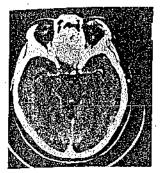




Fig. 2. Olfactory groove meningioma on CT scan extending through the anterior cranial fossa floor

#### Case 3, Nasall Medial Orbital Osteotomy

A 64 year old female was referred by an E.N.T. surgeon with an 8 month history of progressive nasal obstruction. A nasal polypectomy had been performed and the histology revealed a low grade chondrosarcoma.

A C.T. scan was done (Fig. 3).

In order to gain access to the lesion a low combined frontonasal approach was designed.

A right parasagittal incision was carried down into the medial orbital region and extended into a right lateral rhinotomy. A right frontal craniotomy was performed and a bone segment consisting of the right supraorbital margin, medial orbital margin and lateral nasal bones was mobilised. The posterior aspect of the nasal septum was removed and with the dissection of the soft tissues away from the skull base an en-bloc resetion of the tumour was possible under direct vision. The osteotomised bone segment was replaced and rigidly fixed.

At 2 1/2 years post surgery the patient is clinically and radiologically free of residual recurrent disease (Fig. 4).

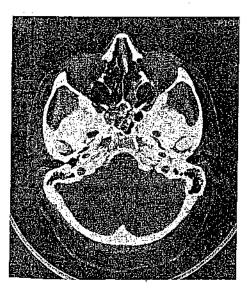


Fig. 3. CT scan illustrating a tumour in the upper clivus, sphenoid sinus and posterior ethmoid air cells



Fig. 4. 2 1/2 years post operation; no evidence of tumour on CT scan

#### Case 4, Pedicled Nasal/Maxillary Osteotomy

A 44 year old male presented with a 4 month history of increasing difficulty in breathing through the nose and severe persistent frontal headaches.

The C.T. findings are illustrated in Fig. 5.

A biopsy was performed through the right nostril and the histological diagnosis of a malignant fibrous histocytoma was made.

In order to achieve complete exposure for an en-bloc resection a right transfacial approach in combination with a bifrontal cranio-tomy was planned. The latter involved an osteotomy of the maxilla including the hard palate and the infraorbital margin, a portion of the right nasal bones and the right zygoma.

Following a bilateral craniotomy an extradural approach was used and the posterior aspect of the tumour near the jugum sphe noidale was identified. The dura was opened and having identified the optic nerves, under direct vision, the posterior aspect of the tumour capsule was dissected from the sphenoid sinus, medial orbital walls and the optic nerves. A standard Weber-Ferguson maxillectomy incision with a Diffenbach extension along the lower eyelid was used. The palatal mucosa was incised lateral to the midline. The medial canthal ligament was tagged with a suture for subsequent reattachment. The nasolacrimal duct was transected. The hard palate was sectioned in the midline. The soft tissue incisions and the bone cuts were staggered so as not to be coincident. It was not necessary to section the soft palate, Final mobilisation of the right facial skeleton described above was performed by separating the pterygomaxillary suture with a curved osteotome (Fig. 6). The infraorbital nerve on the right side was sectioned to allow complete mobilisation of the right midface. The ends of the infraorbital were tagged for subsequent microneural anastomosis. Access was still limited in the midline. A contra lateral nasal osteotomy was then performed and the nasal skeleton: was displaced to the opposite side, attached to a soft tissue pedicle. Complete visualisation was then possible. An en-bloc resection of the tumour was then carried out under direct vision.

The defect in the anterior cranial fossa measuring  $6 \times 2.5$  cm was reconstructed with an inner table calvarial bone graft harvested from the craniotomy flap. A galeal-frontalis flap was raised and

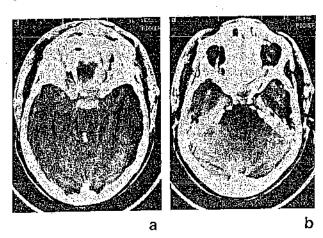


Fig. 5. (a, b) CT scan showing a tumour in the nasal cavity, post nasal space, sphenoid sinus (close to the optic chiasm), and under the frontal lobe

inserted between the bone graft and dura. A microneural anastomosis of the infraorbital nerve was performed and the facial skeleton was replaced and rigidly fixed. As in previous cases the bone plates, were placed prior to mobilisation so allowing accurate reconstruction.

Postoperatively the patient had high-dose radiotherapy. The patient has bilateral anosmia but no evidence of recurrent or residual disease 18 months after surgery (Fig. 7).

The advantage of these approaches has been the ability to dismantle and reassemble the midfacial skeleton which provides access to pathology involving the midface, orbit and skull base without resection of uninvolved structures.

These approaches have been used in 25 cases (Table 2).

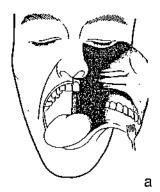
#### Transoral Approaches

. These are principally the Le Fort I osteotomy and its variants.

This procedure involves exposing the maxilla via an intraoral (vestibular) incision and performing an osteotomy at the Le Fort 1 level, i.e., just above the floor of the nasal cavity. The maxilla is then mobilised on a vascularised soft tissue pedicie posteriorly.

Vertical exposure with this technique extends from the middle ethmoidal air cells to the foramen magnum and the anterior arch of the atlas. The maxilla is moved inferiorly through the normal range of mouth opening<sup>4, 47</sup>. Horizontal exposure is reported to be 8 cm anteriorly and 5 cm posteriorly in the region of the pterygoid





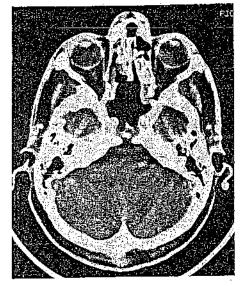


Fig. 7. No evidence of recurrent or residual disease 18 months after surgery

plates<sup>38</sup>. Additional vertical exposure to the level of the 3rd cervical vertebra can be achieved by a midline sagittal section of the hard and soft palate<sup>3, 19, 23, 37</sup>.



Fig. 6. Line diagram (a) and operative photograph (b) demonstrating facial access to the inferior aspect of the turnour

Table 2. Transfacial Approach (Medial Orbital Access). Age range 46-66 years

Pathology	Number of cases		
Adenocarcinoma ethmoid	21	:	
Chondrosarcoma	2		
Malignant histiocytoma	1		
Meningioma	1	•	
Total	25		

The intact pterygoid plates restrict access laterally but can be either out-fractured<sup>23</sup> or resected to improve exposure. In the region of the clivus, craniocervical junction and upper cervical vertebrae, the lateral limits are the hypoglossal nerves, vertebral arteries and jugular foramina. The fossae of Rosenmuller provide an anatomical landmark of this lateral limit<sup>3, 19</sup>. The vertebral and internal carotid arteries may be distorted and displaced emphasising the need for good preoperative imaging<sup>23</sup>. Despite out-fracturing the pterygoid plates this approach provides poor access to tumours arising from the medial aspect of the petrous bone even when the tumour extends anterior to the brain stem. We have found that such cases require a Le Fort 1 osteotomy followed by a subsequent lateral approach.

#### Case 5, Transoral Approach with Le Fort I Osteotomy

A 32 year old female, affected at the age of 7 by juvenile rheumatoid arthritis, presented with an 8 month history of progressive tetraparesis. Plain X-rays and MRI scans are shown in Fig. 8.

A standard transoral approach would not have allowed access to the peg which lay behind the clivus. A further problem was limited opening of the mouth due to temporomandibular joint alteration.



Fig. 9. Post operative X-ray following odontoid peg resection

Because of these combined features the transoral approach with a Le Fort I osteotomy was planned.

An intraoral vestibular incision was employed extending from the right to the left zygomatic buttress. Complete subperiosteal dissection of the maxilla up to the infraorbital nerves superiorly and

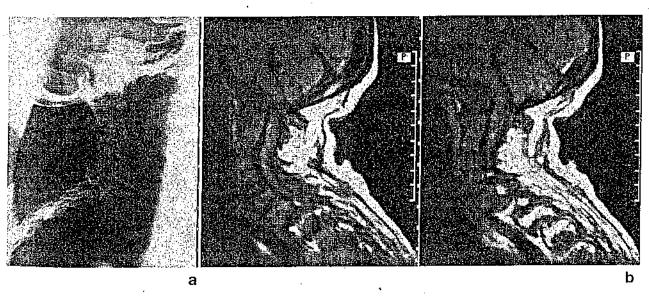


Fig. 8. Plain X-rays (a) and MR images (b) illustrate platybasia with protrusion of the odontoid peg through the foramen magnom with marked compression of the lower brainstem

Table 3. Transoral Approach + Le Fort 1

Pathology	Number of cases		
Chordoma	·2	,	
Clivus chordoma	3	•	
Juvenile rheumatoid arthritis	1		
Congenital	]		
Total	7		

pterygoid plates posteriorly was performed. Osteotomies were made just above the floor of the nose. Bone plates were placed and removed before completing the maxillary osteotomy. The mobilised maxilla was divided in the midline and the soft palate was sectioned lateral to the uvula. Retraction of the divided hard and soft palate and resection of the vomer provided unrestricted exposure of the clivus, craniocervical junction and upper cervical vertebrae.

A midline incision was made in the posterior pharyngeal wall extending from the mid clivus to the body of C 2. The anterior arch of the atlas was identified and removed using a high speed drill. A groove was drilled in the lower third of the clivus. Only at this point could access be gained to drill away the odontoid peg and decompress the neural structures (Fig. 9). The pharyngeal wall was closed in layers. Bone plates secured the maxilla in its original position and the soft palate was closed in layers.

The most significant contribution of the Le Fort I osteotomy has been in surgical exposure of the clivus and upper cervical vertebrae<sup>3, 19, 23, 38</sup>, structural abnormalities of the craniocervical junction<sup>19, 23, 37</sup> and aneurysms of the posterior circulation<sup>4, 23</sup>. The Le Fort I osteotomy, however, has a very limited role in the treatment

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Table 4. Transzygomatic Approach. Age range 18/12-75 years

Pathology	Number of patients	
Vascular	26	
Meningioma	25	
Other tumours	31	
Total	82	

The transzygomatic approach was used to excise 3 arteriovenous malformations and clip 23 aneurysms including 17 basilar aneurysms, 3 anterior communicating artery aneurysms (1 giant), 1 internal carotid artery aneurysm and two giant ophthalmic artery aneurysms. It was used to remove 6 cavernous sinus meningiomas, 1 clivus meningioma, 2 petrous ridge meningiomas, 8 meningiomas of the middle cranial fossa, 6 sphenoid wing, and 2 suprasellar meningiomas. Other tumours removed by this route include craniopharyngiomas (10), glioma (1), schwannoma (3), optic pathway glioma (4), pituitary tumour (5), and 8 other orbital lesions.

of malignant disease of the midface and skull base which are more adequately accessed by the transfacial approaches.

This approach has now been used in 7 patients (Table 3).

Anterior Approaches via the Mandible

The anterior approaches via the mandible are based on the "mandibular swing" procedure<sup>40</sup> which involves dividing the lower lip in the midline and sectioning the mandible anteriorly. The hemimandible is swung laterally. This simple and versatile technique has a long established role in head and neck oncology<sup>29, 40</sup> and has been used to improve access to the floor of the mouth, tongue, ton-

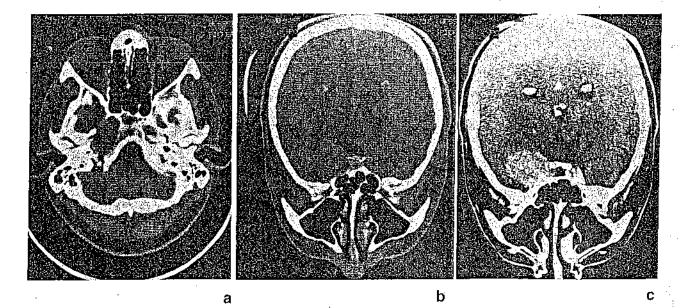


Fig. 10. (a-c) CT scan demonstrating a right bilobed soft tissue mass passing through a basal defect involving the carotid canal and the adjacent bone across to the jugular foramen. The intracranial component of the tumour involves the medial right temporal lobe in close relationship to the cavernous sinus

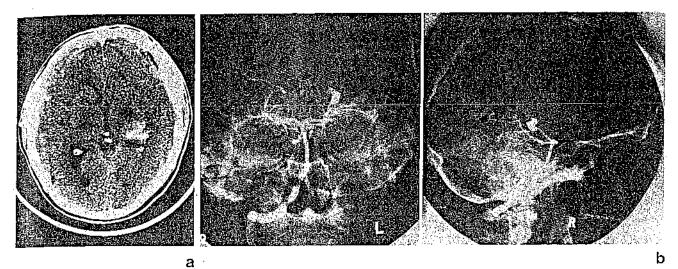


Fig. 11. The CT scan (a) demonstrates blood in the left temporal lobe extending into the basal ganglia. Cerebral angiography showed a large left posterior cerebral artery aneurysm (b)

sillar fossa, soft palate, pharynx, pterygomandibular region (medial aspect of the mandibular ramus), and for the removal of deep lobe parotid tumours<sup>7,9,10,18,29,39,40</sup>.

#### Case 6, Transzygomatic and Mandibular Osteotomies

A 44 year old male presented with a one month history of headache, nausea and vomiting, right facial numbness and double vision. He had an incomplete right third nerve palsy, trigeminal sensory disturbance, a right 6th nerve palsy and wasting of the right side of the tongue.

The C.T. scan is shown in Fig. 10.

In order to expose the lesion with direct access to the infratemporal fossa and exposure of the extracranial course of the internal

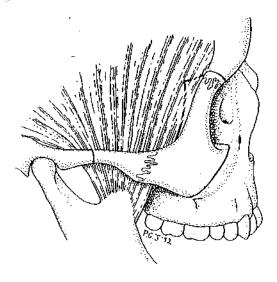


Fig. 12. Line diagram depiciting zygomatic osteotomics

carotid artery to the base of the skull a combination of a transzygomatic and mandibular osteotomy was planned.

The transzygomatic approach allowed a lower and more direct approach to the floor of the middle fossa and medial aspect of the temporal lobe<sup>31</sup>. The zygoma was mobilised. Following a temporal craniotomy the floor of the middle cranial fossa was removed to skeletonise the foramena ovale and spinosum. The intracranial portion of the tumour which was extradural and situated medial to the second and third divisions of the trigerninal nerve was removed.

Through a lip-splitting submandibular approach the mandibular osteotomies were performed dividing the mandible anterior to the mental foramen and above the lingula in the ascending ramus. These procedures allowed access to the infratemporal fossa and floor of the middle fossa. The intra- and extracranial portions of the tumour were removed under direct vision. The histological diagnosis was a chondrosarcoma.

The patient remains well 24 months after the operation. He has a mild 6th nerve palsy with improving sensation in the second and third divisions of the trigeminal nerve.

A horizontal osteotomy of the mandibular ramus<sup>6</sup> with further soft tissue dissection laterally provides access to tumours in the lateral skull base (pterygoid space, infratemporal fossa and parapharyngeal space). Alternatively the dissection can be developed towards the midline for exposure of the nasopharynx, clivus and the anterior aspect of the cervical vertebrae from C1-C7<sup>25, 27</sup>.

The mandibular swing procedure is a versatile approach that can be extended as required to provide increased access. It fulfills the criteria of being both flexible and extensile.

These approaches have been used in 2 such cases (Table 4, "other tumours", n = 31).

#### Lateral Approaches

The lateral approaches are based upon the temporary disarticulation of the zygoma, usually pedicled to the masseter muscle. This procedure forms the basis of a number of approaches to areas pre-

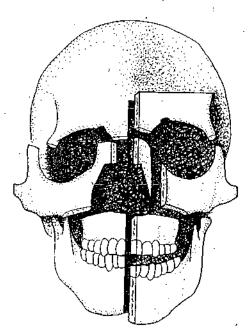


Fig. 13. Photograph of the facial skeleton "exploded" to illustrate the concept of the extensile modular approach

viously considered to be inaccesible, without significant attendant morbidity<sup>1, 17, 31, 32</sup>.

The zygoma is the cornerstone of the facial skeleton. When disarticulated it affords access to the orbital contents laterally <sup>11</sup>. When combined with osteotomies of the mandibular ramus, e.g., the coronoid process, direct access to the infratemporal fossa is achieved <sup>33</sup>. Exposure by this route is, however, limited both medially and in feriorly and is useful mainly for the removal of benign pathology. Though advocated for the removal of malignant lesions we share the view that this approach should not be used as the sole means of access in such cases <sup>33, 34</sup>.

Temporary disarticulation of the zygoma gives access to the infratemporal fossa, the middle cranial fossa, the postero-lateral portion of the orbit, the cavernous sinus, petrous apex and the interpeduncular cistem<sup>33</sup>. The authors have used this approach in 82 patients for a variety of pathologies both extracranial, skull base and intracranial. These include orbital tumours, giant ophthalmic artery aneurysms, cavernous sinus tumours, tumours involving the medial aspect of the petrous bone, and the tentorium as well as posterior circulation aneurysms (Table 4).

#### Case 7, Zygomatic Osteotomy

A 50 year old male neurologically intact was admitted following a subarachnoid haemorrhage. The CT scan and cerebral angiogram are shown in Fig. 11, which demonstrate a large left posterior cerebral artery aneurysm and blood in the left temporal lobe.

In order to obtain a low direct approach to the posterior cerebral artery aneurysm a transzygomatic approach was performed<sup>31</sup>.

The site of the osteotomy bone cuts on the zygoma are indicated in Fig. 12. Following mobilisation of the zygoma and reflection of the temporal muscle inferiorly, a low temporal

craniotomy (to the floor of the middle cranial fossa) was performed. The greater and lesser wings of the sphenoid were removed as far medially as the superior orbital fissure and the anterior clinoid process. Via a transylvian approach the aneurysm was clipped. Using this access the angle of approach is flexible, i.e., temporal or pterional and the aneurysm may be observed in one direction – pterional while the clip is applied in another – temporal.

Two years post surgery the patient remains well with slight loss of fine movement in the right hand.

With this approach the surgeon is immediately at the level of the skull base and extensive removal of bone from the middle cranial fossa floor and greater and lesser wings of the sphenoid does not produce a cosmetic defect. The approach fulfills the important surgical criteria of obtaining a straight line between the surgeon and pathology with minimal brain retraction.

The detachment of the temporalis muscle from its insertion is regarded as having two disadvantages. Firstly the muscle bulk can be an obstacle to the surgical exposure of the infratemporal fossa and secondly the subsequent hollowing of the temporal fossa<sup>15</sup>.

#### Discussion

Surgical access to intracranial, skull base and or bital pathology may be achieved either by resecting interventing bony anatomy<sup>12, 27</sup> or preferably by temporary mobilisation and replacement.

The concept of performing access osteotomies of the facial skeleton is not new<sup>9-11, 16, 30</sup>. The stimulus to the recent development of techniques of temporary disarticulation of the craniofacial skeleton to improve surgical access was the pioneering work of Tessier in the field of craniofacial surgery<sup>21, 41</sup>.

The surgical approaches involving varying degrees of craniofacial disassembly have been developed with the aim of providing increased and more direct exposure of the pathology in this complex region. Our concept in using these approaches is to obtain a straight line between the surgeon and the pathology. It is equally important that vital structures such as the carotid artery, cranial nerves and eye are protected following displacement of the surrounding skeleton<sup>27, 35</sup>. Morbidity is reduced by minimising brain retraction. Retraction of the globe is preferred to retraction of the brain.

The localisation of pathology has been greatly facilitated by current imaging techniques<sup>35</sup>. A combination of high resolution C.T. scanning, magnetic resonance imaging and angiography may be required to plan the approach. In spite of sophisticated imaging the pathology found at operation may be more extensive requiring modification of the planned access during the operation. The exposure needs to be extensive. The division of the craniofacial skeleton into

separate modules has proved to be of benefit in planning (Fig. 13). A modular approach is adopted in which additional bony modules are mobilised as necessary.

The nasal and orbital skeletons and the zygoma can be exposed using a bicoronal scalp incision and extensive subperiosteal dissection33. Appropriate periosteal releasing incisions permit easier retraction of the scalp/facial soft tissue flap<sup>36</sup>. The entire mid facial skeleton can be exposed, avoiding facial incisions, if an intraoral maxillary labial vestibular incision is combined with a bicoronal flap. When facial incisions are required, as in cases 3, 4, and 6, the site of the incision is chosen so that natural skin creases are utilised and the resultant scars are inconspicuous. Wherever possible bone segments should be pedicled to their attached soft tissues to preserve their blood supply. Rapid bone union is then more likely minimising the risk of infection and loss of bone segments11. <sup>34</sup>. The excellent blood supply of the craniofacial skeleton, however, does permit the complete detachment of bone segments and their replacement as free bone grafts<sup>20</sup>.

Prophylactic antibiotics are routinely used. A high speed drill (Anspach, The Anspach Effort Inc., USA) is essential to produce controlled, fine, accurate osteotomies and greatly increases the speed of the procedure.

Deliberate sectioning of sensory nerves may be required as in case 4. The infraorbital nerve is the sensory nerve most commonly involved but it is usually not necessary to divide the supraorbital or inferior alveolar nerves to improve access although recovery of sensation may be expected with primary microneural anastomosis at the completion of the procedure<sup>8</sup>. Deliberate sectioning of the frontal branch of the facial nerve has also been described by Janecka et al.24 as part of their technique for extensive exposure of the infratemporal fossa. Primary microneural anastomosis resulted in recovery of function in their cases. Recovery of sensation or function cannot be guaranteed in all cases following nerve section and must be weighed against the potential benefits of the increased exposure<sup>24</sup>.

The use of rigid fixation in the form of bone plates specifically designed for the craniofacial skeleton (Luhr, Howmedica, U.K.) ensures accurate replacement of all mobilised bone segments so preserving form and function in this critical area. The bone plates are placed prior to mobilising the bone segment and

are then removed. Rapid and accurate replacement of the bone segments is then possible at the completion of the procedure. A further advantage of rigid fixation is that it allows the surgeon to extend the exposure if necessary by further bone mobilisation whilst ensuring accurate replacement. The use of wire ligatures to stabilise bone segments does not of course preclude extension of the exposure but pre-localisation of bone segments before removal is not possible and accurate three dimensional orientation and fixation can be both difficult and time consuming. The stability achieved with the use of wire is less than that achieved with the use of bone plates. Multiple wire ligatures may be required particularly when the bone is subject to dynamic muscle forces<sup>22</sup>.

In our experience, utilising these techniques for a variety of lesions in 150 patients, the surgical morbidity has been low and acceptable. This has also been the experience of other workers<sup>1-8, 11-14, 18-21, 23-29, 31, 32, 34,</sup> 36-48, 40, 42, 43. In 2 of our cases, in which the hard and the soft palate were divided, velopharyngeal incompetence with resultant nasal escape of speech occurred which necessitated a further surgical procedure for correction. Only 2 cases in our series have developed an infection resulting in the loss of their bone flaps. There have been no cases of loss or infection of mobilised facial/supraorbital bone segments. We have recently reviewed the morbidity of the zygomatico-temporal approach in some detail<sup>16</sup>. Minimal enophthalmos occurred in a small number of cases but this did not cause a clinical problem. Temporal hollowing after mobilisation and replacement of the temporalis muscle was not a cause of concern for the patients. Ptosis of the upper eyelid on the side of the osteotomy was a common postoperative finding but it usually resolved within 8 months of surgery. The patients experienced no long term ocular dysfunction.

There have been problems due to the pathology rather than the approach, e.g., cerebral ischaemia following the clipping of an aneurysm, but the morbidity directly associated with the access has been minimal.

We do not suggest that techniques employing craniofacial access osteotomies are required in every case. However, they do provide a useful adjunct to conventional approaches and occasionally permit effective treatment of previously inoperable conditions<sup>23</sup>. We have found the frequency with which these methods are employed has increased in parallel with our experience.

#### Conclusions

A flexible approach to skull base surgery has many advantages. One need not be confined to anatomical facial bones or bony structures or even previously described techniques. By considering the skull base and the facial bones as an osteoplastic unit osteotomies may be designed to gain access to this difficult area with minimal disturbance of neural structures. This and subsequent accurate 3-dimensional reconstruction, using appropriately designed bone plates, minimise post operative complications and preserve ocular function with good cosmesis. It is our experience that by breaking away from rigid concepts and combining the skills of maxillofacial surgeons and neurosurgeons better access to skull base and orbital lesions can be achieved without a significant increase in attendant morbidity.

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### A Modified Transfacial Approach to the Clivus

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ANTERIOR APPROACHES TO the clivus must provide excellent visualization of the lesion, give adequate access for dural repair, and be cosmetically acceptable. Most current approaches enter through the nasopharynx or oropharynx, with either palatal, maxillary, or mandibular splitting for greater exposure. We have modified the transfacial approach described by others, which provides excellent access to the clivus along its rostrocaudal extent. A lateral rhinotomy incision is used and carried along the base of the right alae nasi and columella. The nasal bones are osteotomized bilaterally, and the nose is rotated on a pedicle flap, thus opening the entire nasal cavity to view. The septum and medial maxillary walls are removed. This provides excellent visualization of the ethmoid, sphenoid, posterior nasopharynx, and upper oropharynx. At the conclusion of the procedure, the nasal incision is closed, with good cosmesis. A case of recurrent chordoma of the middle and lower clivus is presented to exemplify this technique. The approach has since been used to approach clivus tumors and midline aneurysms of the vertebrobasilar system. (Neurosurgery 36:101–105, 1995)

Key words: Clivus, Cranial base surgery, Transclival approach

ultiple anterior approaches to the clivus have been described, using a combination of oropharyngeal and nasopharyngeal routes. We have approached lesions of the lower clivus and odontoid through the oropharynx (4, 8, 14, 15, 21-24), combined, if needed, with palatal (1, 12, 13, 17) or mandibular (5, 10, 18) splitting. Lesions of the upper and middle clivus can be biopsied transsphenoidally (6, 19, 20) or transethmoidally; some lesions can be resected through a modified transsphenoidal or midface degloving approach (6, 20, 25). Extensive maxillotomies have been described to allow more generous exposure (3, 16, 29). We have found, however, that a transfacial approach modified from that described in the ear, nose, and throat literature (2, 7, 9, 28) avoids injury to the hard and soft palate, is cosmetically acceptable, and provides excellent visualization of the clivus in its rostrocaudal and lateral extent. We are presenting a case of a clivus chordoma in which this approach was used; it has also successfully been used to clip otherwise inaccessible aneurysms of the vertebrobasilar system, as well as other tumors involving the clivus.

#### CASE HISTORY

The patient was admitted with a 3-year history of headaches and neck discomfort; she was neurologically normal. A magnetic resonance image demonstrated a large tumor involving the middle and lower clivus. There was displacement of the left vertebral artery and compression of the anterior pons, with

extension to the foramen magnum and odontoid. The tumor was debulked via a transoral approach at another hospital; pathology demonstrated a chondroid chordoma. She was referred for proton beam therapy. It was thought that additional tumor should be removed before radiation therapy. Because of the involvement of the lower clivus and occipital condyles, a posterior occipital-cervical fusion was first performed, which led to a significant improvement in her pain. Two months later, she underwent a modified transfacial approach to her residual tumor, with a gross total resection of her remaining disease. The tumor had eroded through the retroclival dura, which was resected and repaired with fat, fascia lata, and a split-thickness skin graft. Postoperatively, she remained neurologically normal, without evidence of cerebrospinal fluid leak, and had an uneventful postoperative course. She has since received a course of proton beam radiation therapy to the tumor bed.

#### **SURGICAL TECHNIQUE**

The surgical team included an otolaryngologist, a reconstructive otolaryngologist, and a neurosurgeon. The patient was orally intubated; a tracheostomy is not routinely performed. A lumbar drain was placed and remained postoperatively for 3 to 5 days. The hypopharynx was packed, and the nasal cavity was bathed with oxymetazolone (Afrin, Schering Co., Kenilworth, NJ). Bilateral tarsorrhaphies were performed. The left facial artery was identified with a Doppler flow probe

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and was carefully preserved to ensure the vascular supply to the nasal pedicle. A lateral rhinotomy incision was performed from the glabella, along the nasofacial line, around the right ala nasi, across the columella to the base of the left ala. In contrast to the original ear, nose, and throat descriptions (2, 11, 27, 28), the incision was not carried onto the philtrum, the lip was not split, and we did not divide the hard or soft palate. The nasal bones were osteotomized on the right, and the cartilaginous septum was dislocated from the vomer. The left nasal bone was osteotomized by making a stab incision anterior to the inferior turbinate and elevating a pocket in the subperiosteal plane to preserve the facial artery supply. The nasal bone was divided at its junction with the frontal bone, and the cartilaginous septum was divided from the ethmoid. The nasal pedicle was rotated to the left. The flap was returned to its normal position for 5 minutes every hour to prevent prolonged ischemia. The medial wall of the maxillary sinus, including the inferior turbinates, was removed. The bony septum was removed. The left middle turbinate was also removed, and the ethmoid air cells were opened widely. The anterior face of the sphenoid was drilled away. A midline incision was made in the retropharyngeal mucosa and dissected from the underlying tumor. The clivus superior to the tumor was drilled until uninvolved dura was reached, and the tumor dissection was then performed circumferentially. In this case, the tumor had eroded through the dura, which was resected to the arachnoid layer. The basilar artery and vertebrobasilar junction were easily visualized in the midline, and this approach has been useful for aneurysms of the junction. After satisfactory tumor removal, the dura was inspected. There is sometimes sufficient exposure to allow direct repair with a fascia lata graft. In this case, a small opening in the arachnoid was patched with Gelfoam (Upjohn, Kalamazoo, MI) and fascia and buttressed in place with a split-thickness graft, followed by carefully placed nasal packing. Although not used in this case, fibrin glue can be useful. The packing remained in place for 12 to 14 days. Lacrimal duct tubing was placed whenever a medial maxillectomy was done, and the lateral rhinotomy incision was then closed.

#### DISCUSSION

Multiple approaches have been described to reach the centrally placed clivus and midline cranial base lesions; these have been reviewed in standard texts. Small tumors of the upper third of the clivus can be resected transethmoidally or transsphenoidally (6, 19, 20); these approaches provide only a limited lateral view. A wider reach can be obtained with the midface degloving approach (3, 16, 25), although with limited caudal exposure. This can be improved by splitting the soft and hard palate, combined with extensive maxillotomies (7, 9, 29), allowing visualization of the caudal clivus. Lower clival and upper cervical lesions can be approached transorally (4, 8, 14, 15, 21-24), sometimes combined with mandibular splitting (5, 10, 18). A transfrontal-transcranial approach has been described (11, 26, 27), reaching the clivus through a bifrontal craniotomy after resection of the supraorbital bar. The transfacial approach described here offers direct access to the clivus along its rostrocaudal extent, without an extended maxillotomy (unless exposure of the upper cervical spine is also required) (Fig. 1). Although the soft palate can be retracted, osteotomy of the hard palate is not required, and difficulties in the approximation of the facial skeleton are avoided. The price for avoiding extensive facial osteotomies is the lateral rhino-

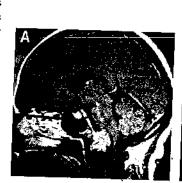




FIGURE 1. A and B, preoperative axial and sagittal magnetic resonance images show the recurrent clivus chordoma, with the degree of access obtainable by this approach.

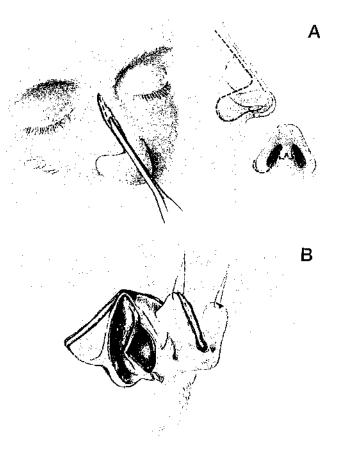


FIGURE 2. A, the lateral rhinotomy incision curves around the right ala, across the columella, to the base of the left ala. B, the nasal pedicle is raised, and the septum is resected.

tomy incision (Fig. 2). and the creation of the nasal pedicle, as opposed to the sublabial gingival incision used with extended maxillotomies; this is cosmetically acceptable and not disfiguring (Fig. 3). Because the turbinates and medial walls of the maxilla are removed, there is minimal bony impedance to lateral exposure, which is then limited by the carotids and medial cavernous sinus rostrally and the jugular foramen and lower cranial nerves caudally; these are anatomical limitations and are imposed in other anterior approaches as well.

The extensive rostrocaudal exposure obtained by this technique is not necessary for the majority of clival tumors. Those of the upper half can reasonably be accessed through transsphenoidal/transethmoidal approaches alone, avoiding the nasal pedicle flap. Those confined to the lower third can be reached transorally (without a facial incision). Tumors with extensive invasion lateral to the carotid or extending into the medial petrous bone will be incompletely resected through this (or any solely anterior) approach. By the transfacial technique, surgically useful exposure can easily be obtained to the anterior arch of C1, as was demonstrated by this case, and, with depression of the palate, the odontoid can be visualized as well. For lesions confined to C1-C2 (without rostral extension), a transoral approach may be preferable. The modified transfacial approach, however, can be used to advantage for predominantly midline lesions that extend along the length of the rostrocaudal extent of the clivus.

As others have noted, a major disadvantage to intra-arachnoid dissection from anterior approaches is the risk of cerebrospinal fluid leak. In this case, the arachnoid was opened during tumor removal but was sealed with Gelfoam, fat, and fascia lata (Fig. 4). Fibrin glue was not used in this case but has been of benefit. The exposure is such that a direct dural repair can sometimes be accomplished, but this remains a significant risk. In cases where this approach has been used for the clipping of midline aneurysms of the vertebrobasilar system, postoperative cerebrospinal fluid leaks have been difficult to manage, requiring closure of the defect with a mucosal-periosteal flap (C. Ogilvy, personal communication).

With the variety of anterior approaches described, the surgeon now has the option of tailoring the operative exposure to the location and extent of the clival lesion. The modified transfacial approach merits inclusion in this armamentarium.





FIGURE 3. A and B, postoperative photographs show a cosmetically acceptable scar along the right nasofacial line.

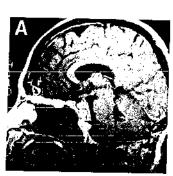




FIGURE 4. A and B, postoperative magnetic resonance images show the degree of tumor resection achieved, with residual fat packing the clival opening. The patient can now receive proton beam radiosurgery with significantly decreased risk of brain stem radiation injury.

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#### **COMMENTS**

The authors describe a new, modified transfacial approach to the clivus that is cosmetically acceptable for the patient. In my own experience, as far as possible, I prefer to avoid any facial scar and any osteotomy of the facial skeleton. According to the level of the clival lesion, a subfrontal transbasal approach or transphenoidal or transoral approach is chosen. The transbasal is preferred in huge clival tumors invading the sphenoid body or sphenoid sinus and extending anteriorly to the optic nerves (it may be combined in the same step with the transphenoidal). The transphenoidal approach allows the surgeon to reach the upper half of the clivus below the sella. The transoral allows one to reach the lower half of the clivus down to C1 and C2. These anterior extradural approaches are, for me, devoted to the removal of clival lesions localized on the midline and without important lateral extent. Does this new transfacial approach bring us more than the others?

As it is stressed by the authors, this way does not give more room laterally—except anteriorly with the removal of the turbinates, but not posteriorly where we are likewise concerned with the carotid arteries, the medial cavernous sinus, and the lower cranial nerves. The main advantage is to add, by this

single transfacial route, the possibilities of the transphenoidal and the transoral approaches, avoiding any injury for the hard and the soft palate; I remember the case of a chordoma removed transphenoidally in which the recurrence occurred downward. This approach certainly provides a better exposure on a limited clival area, including the lower limit of the transphenoidal approach and the upper limit of the transphenoidal approach and the upper limit of the transphenoidal approach and the upper limit of the transphenoidal approach and the closure of the pharyngeal plane. The anterior arch of C1 has been easily reached in this way, but, in spite of the *Figure 1* demonstration, C1 is probably the most remote test limit available by this approach; because of the tumor extension toward the odontoid, I would have operated on this patient using a transoral route.

As with all transfacial or other anterior extradural approaches, the major risk remains a cerebrospinal fluid leak and a secondary infection in tumors destroying the dura or extending intra-arachnoidally; this risk increases with the size of the dural defect. Few author's have been successful in the removal of intra-arachnoidal tumors or aneurysm surgery. I disagree with the use of such ways for the surgery of aneurysms, even in skillfull hands, when we now have the alternative of endovascular treatment.

In my opinion, this modified transfacial approach should be preferred in extradural tumors confined on the midline and extending from the level of the sellar floor to the foramen magnum. C1 and C2 are more easily reached through the transoral route.

Another point concerns, more specifically, the chordomas. The patient was postoperatively sent for proton beam irradiation. I am tempted, in such cases with an apparant total removal, not to propose proton beam therapy systematically and to ask, instead, for a strict follow-up, particularly in relatively old patients. Proton beam therapy will be given in cases of subtotal or incomplete removal or when a small recurrence is suspected. With this study, the authors improve our possibilities in the always difficult management of such clival lesions.

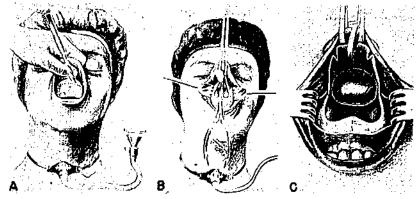
Patrick J. Derome Suresnes, France

I agree with the authors that this modified transfacial approach to the clivus provides an excellent visualization of the ethmoid, sphenoid, posterior nasopharynx, and upper oropharynx. I also agree that one can achieve a good cosmetic postoperative appearance of the patient, but the general question is whether every case of clivus chordomas or other pathologies of the clivus need osteotomy of the nasal bones bilaterally with following rotation. We have applied all types of transfacial approaches to the clivus with minimal and maximal transsection and resection of the facial skeleton to increase our view to the entire clivus for the optimal resection of pathology with intradural and extradural extensions. With increasing experience, we have reduced our approach to a simple lateral rhinotomy incision, following the classic transethmoidal approach to the sphenoid sinus, with a modification of complete exposure of the lacrimal duct and the partial removal of the medial orbital wall. The septum nasi is transsected, and

the septum can be displayed temporally to the contralateral side to give, from one side, a good overview to the cranial and middle third of the clivus, as well as to the contralateral petrous bone. There is no need to extend this exposure for the complete removal of the tumor. In cases of bilateral extension, for a better view to the homolateral side, a maxillotomy also can extend the primary view to this side. I would like to support the opinion of the authors that an injury to the hard and soft palate can be avoided by the simple technique of the described modified transfacial approach to the clivus. I also think that the bilateral

osteotomy of the nasal bones is unnecessary in every case. Surgery of the clivus will remain a region of controversy, with numerous options of approaches and their modification, with more or less satisfying results. We should continue to work on this field and remain open to any useful new approaches. It should be our future task to achieve maximal view to the pathology by as minimal an approach as possible.

Madjid Samii Hannover, Germany



Infranasal operation used by A.E. Halstead in 1909.

Halstead AE: Remarks on the operative treatment of tumors of the hypophysis: With the report of two cases operated on by an oronasal method. Tr Am S A 28:73-93, 1910.

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## A Multidisciplinary Approach to Tumours Involving the Orbit: Orbital Re-Construction, a 3-Dimensional Concept

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#### Summary

Radical tumour removal in the region of the anterior skull base with involvement of the orbit requires not only good exposure but also acceptable reconstruction with good cosmesis, no visible scars and no injury to the eye.

The possible approaches, which should be flexible and adapted to the location and extent of the pathology and the appropriate methods of reconstruction, are illustrated by four patients. The relevant literature is reviewed. Emphasis on the need for a 3-dimensional concept in the reconstruction and the importance of a multi disciplinary team is stressed.

Keywords: Cranio-orbital tumours; extensive resection; immediate 3-D reconstruction.

#### Introduction

The recent expansion of skull base surgery has produced many surgical challenges. Extensive tumour removal in the region of the anterior skull base requires not only good exposure but also acceptable reconstruction. The aim in dealing with benign/low grade malignant tumours in this area should be a complete and radical resection, good cosmesis, no visible scars and no injury to the eye<sup>13, 14</sup>. Extensive tumour removal from around the orbit requires a multidisciplinary team, a flexible surgical approach and a need for a 3-dimensional concept with reconstruction. We have used four cases to illustrate some of these requirements and to highlight some important technical aspects.

#### Patients

We present four patients whose ages ranged from eight weeks to forty-nine years. Three patients were female. Two patients presented with diplopia and one with supra-orbital pain. All patients had proptosis and in addition one had infero-lateral displacement of the globe. Two patients had an obvious temporal mass and the other two had prominence of the maxilla. One patient had a swollen

upper eyelid. Other ocular features included lid-lag in one patient, a defect of upward gaze in two and an afferent pupillary defect in one. The baby had a clear discharge from the affected eye. These features are summarized in Table 1.

#### Access

Operative features common to all of the cases included a bi-coronal skin flap and a bi-frontal craniotomy. Peri-operative spinal drainage was employed in the adults. A zygomatic osteotomy was performed in two cases, each of whom had an extensive meningioma en-plaque involving the orbit, thus necessitating additional lateral access (Fig. 1). While a superior orbitotomy was necessary in each case in two patients in order to improve access bilateral orbitotomies were performed. In one patient who had an extensive subcranial tumour a lateral rhinotomy was required (Fig. 2). In each case the planned resection depended on the extent of the tumour which was determined pre-operatively after detailed CT scans MR imaging.

Each case required an extensive resection and Table 2 sumarizes the information on access and resection.

Table 1. Clinical Features of the Four Patients

Patient	Age	Sex	Symptoms			
			Diplopia	External ocular movements	Pain	
1. MM	36	F	yes	defect upward gaze	no	
2. \$\$	49	F	по	поппла1	yes	
3. ND	8/52	M	not known	normal	DO	
4. AC	22	F	yes	defect upward gaze	по	

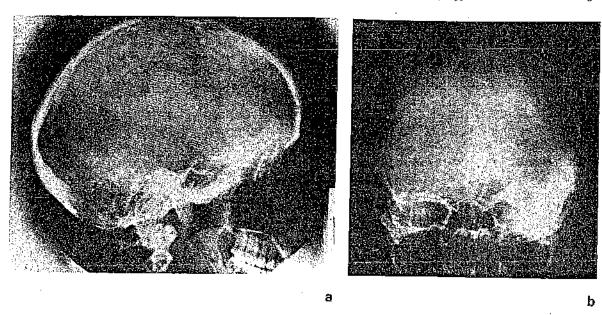


Fig. 1. (a, b) Typical appearances of meningioma-en-plaque with sclerosis and thickening of the right orbital roof on P-A and lateral skull X-rays

Table 2. Operative Features; Access and Resection

Patient	Access spinal drain	Access skin flap	Access craniotomy	Access osteotomies	Resection
1. MM	yes yes	bicoronal bicoronal	bifrontal bifrontal	transzygomatic superior orbitotomy transzygomatic bilateral orbitotomies	posterior orbital wall lateral orbital wall orbital roof dura cranial vault temporalis muscle galea cranial vault superior orbital margin medial orbital wall orbital floor
. ND	no	bicoronal	bifrontal	superior orbitotomy	dura orbital roof medial orbital wall
. AC	yes	bicoronal	bifrontal	bilateral orbitotomies lateral rhinotomy	anterior fossa floor anterior fossa floor right orbital roof right orbital medial wal left orbital floor

#### Reconstruction

We wish to highlight a number of aspects related to the reconstruction. These include the dural closure, a 3-dimensional orbital reconstruction, the calvarial and anterior fossa repair, the use of calvarial bone grafts and rigid fixation. In the first case the dural defect was repaired using fascia lata and the orbit was reconstructed using inner table bone obtained from a contra-lateral osteoplastic bone flap. This was rigidly fixed using mini-plates and screws\* (Fig. 3 a, b).

<sup>\*</sup> Luhr, Howmedica International.



Fig. 2. CT scan showing extensive anterior skull base tumour (osteofibroma) extending sub cranially to the hard palate. The tumour involves the medial wall of both orbits and has produced proptosis

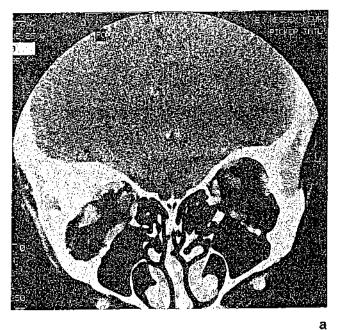
Table 3. Techniques Used in the Reconstruction

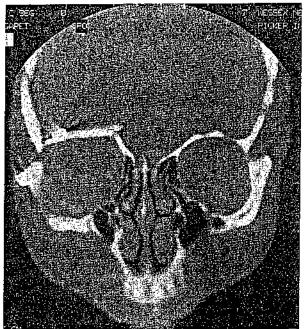
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Patient	Calvarial/orbital reconstruction	Dural repair	Fixation
J. MM	inner table contralateral osteoplastic flap .	fascia lata galeal flap	rigid mini plates and screws
2. SS	inner table contralateral osteoplastic flap	pericranium	rigid mini plates and screws
3. ND	full thickness bone parietal	pericranium	tissue glue
4. AC	inner table	galeal flap pericranium	rigid mini plates and screws

The second patient required both pericranium and Xenoderm to repair a large dural defect. Inner table bone from a contra-lateral osteoplastic flap and split rib grafts were required to reconstruct the cranium. In this case because the resection involved the superior orbital margin and orbital roof, using a template, inner table bone was suitably contoured for the reconstruction and rigidly fixed using mini-plates and screws. Because of the extensive calvarial resection it was nec-

essary to supplement the inner table grafts with split rib grafts (Fig. 4a-f).

Reconstruction of the orbit and the anterior cranial fossa floor in the third patient required full thickness bone. As the reconstruction was in a baby tissue glue was used for fixation, rather than the rather bulky miniplates and screws; the more recently introduced microplates and screws would also be appropriate (Fig. 5 a-c).





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Fig. 3. (a) Pre-operative appearances showing extensive meningioma-en-plaque involving the sphenoid wing and orbit. (b) Postoperative coronal CT scan. The roof, medial and lateral orbital walls have been reconstructed using inner table calvarial bone rigidly fixed with miniplates and screws

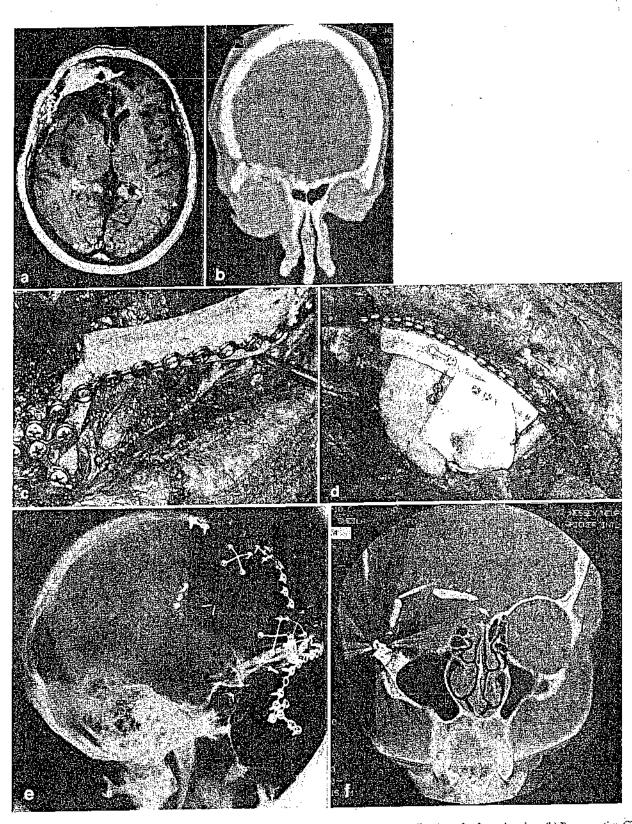


Fig. 4. (a) Pre-operative MRI scan showing a portion of the meningioma-en-plaque extending into the frontal region. (b) Pre-operative CT scan showing the extent of bony involvement of the right orbital roof and temporal bone. (c) The supraorbital margin has been resected. Using a template of miniplates a new supraorbital margin has been constructed with caivarial bone. This has been rigidly fixed to the frontal process of the zygoma after relocation of the zygomatic osteotomy. (d) Operative photograph showing the reconstructed orbital "box" after location and fixation of the new supraorbital margin. (e) Postoperative skull X-rays showing the orbital and carvarial reconstruction. (f) Postoperative coronal CT scan depicting the complex orbital reconstruction

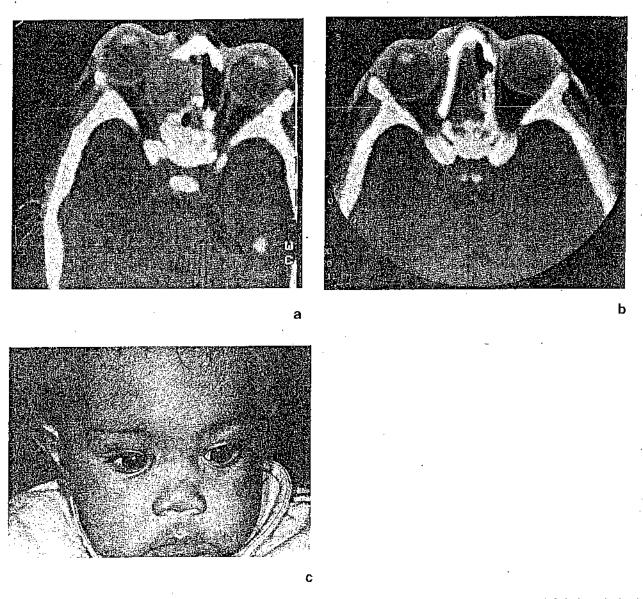


Fig. 5. (a) Pre-operative CT scan showing extensive intra-orbital tumour extending into the anterior cranial fossa and inferiorly to the hard palate. (b) Postoperative CT scan. The medial orbital wall has been reconstructed. (c) Clinical appearances postoperatively. The globe position is satisfactory and on testing extra ocular movements were normal

The dural defect in the fourth patient was repaired using pericranium. Inner table bone graft was obtained from the bifrontal flaps and used to repair the bilateral orbital defect. The left orbit was reconstructed using rigid fixation and lag screws while with the right orbital roof and upper part of the medial orbital wall tissue glue was used. The left canthal ligament was wired into a nasal bone graft.

In the adults the posterior wall of the frontal sinus was removed together with mucosa and irregular bone contours were smoothed away with the high speed drill.

The fronto-nasal duct was sealed with a plug of temporalis muscle and covered with bone dust. In cases 1 and 4 this and the reconstructed anterior cranial fossa floor were covered with a vascularised galeal flap. In case 2 a galeal flap was not available because of infiltration of the skin flap with tumour and therefore pericranium was used.

Postoperatively these patients should be nursed in an intensive treatment area where the nursing staff are familiar with care of the airway, observation of the neurosurgical patient and the management of spinal

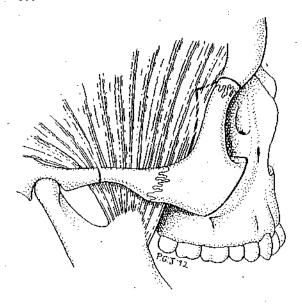


Fig. 6. Line diagram depicting the location of the zygomatic osteo-tomies

drainage. Broad spectrum prophylactic antibiotics, usually begun with induction of anaesthesia, are continued for thirty-six to forty-eight hours. Standard care of the eye is required. We have noted in two patients (cases 2 and 4) a temporary enophthalmos with associated low intra-ocular pressure. Normal intra-ocular pressures returned within forty-eight hours of the operation and there was no subsequent complications with the globe in these patients.

#### Outcome

Follow-up ranged from one to two years. Each patient had a ptosis postoperatively. This had resolved by eight months in three patients while in one patient (case 2) some ptosis remains at one year postoperatively. In one patient (case 1) there was postoperative proptosis which resolved within a month. In addition postoperative diplopia occurred in all the adult patients and subsequently resolved.

#### Discussion

Previous authors have made the observation that these complex cases require a multidisciplinary team approach<sup>1, 2, 4, 6, 15, 19</sup>. Pre-operatively, in order to adequately assess the full extent of the lesion detailed radiology is required. This includes plain skull X-rays, CT scanning with assessment of the orbit in axial and coronal planes using bone algorithms and magnetic resonance imaging. The extent of the resection and the

requirements of the reconstruction need to be fully discussed by the Neuro-radiologist, Neurosurgeon, Facio-maxillary Surgeon, and Neuro-anaesthetist prior to surgery.

Whenever possible facial incisions are avoided. The bicoronal scalp flap has proved particularly useful in all our cases and with extensive subperiosteal dissection the nasal skeleton, entire orbital skeleton and zygoma may be exposed<sup>26</sup>. Appropriate periosteal releasing incisions permit easier retraction of the scalp/facial soft tissue flap<sup>29</sup>. Using this approach we have been able to dismantle the entire medial, superior and lateral orbital skeleton without the need for facial incisions.

The excellent blood supply of craniofacial skeleton permits mobilisation of bone fragments either pedicled to their soft tissue attachments i.e. maxilla, zygoma<sup>2, 4, 6, 24, 26, 29, 33, 34</sup> or else as free bone fragments i.e. superior orbital skeleton<sup>15, 19, 20, 25</sup>. The orbital skeleton may therefore be dismantled as necessary to provide increased and more direct exposure to the underlying pathology<sup>19, 25</sup>.

The approach selected is dependent upon the site, nature and extent of the pathology and is entirely flexible. In practical terms the approach may be from a lateral, medial or superior direction and in our patients a combination of these approaches were employed. In cases 1 and 2 there was complete mobilisation of the zygoma using the osteotomies illustrated in Fig. 6. The zygoma is pedicled to the masseter muscle and removal of the greater wing of the sphenoid, if necessary, to the superior orbital fissure completes the exposure<sup>24</sup>. In these two patients there was extensive tumour involvement so a more radical removal of bone was required.

A superior approach to the orbit was carried out in all four patients and was tailored to the requirements of each case. In patient four, because access to the tumour was restricted, mobilisation of the frontal bone in the glabellar area, frontal process of the maxilla, the adjacent anterior lacrimal crest and nasal bone was necessary.

The medial canthal ligament was detached from its insertion on the anterior and posterior lacrimal crest in case four and was reattached at the end of the procedure. However a transnasal canthopexy may be required, a technique commonly employed in naso-orbital trauma<sup>11</sup>.

A water tight dural repair is essential and in these cases perioranium, fascia lata and vascularised galeal flaps were used<sup>5, 16, 20, 22, 31</sup>.

Because our patients were young, three were female

and the tumours were benign, resection had to be extensive and a good reconstruction was even more important.

The orbit has been described as the most significant functional area of the face<sup>17</sup>. The position of the globe in 3 dimensions is determined by the relative volume of the orbital cavity and its soft tissue contents. The aim in reconstruction after tumour resection should be to re-establish the orbital skeleton and this requires orientation of the lateral and medial walls, the roof and floor and the alignment and configuration of the orbital rim<sup>3</sup>. It is essential that the globe is positioned correctly if orbital dystopia and hypertelorism are to be avoided<sup>8, 12, 14, 23</sup>. In all four patients this was achieved.

Immediate bony reconstruction is not desirable following cranio-facial resection of a malignant tumour since early recurrence may be difficult to detect and if a further resection is required subsequently reconstruction can be complicated <sup>13,14</sup>. By contrast after resection of a benign tumour where a satisfactory clearance of the tumour is achieved immediate reconstruction should be performed <sup>35</sup>. Combined resection and reconstruction avoids the soft tissue shrinkage which may make delayed reconstruction more difficult <sup>10,35</sup>.

The use of autogenous bone grafts in cranio-facial reconstruction is well established<sup>9, 12, 18, 20, 28,(30, 32</sup>, Potential donor sites include ileum, ribs and calvarium. Each of these sites have certain advantages and disadvantages. The calvarium has been extensively used as a donor site when cranio-facial reconstruction is required and in this context offers distinct advantages over alternative donor sites20. The inner table of the skull can be harvested from an osteoplastic bone flap without disturbing the periosteal pedicle and there is no donor site defect20. In very extensive defects, as illustrated by the second case, a further source of autogenous bone will be required and in this patient we used split rib. In the baby full thickness bone was obtained from the parietal region. Where an orbital reconstruction is required calvarial bone may not be sufficiently malleable35 although this was of no significance in the cases described because the calvarial graft could be extensively shaped and contoured with a burr. In extensive orbital roof defects (case 4) it is not always possible to rest the bone graft on sound bone and so the graft is cantilevered. For reconstruction of the orbital floor where complex contour defects may occur ileum or rib can be readily shaped using appropriate instrumentation. However in case 4 calvarial bone was

used. There is a further factor to be considered and this is the observation that grafts should be in contact with vascularised tissue on at least one of its surfaces<sup>25</sup>.

While isolated orbital roof or floor defects may be grafted without rigid fixation 18, 27 complex reconstruction of the orbital skeleton requires the use of rigid fixation of bone grafts using mini-plates and screws. This produces stability in 3-dimensions and reduces resorption of the bone grafts 18. The use of rigid fixation in the form of bone plates specifically designed for the craniofacial skeleton (Luhr, Howmedica, International) ensures accurate replacement of all mobilised bone segments. In all our cases bone plates were placed prior to mobilising the bone segment and were then removed. Rapid and accurate replacement of bone segments was then possible at the completion of the procedure. A further advantage of rigid fixation is illustrated in cases 1, 2 and 4 where extension of the exposure was achieved by further bone mobilisation whilst ensuring accurate replacement. While wire ligatures were not used in our cases its use to stabilise bone segments does not, of course, preclude extension of the exposure. However, pre-localisation of bone segments before removal is not possible and accurate 3dimensional orientation and fixation can be both difficult and time consuming. The stability achieved with the use of wire is less than that obtained by the use of bone plates. Multiple wire ligatures may be required particularly when the bone is subjected to significant muscle forces from the masticatory musculature - a minimum of three point fixation is required to stabilise the zygoma<sup>17</sup>.

In conclusion, the original aims of surgery in these patients were achieved with good clearance of the tumour, excellent cosmesis and temporary ocular problems. The principle of the access procedures used, although complex, is conceptually similar to that of minimally invasive surgery. The aim being a short straight line between the surgeon and the pathology with little brain retraction. We wish to emphasise the need for a multidisciplinary team of surgeons and for a flexible approach in dealing with these tumours arising in the skull base and involving the orbit.

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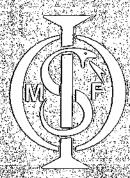
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# Maxillo-malar osteotomy as an approach to the clivus

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Among various approaches to the clivus and upper cervical spine, transmaxillary access gives the neurosurgeon optimal visibility. Maxillomalar osteotomy permitting the reflection of the osteotomized segment pedicled to the cheek after a Weber-Fergusson type cutaneous incision is the method that for the authors gives the best visibility. A wide operating field from upper clivus to C4 can be obtained by performing a maxillo-malar osteotomy associated with a midline splitting of hard and soft palate. The authors have performed this kind of access in five cases for neurosurgical purposes. Healing was always uneventful and no complications were observed. Occlusion was always restored without intermaxillary fixation, facial scars were of good quality and the only drawback was the section of infraorbital nerve.

[J Neurosurg Sci 1993;37:195-201].

Key words: Osteotomy - Maxillo-malar osteotomy - Clivus access.

Access osteotomies are certainly no innovation in cranio-maxillo-facial surgery. In fact, as far as the middle of the last century, Langhenbeck, Cheever and Kocher, to reach deep regions as the rhinopharynx performed Le Fort I type osteotomies in one or two fragments, in association with upper median labiotomy extended to a greater or lesser degree to the paralateronasal level.

Other skeletal structures of the head subjected to osteotomy have been: the zygoma,<sup>5</sup> for access to the orbital content; the nasal pyramid,<sup>6</sup> for access to the hypophysis; the mandible, at the level of

the symphysis <sup>7</sup> and of the angle, <sup>8</sup> for access to the oropharynx.

All these osteotomies had the purpose of allowing safe access from both the surgical and the oncological viewpoint, minimalizing the morphological and functional consequences.

Today, thanks to the experience gained in osteotomies for correction of maxillary deformities and to the availability of new instruments (reciprocating microsaws), new osteotomic designs have been drawn up which allow for the displacing of larger skeletal segments.

Thus we have the maxillo-genial flap, the zygomatic-maxillo-genial flap, the naso-maxillo-genial flap to and the zygomatic-maxillo-genial paramedian flap. 12

The ever-increasing cooperation between maxillo-facial surgeons and neurosurgeons, in both the malformative and oncological fields, <sup>13</sup> has led to the natural conclusion that these extended access osteotomies can be used to reach deep regions such as the clivus, difficult to tackle using traditional accesses.

In recent years we have successfully used the zygomatic-maxillo-genial flap for access to the clivus in collaboration with various neurosurgical clinics (Hospital of Parma, San Raffaele and Policlinico University Hospitals of Milano) and ENT clinics (II ENT Clinic of University Hospital of Parma). Thus, we think it could be of some interest to present the technical

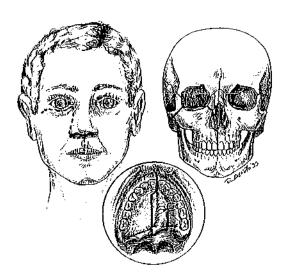


Fig. 1.—Drawing of the cutaneo-mucosal incisions and osteotomies.

aspects of its execution and to discuss its advantages and disadvantages, indications and limits.

#### Operating technique

At first, a cutaneous incision (Fig. 1) is made starting with the division through all its thickness of the upper lip on the midline.

The incision then proceeds at the side of the nose almost to the internal cantus, continuing laterally along the lower eyebrow to the malar body, parallel to the skin folds. Along the whole line of incision, the cut is deepened until the osseous plane is reached, including the periosteum.

Thus, the interincisive median suture is exposed, as the anterior nasal spina, the piriform aperture margin, the maxillary ascending ramus and the inferior and lateral orbital margin; at the level of the malar body, a subperiosteal tunnel is performed, from the inferolateral orbital margin to the inferolateral margin of the zygoma. We then proceed to the subperiosteal undermining of the orbital floor so as to reveal laterally the lower orbital fessure, deeply the infraorbital nerve and

medially the lacrimal sac, which is sectioned at the level of the entrance to nasolacrimal canal.

Then comes the endoral stage, using a cervical incision, on the palatine side, from the controlateral central incisor to the last molar. There follows the subperiosteal undermining of the palatine fibromucosa, which is lifted to the median line and freed from the posterior margin of the hard palate by sectioning the palatine major neurovascular bundle.

Before proceeding to the various bony sections it is advisable to adapt the osteosynthesis plates placing them across where the osteotomic sections will be, at the same time making the screw holes. By so doing, the reconstruction will not only be quicker, but also considerably more precise.

At this point, the osteotomic sections are made, preferably with a reciprocating microsaw (Fig. 2). At the level of the malar body the section goes from its inferior border to the inferolateral orbital margin proceeding deeply, in the orbital floor, to reach the inferior orbital fissure. At the maxillary ascending ramus the section is taken medially to the lacrimal sac to the piriform aperture margin above the inferior turbinate. At the orbital floor, after sectioning in the depth the infraorbital neurovascular bundle, we carry out the osteotomy going from the inferior orbital fissure to the section previously performed medially to the lacrimal sac. On the interincisive midline suture an osteotomy is performed down to the level of the nasopalatine canal.

Then we proceed to the osteotomy of the hard palate beginning a few millimetres to the side of the posterior nasal spina, proceeding frontwards parallel to the median suture, to reach the nasopalatine canal.

Upon completion of the osteotomies we proceed, by means of delicate leverage with chisels inserted into the interincisive and zygomatic osteotomies, to fracture the remaining posterior connections (pterygomaxillary suture and posterior wall of the

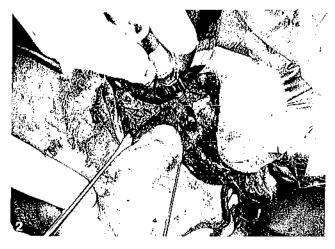




Fig. 2.—Osteotomic section using a reciprocating microsaw. Fig. 3.—Lateral reflection of the maxillo-malar-cheek flap.

maxillary tuberosity) and to laterally luxate the maxillomalar complex.

Full mobilization of the flap is obtained, after tilting it laterally, only if the periosteum of the retromolar region is vertically cut (Fig. 3).

At this stage the mucosa of the lateral wall of the nasal fossa and the turbinate are removed, thus already obtaining a considerable view of the rhinopharynx. To increase this, after having removed the posterior part of the nasal septum, the posterior nasal spina and part of the controlateral osseous palate, we remove the entire pterygoid process, thus obtaining an ample view from the sphenoidal sinus to C2.

If a larger access is required (till to C3-C4), a midline splitting of hard and soft palate is performed (Figs. 4 A-B, 5).

Thus the maxillofacial stage of access to the clivus can be considered at the end and the neurosurgical stage can begin.

At the end of the latter, the osteotomized segment is replaced, after a fine catheter has been inserted into the lacrimal sac at its sectioning and placed into the nasal cavity.

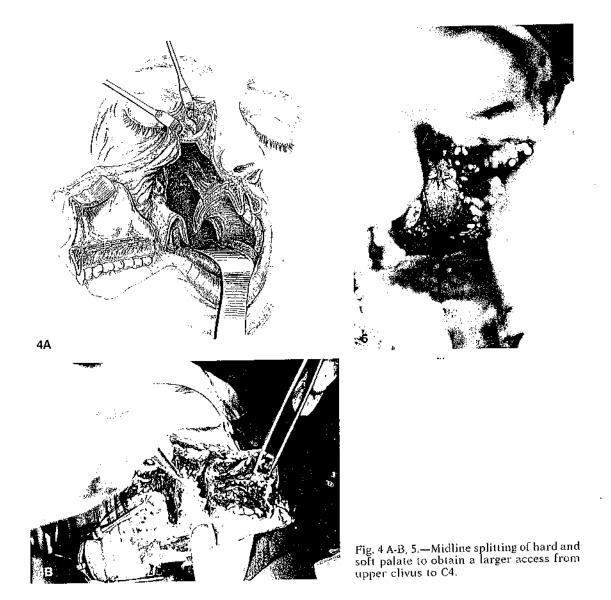
If, prior to the osteotomies the osteosynthesis plates have been prepared, recourse to temporary intermaxillary fixation may not be necessary; otherwise this is indispensable, before the application of osteosynthesis devices, in order to reestablish the correct occlusion. Once the osteosyntheses have been carried out (Fig. 6), suture of the palatal flap to the tooth collars and a careful suture in layers of the cutaneous incision are carried out.

#### Clinical cases

Besides the numerous cases in which this access has been used for rhinopharyngeal neoplasms, the zygomatic-maxillogenial flap was used by us as access to the clivus (Figs. 7-14) in 5 cases (3 cordomas, 1 chondrosarcoma, 1 high dislocation of the odontoid process). One of these cases was a child aged four.

In all cases the access flap was carried out without any problem, permitting an easy execution of the neurosurgical stage without complications. Reassembling was with microplates in 3 cases, with wire in the other 2 cases (one edentulous).

The postoperative course was regular in all cases, with rapid healing and no par-



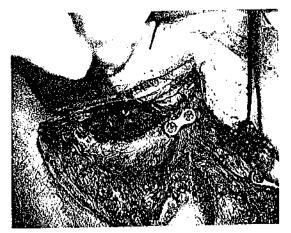
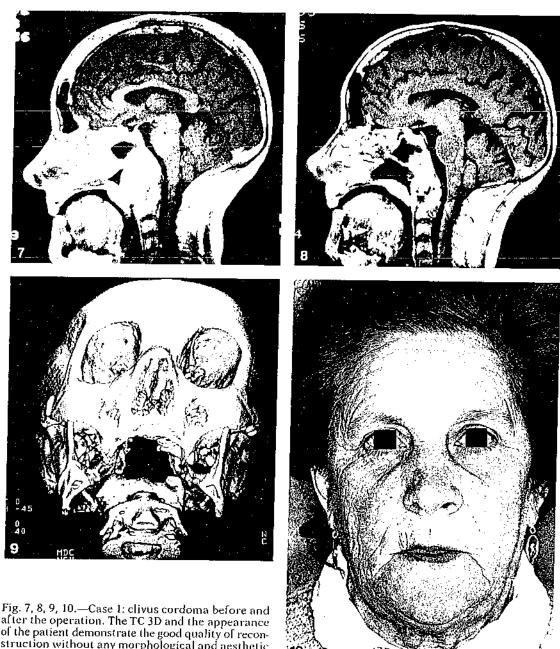


Fig. 6.—Plating of the osteotomyzed segments.

ticular functional or aesthetic consequences: dental occlusion was in all cases perfectly re-established, as was facial morphology, the cutaneous scars being of optimal quality. In the territory innervated by the infraorbital nerve a numbness invariably remained; but this, in time, showed a progressive reduction.

#### Discussion

For access to the clivus and to the C1-C2 sector, in relation to the extension in cranio-caudal and lateral direction of the



after the operation. The TC 3D and the appearance of the patient demonstrate the good quality of reconstruction without any morphological and aesthetic impairement.

pathological process, the neurosurgeon has various routes at his disposal.

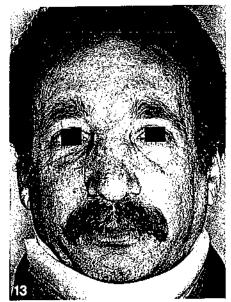
Among these, the anterior transoral and transfacial ones are particularly useful.

Lesions located at the upper and middle clivus are easily reached by means of a Le Fort I maxillary osteotomy. 14-16 If a median osteotomy is added to this, with median section of the soft palate,17 exposure is increased to the whole clivus.

Wide exposure for large tumours of the clivus can be obtained 18 by means of an hemimaxillectomy (operation unnecessarily too mutilating, even after recosntruction with temporalis muscle flap) or, in case of smaller ones, by an hemi-Le Fort I osteotomy with cutaneous incision type Weber-Fergusson.







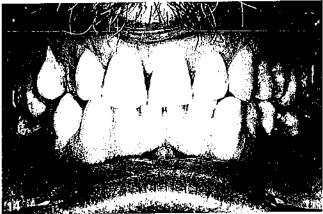


Fig. 11, 12, 13, 14.—Case 2: high dislocation of the odontoid process treated with the same procedure. A minimal scar is appreciable without any modification of preoperative occlusion obtained with plating and without intermaxillary fixation.

The lower portion of the clivus and the C1-C4 sector can be reached through the oral route alone. 19 20

In any case the access to this region is however greatly improved by the transmandibular route <sup>21</sup> <sup>22</sup> which, when combined with median section of the soft palate and removal of the posterior part of the osseous palate or even with a Le Fort I osteotomy with median section, <sup>17</sup> allows for access from C4 to upper clivus.

Mandibulotomy is, however, prone to a certain morbidity rate, with postoperative phase affected by dysphagia, considerable oedema of the oral floor, rather noticeable scar on the lower lip and possible lesion of the hypoglossal nerve. If mandibu-

lotomy is accompanied by median glossotomy 23 tracheotomy becomes indispensable.

The great advantage of labiomandibulotomy is that of allowing the checking of the neurovascular structures of the neck and the cranial base, which makes it particularly suitable for tumours of the clivus with lateral or cervical extension. 13 18

Side by side with this route, great surgical opportunities are offered by the zygomatic-maxillo-genial flap, which in our cases always afforded wide visibility to the neurosurgeon, from the upper clivus to C2 and to C4 with the median section of the hard and soft palate.

The neurosurgical stage was, in all ca-

ses, easily carried out, even without perfect central vision (the latter possibly even being an advantage when opting for an osteotomy controlateral to the side of maximal lateral extension of the tumour).

In no case did we come up against particular problems, either in execution or the post-operative phase (which always without intermaxillary fixation), and consequences in all cases were minimal: scars were always of good quality and the numbness caused by infraorbital nerve section never caused particular problems, a certain sensitivity always being regained some time after surgery.

It must be remembered, furthermore, that in children the presence of the tooth buds prevents the execution of a Le Fort I osteotomy, and thus for transmaxillary access, zygomatic-maxillary osteotomy re-

mains the only option.

On the whole, therefore, we consider the route described to be a good access to the cranial base for lesions of considerable extension, which the neurosurgeon should be made aware of; in close collaboration with the maxillo-facial surgeon he may thus find solutions to the complex problems of access posed by pathologies located at deep sites particularly difficult to reach always taking in mind the contraindications of all transoral and transfacial accesses in case of dural involvement.

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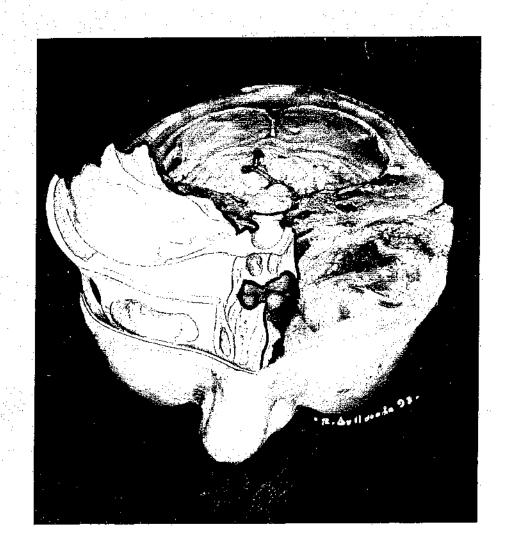
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# Sociedad Española de Otorrinolaringología y Patología Cérvico-Facial

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Cádiz, 19-23 de septiembre de 1993

# Maxilotomía en bisagra o desarticulación temporal pediculada a mejilla del maxilar superior

J. J. ALVAREZ VICENT, L. ROMERO CASTELLANO y C. DOMINGO CARRASCO

#### INTRODUCCION

Existen tres tipos de tratamiento para los tumores benignos y malignos de cabeza y cuello: físico, químico y quirúrgico, intentando la curación definitiva. Quizá prima todavía la cirugía sobre un porcentaje elevado de estos tumores (excepción de linfomas, etc.).

Es, pues, el cirujano el que recibe al enfermo y sienta las bases del tratamiento, así como la elección de la técnica quirúrgica a seguir. La elección debe hacerse en función de los siguientes parámetros;

- Abordaje del lugar tumoral (cómodo, amplio, asequible).
- Posibilidad de exitrpación completa (zonas de asiento y expansión).
- Posibilidad de cierre y reconstrucción (funcional y estético).

Si bien estos parámetros en otras zonas de nuestra especialidad son más fáciles de conseguir, en la base del cráneo y zona rinofaríngea se hacen extremadamente difíciles. Si hacemos un abordaje amplio y que nos dé fácil acceso, la reconstrucción posterior es dificultosa o viceversa.

Ya en 1820, y por tanto quince años antes de la anestesia de Morton, se practica la primera maxilectomía. Lógicamente las hemorragias eran copiosas. La extirpación del maxilar produce un campo amplio a la rinofaringe, pero queda una alteración estética indeseable.

El término maxilectomía es ambiguo, ya que puede ser total o parcial si se extirpan sólo algunas zonas del maxilar. En este último caso se dejan estructuras que faciliten el aspecto estético del enfer-

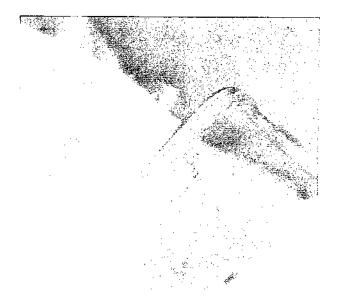




FIG. 1.—Incisión de la fibromucosa palatina.

FIG. 2.—Osteotomía de la apófisis pterigoides.



FIG. 3.—Incisión previamente marcada.



FIG. 5.—Incisión de partes blandas.

mo sometido a estas intervenciones (1). El término de maxilotomía debemos dejarlo para la fractura y dislocación del maxilar, así como su posterior reposición, no extirpando entonces ningún fragmento del maxilar, el cual queda, por tanto, restituido anatómicamente en su totalidad.

Numerosas técnicas se han ideado para el abordaje transfacial de la zona rinofaríngea para llegar a la difícil accesibilidad del clivus, rinofaringe, seno esfenoidal, retropterigoides, espacio retromaxilar, suelo de la órbita, etc., y no producir grandes deformidades como ocurre con abordajes cervicales (2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21).

Todas las técnicas tienen su utilidad y bien realizadas e indicadas un éxito casi seguro; sin embargo, el acceso transfacial al área retromaxilar, o desarticulación temporal pediculada a mejilla del maxilar superior, ideada por el español HERNANDEZ ALTEMIR (22), es el fin primordial de este capítulo.

La técnica, como bien dice el autor, será modificada por otros en lo sucesivo. Pero no desecha ni menosprecia las técnicas clásicas y sirve para conseguir un campo apropiado (prácticamente a cielo abierto) y una fácil reposición y reconstrucción facial con las mínimas secuelas estéticas. Surge idealmente para la extirpación de angiofibromas gigantes y es ampliable a otro tipo de tumores (cordoma, etcétera).

#### RECUERDO ANATOMICO

El maxilar superior y la mandíbula son los huesos más grandes de la cara. El maxilar superior es una pirámide que contiene la cavidad del seno maxilar. Por arriba limita con la cavidad orbitaria, por debajo con la cavidad oral y por dentro con la cavidad nasal. Se articula con ocho huesos.

- En la línea media y encima de los incisivos se articula con el homólogo contralateral.
- 2. Arriba y adentro se articula con el nasal.
- 3. Encima de éste con el frontal.
- 4 y 5. En la pared interna de la órbita se articu-



FIG. 4.—Incisión ampliada hacia reborde supraorbitario.



FIG. 6.—Exposición de escotadura piriforme.



FIG. 7.—Exposición de huesos propios nasales.

la con el unguis y la lámina papirácea del etmoides.

- 6 y 7. La apófisis palatina del maxilar se articula con el vómer y el palatino.
- Por fuera forma el arco cigomático con el

La inervación del maxilar superior depende por completo de la segunda rama del trigémino o nervio maxilar superior. Nace en el anglio de Gasser y sale por el agujero redondo mayor atravesando sucesivamente la fosa pterigomaxilar y el conducto infraorbitario, del que sale dividiéndose en varias ramas terminales (nn. dentarios, nn. suborbitarios, etcétera).

La irrigación sanguínea deriva de la maxilar interna (arteria maxilar superior), la cual en su recorrido se divide en tres porciones: mandibular, pterigoidea y pterigomaxilar. De esta última porción salen las ramas para el maxilar superior:

 Alveolar posterosuperior. Da ramas para los conductos dentarios posteriores del maxilar.



FIG. 8.—Exposición reborde infraorbitario y nervio infraorbi-



-Exposición del arco cigomático.

- Infraorbitaria. Atraviesa la hendidura esfenopalatina, el conducto infraorbitario y se desparrama por la mejilla.
- Palatina descendente o palatina superior. Atraviesa el conducto palatino posterior y viene a vascularizar toda la mucosa de la bóveda palatina.
- Esfenopalatina. Es la rama terminal de la maxilar interna. Atraviesa el agujero esfenopalatino y se divide en dos ramas. La interna

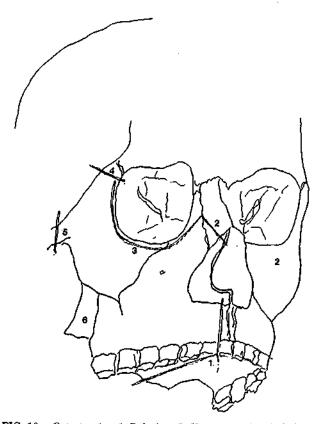
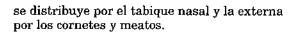


FIG. 10.—Osteotomías. 1: Palatina. 2: Huesos propios. 3: Suborbitaria. 4: Frontoorbitaria. 5: Cigomática. 6: Pterigoidea.



FIG. 11.—Osteotomía del reborde infraorbitario.



 Los tejidos blandos son irrigados por la arteria facial.

#### INDICACIONES DE LA TECNICA

De acuerdo con las bases anatómicas de vascularización e inervación, el doctor HERNANDEZ ALTEMIR ideó una técnica de acceso a todo el espacio retromaxilar consistente en la desarticulación temporalmente del maxilar superior pediculado a la mejilla. Ello evitará las necrosis y demás secuelas indeseables de otras técnicas.

Esta vía está indicada para permitir el aceso a los espacios:

- Retromaxilar.
- Paramaxilar externo.
- Retropterigoideo.
- Cigomático.
- Etmoidal.



FIG. 12.—Osteotomía del paladar óseo.



FIG. 13.—Luxación del maxilar.

- Rinofaríngeo y nasal.
- Esfenoidal.
- -- Clivus.
- Base del cráneo.
- Suelo orbitario.

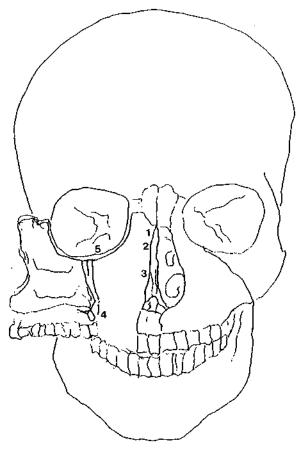


FIG. 14.—Zonas de exposición quirúrgica con la maxilotomía. 1: Etmoides, 2: Seno esfenoidal. 3: Clivus. 4: Fosa pterigomaxilar. 5: Suelo de la órbita.



Reconstrucción con duramadre liofilizada del reborde orbitario extirpado.



-Visualización de septum y cávum. FIG. 17.-

#### DESCRIPCION DE LA TECNICA

La describimos con los tiempos tal y como nosotros la realizamos:

Tiempo 1. Anestesia por intubación orotraqueal, o mejor aún, previa traqueotomía.

Tiempo 2. Tarsorrafia temporal.

Tiempo 3. Infiltración de la fibromucosa palatina e incisión de la misma siguiendo el reborde gingivopalatino hasta la tuberosidad del lado a intervenir (fig. 1).

Tiempo 4. Osteotomía pterigomaxilar (apófisis pterigoides) aprovechando la incisión del tiempo anterior (fig. 2).

Tiempo 5. Incisión previamente marcada desde el labio superior en línea media, surco nasolabial, bordea la nariz hasta llegar a la comisura palpebral interna e incluso sobrepasarla. Desde la comisura palpebral, de una manera horizontal hasta el arco cigomático (figs. 3 y 4).

Tiempo 6. Exposición de estructuras óseas subyacentes a la incisión:

- Arcada dentaria, prolongando la sección del labio con la de la mucosa gingival (fig. 5).
- Escotadura piriforme, despegando la mucosa nasal del suelo y de la cara externa de la fosa. Queda así expuesta la cara interna ósea del maxilar (fig. 6).
- Reborde orbitario interno, y huesos propios nasales, hasta el seno frontal (fig. 7).
- Exposición del reborde orbitario inferior y del nervio infraorbitario (se debe seccionar) (fig. 8).
- Exposición del arco cigomático y borde externo de la órbita (fig. 9).

De esta manera quedan expuestas todas las superficies óseas para comenzar las osteotomías (fig.  $\hat{1}0$ ).

Tiempo 7. Osteotomía de la apófisis cigomática (fig. 9) con sierra de Gigli.

Tiempo 8. Reborde orbitario inferior a pocos milímetros del suelo orbitario, desde la pared externa



FIG. 16.—Extirpación del tumor.



FIG. 18.—Reconstrucción de las osteotomías.

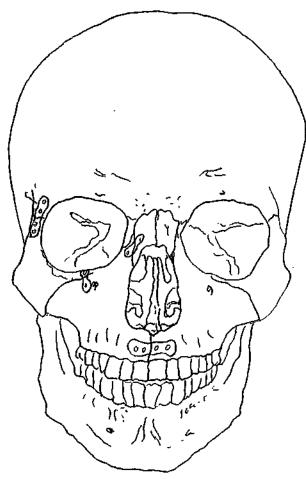


FIG. 19.—Reposición ósea.

de la órbita hasta la región frontomaxilar (huesos propios nasales) (fig. 11).

Tiempo 9. Osteotomía del paladar óseo a entre los dos incisivos de ese mismo lado hasta el reborde palatino posterior, en paralelo al enclave teórico del tabique nasal (fig. 12).

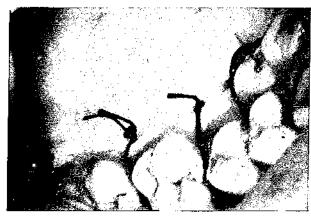


FIG. 20.—Cierre de la mucosa palatina.



FIG. 21.—Imagen estética a los quince días de la intervención.

Tiempo 10. Terminadas las osteotomías es fácil la luxación del maxilar usando como bisagra los tejidos blandos de la mejilla (piel y tejido celular subcutáneo). Quedando expuesta toda la zona del cávum y rinofaringe al abrir completamente la puerta realizada. El bloque luxado mantiene su vascularización durante la intervención a expensas de las arterias faciales (figs. 13 y 14).

El autor recomienda ser conservador con la mayor parte de las estructuras mucosas, vasculares y nerviosas. Si bien nosotros no hemos tenido complicación alguna eliminando la arteria palatina, no suturando el supraorbitario, e incluso llevándonos la pared y el suelo de la órbita, que reconstruimos con duramadre liofilizada en caso de tumoraciones que obligan a extirpaciones importantes, como en los tumores que invaden la pared orbitaria (fig. 15).

La maxilotomía unilateral es fácil y de reconstrucción inmediata. Conservando el dorso nasal y septum puede realizarse de una manera bilateral para mayor acceso a la región tras abrir ambos maxilares.

Queda así expuesto todo el campo quirúrgico que permite extirpaciones de grandes tumores, con visua-



FIG. 22.—Imagen estética a los seis meses de la intervención.

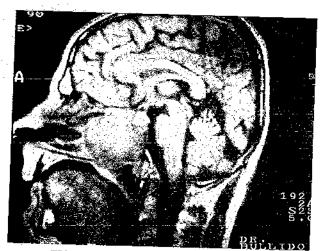


FIG. 23.—Imagen de cordoma rinofaríngeo.

lización del pedículo en los angiofibromas y con acceso a las regiones definidas anteriormente (figs. 16 y 17).

Tiempo 11. Reconstrucción con placas metálicas de las osteotomías (figs. 18 y 19).

Tiempo 12. Reconstrucción de las partes blandas (figs. 20, 21 y 22), quedando una imagen estética muy aceptable.

#### CONSIDERACIONES A ESTA TECNICA

La incisión:

- No daña estructuras nobles.
- No deja secuelas funcionales.
- No deja secuelas estéticas.

La vía de abordaje:

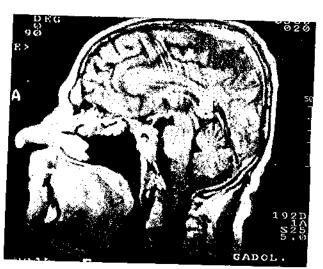


FIG. 24.—Imagen de cordoma rinofaríngeo ya extirpado.

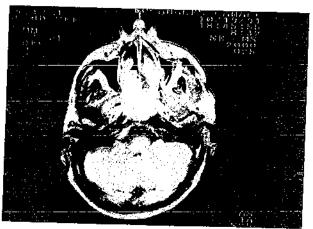


FIG. 25.—Imagen de cordona rinofaringeo.

- Es amplia y a cielo abierto.
- A zonas inaccesibles o al menos de abordaje insuficiente por otras técnicas.
- La fácil exposición de estas regiones permite la exéresis tumoral completa con garantías.

La luxación del maxilar:

- No requiere su posterior reimplantación.
- No conlleva su posible necrosis.
- Puede emplearse bilateralmente en un solo tiempo.

Ampliación, en caso necesario, por procesos neoformativos y oncológicos de maxilotomía a maxilectomía total en el transcurso de la intervención, no habiendo deteriorado otras estructuras que nos permitan la restitución y reconstrucción como en cualquier maxilectomía total.

Es vía de tratamiento combinado para varios especialistas:

Neurocirujanos.

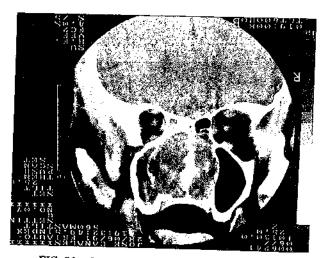


FIG. 26.—Imagen de angiofibroma nasofaríngeo.

- Oftalmólogos.
- Otorrinolaringólogos.
- Maxilofaciales.

En los últimos diez años en nuestro Servicio del Hospital 12 de Octubre hemos realizado maxilectomías totales o parciales en patología no inflamatoria en los siguientes procesos:

- Treinta y cuatro maxilectomías totales por carcinoma.
- Dieciocho maxilectomías parciales por angiofibroma.
- Seis maxilectomías por estesioneuroblastoma.
- Veintiuna maxilectomías por papiloma invertido.
- Ocho dislocación o subluxación maxilar por angiofibromas y cordomas.

Nosotros hemos empleado esta técnica:

- Para angiofibroma nasojuvenil, que invadía el seno esfenoidal.
- En carcinoma adenoides quístico de etmoides con invasión de pared interna de la órbita.
   Ello requirió la reconstrucción de esta pared con liodura.
- Para cordoma.
- En sarcoma maxilar (cara interna). Se conservó la parte externa del maxilar.
- En estesioneuroblastoma (figs. 23, 24, 25 y 26).

Realmente desde que efectuamos este tipo de intervenciones de maxilotomía en bisagra la utilizamos sistemáticamente para todo tipo de tumor maxilar y como vía de acceso a la rinofaringe, ampliando la extirpación ósea si es necesario y reconstruyendo con otras estructuras (colgajo de músculo temporal, etc.) (23, 24) si fuera preciso. La visibilidad y accesibilidad ha sido muy satisfactoria, igual que la cosmética y funcionalidad, y afortunadamente sin complicaciones importantes. Nos resulta de gran satisfacción la realización de una técnica quirúrgica ideada por un cirujano español, el doctor HERNANDEZ ALTEMIR.

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## A Modified Transfacial Approach to the Clivus

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ANTERIOR APPROACHES TO the clivus must provide excellent visualization of the lesion, give adequate access for dural repair, and be cosmetically acceptable. Most current approaches enter through the nasopharynx or oropharynx, with either palatal, maxillary, or mandibular splitting for greater exposure. We have modified the transfacial approach described by others, which provides excellent access to the clivus along its rostrocaudal extent. A lateral rhinotomy incision is used and carried along the base of the right alae nasi and columella. The nasal bones are osteotomized bilaterally, and the nose is rotated on a pedicle flap, thus opening the entire nasal cavity to view. The septum and medial maxillary walls are removed. This provides excellent visualization of the ethmoid, sphenoid, posterior nasopharynx, and upper oropharynx. At the conclusion of the procedure, the nasal incision is closed, with good cosmesis. A case of recurrent chordoma of the middle and lower clivus is presented to exemplify this technique. The approach has since been used to approach clivus tumors and midline aneurysms of the vertebrobasilar system. (Neurosurgery 36:101–105, 1995)

Key words: Clivus, Cranial base surgery, Transclival approach

ultiple anterior approaches to the clivus have been described, using a combination of oropharyngeal and nasopharyngeal routes. We have approached lesions of the lower clivus and odontoid through the oropharynx (4, 8, 14, 15, 21-24), combined, if needed, with palatal (1, 12, 13, 17) or mandibular (5, 10, 18) splitting. Lesions of the upper and middle clivus can be biopsied transsphenoidally (6, 19, 20) or transethmoidally; some lesions can be resected through a modified transsphenoidal or midface degloving approach (6, 20, 25). Extensive maxillotomies have been described to allow more generous exposure (3, 16, 29). We have found, however, that a transfacial approach modified from that described in the ear, nose, and throat literature (2, 7, 9, 28) avoids injury to the hard and soft palate, is cosmetically acceptable, and provides excellent visualization of the clivus in its rostrocaudal and lateral extent. We are presenting a case of a clivus chordoma in which this approach was used; it has also successfully been used to clip otherwise inaccessible aneurysms of the vertebrobasilar system, as well as other tumors involving the clivus.

#### CASE HISTORY

The patient was admitted with a 3-year history of headaches and neck discomfort; she was neurologically normal. A magnetic resonance image demonstrated a large tumor involving the middle and lower clivus. There was displacement of the left vertebral artery and compression of the anterior pons, with

extension to the foramen magnum and odontoid. The tumor was debulked via a transoral approach at another hospital; pathology demonstrated a chondroid chordoma. She was referred for proton beam therapy. It was thought that additional tumor should be removed before radiation therapy. Because of the involvement of the lower clivus and occipital condyles, a posterior occipital-cervical fusion was first performed, which led to a significant improvement in her pain. Two months later, she underwent a modified transfacial approach to her residual tumor, with a gross total resection of her remaining disease, The turnor had eroded through the retroclival dura, which was resected and repaired with fat, fascia lata, and a split-thickness skin graft. Postoperatively, she remained neurologically normal, without evidence of cerebrospinal fluid leak, and had an uneventful postoperative course. She has since received a course of proton beam radiation therapy to the tumor bed.

#### **SURGICAL TECHNIQUE**

The surgical team included an otolaryngologist, a reconstructive otolaryngologist, and a neurosurgeon. The patient was orally intubated; a tracheostomy is not routinely performed. A lumbar drain was placed and remained postoperatively for 3 to 5 days. The hypopharynx was packed, and the nasal cavity was bathed with oxymetazolone (Afrin, Schering Co., Kenilworth, NJ). Bilateral tarsorrhaphies were performed. The left facial artery was identified with a Doppler flow probe

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and was carefully preserved to ensure the vascular supply to the nasal pedicle. A lateral rhinotomy incision was performed from the glabella, along the nasofacial line, around the right ala nasi, across the columella to the base of the left ala. In contrast to the original ear, nose, and throat descriptions (2, 11, 27, 28), the incision was not carried onto the philtrum, the lip was not split, and we did not divide the hard or soft palate. The nasal bones were esteotomized on the right, and the cartilaginous septum was dislocated from the vomer. The left nasal bone was osteotomized by making a stab incision anterior to the inferior turbinate and elevating a pocket in the subperiosteal plane to preserve the facial artery supply. The nasal bone was divided at its junction with the frontal bone, and the cartilaginous septum was divided from the ethmoid. The nasal pedicle was rotated to the left. The flap was returned to its normal position for 5 minutes every hour to prevent prolonged ischemia. The medial wall of the maxillary sinus, including the inferior turbinates, was removed. The bony septum was removed. The left middle turbinate was also removed, and the ethmoid air cells were opened widely. The anterior face of the sphenoid was drilled away. A midline incision was made in the retropharyngeal mucosa and dissected from the underlying tumor. The clivus superior to the tumor was drilled until uninvolved dura was reached, and the tumor dissection was then performed circumferentially. In this case, the tumor had eroded through the dura, which was resected to the arachnoid layer. The basilar artery and vertebrobasilar junction were easily visualized in the midline, and this approach has been useful for aneurysms of the junction. After satisfactory tumor removal, the dura was inspected. There is sometimes sufficient exposure to allow direct repair with a fascia lata graft. In this case, a small opening in the arachnoid was patched with Gelfoam (Upjohn, Kalamazoo, MI) and fascia and buttressed in place with a split-thickness graft, followed by carefully placed nasal packing. Although not used in this case, fibrin glue can be useful. The packing remained in place for 12 to 14 days. Lacrimal duct tubing was placed whenever a medial maxillectomy was done, and the lateral rhinotomy incision was then closed.

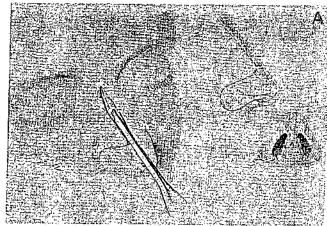
#### DISCUSSION

Multiple approaches have been described to reach the centrally placed clivus and midline cranial base lesions; these have been reviewed in standard texts. Small tumors of the upper third of the clivus can be resected transethmoidally or transsphenoidally (6, 19, 20); these approaches provide only a limited lateral view. A wider reach can be obtained with the midface degloving approach (3, 16, 25), although with limited caudal exposure. This can be improved by splitting the soft and hard palate, combined with extensive maxillotomies (7, 9, 29), allowing visualization of the caudal clivus. Lower clival and upper cervical lesions can be approached transorally (4, 8, 14, 15, 21–24), sometimes combined with mandibular splitting (5, 10, 18). A transfrontal-transcranial approach has been described (11, 26, 27), reaching the clivus through a bifrontal craniotomy after resection of the supraorbital bar. The transfacial approach described here offers direct access to the clivus along its rostrocaudal extent, without an extended maxillotomy (unless exposure of the upper cervical spine is also required) (Fig. 1). Although the soft palate can be retracted osteotomy of the hard palate is not required, and difficulties in the approximation of the facial skeleton are avoided. The price for avoiding extensive facial osteotomies is the lateral rhino





FIGURE 1. A and B, preoperative axial and sagittal magnetic resonance images show the recurrent clivus chordoma, with the degree of access obtainable by this approach.



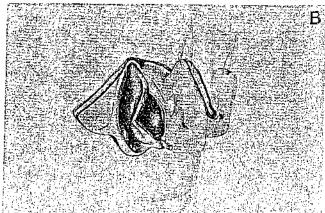


FIGURE 2. A, the lateral rhinotomy incision curves around the right ala, across the columella, to the base of the left ala. B, the nasal pedicle is raised, and the septum is resected.

tomy incision (Fig. 2). and the creation of the nasal pedicle, as opposed to the sublabial gingival incision used with extended maxillotomies; this is cosmetically acceptable and not disfiguring (Fig. 3). Because the turbinates and medial walls of the maxilla are removed, there is minimal bony impedance to lateral exposure, which is then limited by the carotids and medial cavernous sinus rostrally and the jugular foramen and lower cranial nerves caudally; these are anatomical limitations and are imposed in other anterior approaches as well.

The extensive rostrocaudal exposure obtained by this technique is not necessary for the majority of clival tumors. Those of the upper half can reasonably be accessed through transsphenoidal/transethmoidal approaches alone, avoiding the nasal pedicle flap. Those confined to the lower third can be reached transorally (without a facial incision). Tumors with extensive invasion lateral to the carotid or extending into the medial petrous bone will be incompletely resected through this (or any solely anterior) approach. By the transfacial technique, surgically useful exposure can easily be obtained to the anterior arch of C1, as was demonstrated by this case, and, with depression of the palate, the odontoid can be visualized as well. For lesions confined to C1-C2 (without rostral extension), a transoral approach may be preferable. The modified transfacial approach, however, can be used to advantage for predominantly midline lesions that extend along the length of the rostrocaudal extent of the clivus.

As others have noted, a major disadvantage to intra-arachnoid dissection from anterior approaches is the risk of cerebrospinal fluid leak. In this case, the arachnoid was opened during tumor removal but was sealed with Gelfoam, fat, and fascia lata (Fig. 4). Fibrin glue was not used in this case but has been of benefit. The exposure is such that a direct dural repair can sometimes be accomplished, but this remains a significant risk. In cases where this approach has been used for the clipping of midline aneurysms of the vertebrobasilar system, postoperative cerebrospinal fluid leaks have been difficult to manage, requiring closure of the defect with a mucosal-periosteal flap (C. Ogilvy, personal communication).

With the variety of anterior approaches described, the surgeon now has the option of tailoring the operative exposure to the location and extent of the clival lesion. The modified transfacial approach merits inclusion in this armamentarium.





GURE 3. A and B, postoperative photographs show a cosetically acceptable scar along the right nasofacial line.

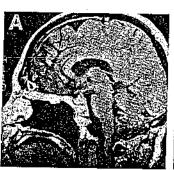




FIGURE 4. A and B, postoperative magnetic resonance images show the degree of tumor resection achieved, with residual fat packing the clival opening. The patient can now receive proton beam radiosurgery with significantly decreased risk of brain stem radiation injury.

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#### **COMMENTS**

The authors describe a new, modified transfacial approach to the clivus that is cosmetically acceptable for the patient. In my own experience, as far as possible, I prefer to avoid any facial scar and any osteotomy of the facial skeleton. According to the level of the clival lesion, a subfrontal transbasal approach or transphenoidal or transoral approach is chosen. The transbasal is preferred in huge clival tumors invading the sphenoid body or sphenoid sinus and extending anteriorly to the optic nerves (it may be combined in the same step with the transphenoidal). The transphenoidal approach allows the surgeon to reach the upper half of the clivus below the sella. The transoral allows one to reach the lower half of the clivus down to C1 and C2. These anterior extradural approaches are, for me, devoted to the removal of clival lesions localized on the midline and without important lateral extent. Does this new transfacial approach bring us more than the others?

As it is stressed by the authors, this way does not give more room laterally—except anteriorly with the removal of the turbinates, but not posteriorly where we are likewise concerned with the carotid arteries, the medial cavernous sinus, and the lower cranial nerves. The main advantage is to add, by this

single transfacial route, the possibilities of the transphenoida and the transoral approaches, avoiding any injury for the hard and the soft palate; I remember the case of a chordoma re moved transphenoidally in which the recurrence occurred downward. This approach certainly provides a better exposure on a limited clival area, including the lower limit of the transphenoidal approach and the upper limit of the transphenoidal approach and the closure of the pharyngea plane. The anterior arch of C1 has been easily reached in this way, but, in spite of the Figure 1 demonstration, C1 is probably the most remote test limit available by this approach; because of the tumor extension toward the odontoid, I would have operated on this patient using a transoral route.

As with all transfacial or other anterior extradural ap proaches, the major risk remains a cerebrospinal fluid leak and a secondary infection in tumors destroying the dura or extending intra-arachnoidally; this risk increases with the size of the dural defect. Few authors have been successful in the removal of intra-arachnoidal tumors or aneurysm surgery. disagree with the use of such ways for the surgery of aneurysms, even in skillfull hands, when we now have the alternative of endovascular treatment.

In my opinion, this modified transfacial approach should be preferred in extradural tumors confined on the midline and extending from the level of the sellar floor to the foramer magnum. C1 and C2 are more easily reached through the transoral route.

Another point concerns, more specifically, the chordomas The patient was postoperatively sent for proton beam irradiation. I am tempted, in such cases with an apparant total removal, not to propose proton beam therapy systematically and to ask, instead, for a strict follow-up, particularly in relatively old patients. Proton beam therapy will be given in cases of subtotal or incomplete removal or when a small recurrence is suspected. With this study, the authors improve our possibilities in the always difficult management of such clival lesions.

Patrick J. Derome Suresnes, France

I agree with the authors that this modified transfacial approach to the clivus provides an excellent visualization of the ethmoid, sphenoid, posterior nasopharynx, and upper oropharynx. I also agree that one can achieve a good cosmetic postoperative appearance of the patient, but the general question is whether every case of clivus chordomas or other pathologies of the clivus need osteotomy of the nasal bones bilaterally with following rotation. We have applied all types of transfacial approaches to the clivus with minimal and maximal transsection and resection of the facial skeleton to increase our view to the entire clivus for the optimal resection of pathology with intradural and extradural extensions. With increasing experience, we have reduced our approach to a simple lateral rhinotomy incision, following the classic transethmoidal approach to the sphenoid sinus, with a modification of complete exposure of the lacrimal duct and the partial removal of the medial orbital wall. The septum nasi is transsected, and

the septum can be displayed temporally to the contralateral side to give, from one side, a good overview to the cranial and middle third of the clivus, as well as to the contralateral petrous bone. There is no need to extend this exposure for the complete removal of the tumor. In cases of bilateral extension, for a better view to the homolateral side, a maxiliotomy also can extend the primary view to this side. I would like to support the opinion of the authors that an injury to the hard and soft palate can be avoided by the simple technique of the described modified transfacial approach to the clivus. I also think that the bilateral

osteotomy of the nasal bones is unnecessary in every case. Surgery of the clivus will remain a region of controversy, with numerous options of approaches and their modification, with more or less satisfying results. We should continue to work on this field and remain open to any useful new approaches. It should be our future task to achieve maximal view to the pathology by as minimal an approach as possible.

Madjid Samii Hannover, Germany







Infranasal operation used by A.E. Halstead in 1909.

Halstead AE: Remarks on the operative treatment of turnors of the hypophysis: With the report of two cases operated on by an oronasal method. Tr Am S A 28:73-93, 1910.

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## OTORRINOLARINGOLOGÍA 1998

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# Tumores de la fosa infratemporal y sus vías de abordaje

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#### ANATOMÍA QUIRÚRGICA

La fosa infratemporal está limitada medialmente por el ala externa de la apófisis pterigoides, que se continúa hacia atrás por el tensor del velo del paladar y el constrictor superior de la faringe.

La pared lateral de la fosa está constituida de arriba abajo por la cara interna del arco cigomático, masetero y tendón del músculo temporal, y rama ascendente de la mandíbula. El techo de la fosa está formado por la superficie infratemporal del ala mayor del esfenoides y en una pequeña proporción de su parte posterior por la escama del temporal.

El límite inferior de la fosa está constituido por la inserción del pterigoideo medial en la cara interna de la mandíbula, donde comunica con el espacio parafaríngeo, mientras que la porción posterolateral del maxilar superior delimita la pared anterior. Por último, el límite posterior de la fosa está abierto.

La fosa infratemporal comunica con la fosa pterigopalatina, que está en la unión de las paredes anterior y medial, y a través de la hendidura esfenomaxilar o fisura

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Las figuras 1, 11, 14, 16, 18a, 18b, 18c, 20a, 20b, 22a, 22b, 22c, 23a, 23b, 23c, 24a y 24b, aparecen, en color, en láminas aparte.

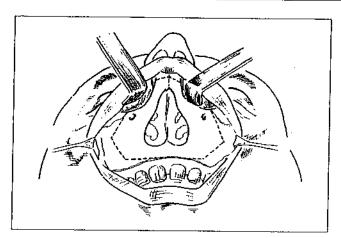


Figura 13.. Degloving facial y osteotomías a realizar en la translocación facial anterior.

con sierra unas osteotomías en la cara anterior del maxilar un poco por encima del nivel del suelo de las fosas nasales, en la unión del maxilar con el malar, en la parte anterior del suelo de la órbita, en la unión de la rama ascendente del maxilar con el hueso propio y en las partes inferior y posterior de la pared medial del maxilar. Con ello se liberan las paredes anterior, medial y parte de la superior del maxilar. extrayéndolas en bloque. La mucosa de la pared lateral de la fosa nasal junto con el cornete infe-

rior se pedicula sobre su parte anterosuperior y se rechaza medialmente, accediéndose a la rinofaringe. Si se extirpa la pared lateral y posterior del seno maxilar se alcanzan las fosas pterigopalatina e infratemporal, pudiendo resecarse también tumores en esta localización, fundamentalmente cuando son benignos y no tienen una excesiva extensión en la fosa infratemporal. Posteriormente se repone el hueso por medio de microplacas (Figs. 12, 13 y 14).

Maxilectomía temporal ("maxillary swing")

Esta técnica se ha propuesto en los angiofibromas y en los tumores malignos de la rinofaringe. Para ello, se realiza una incisión de Weber-Ferguson ampliada hasta el cigoma, continuándose la incisión translabial de forma longitudinal por toda la parte medial del paladar, y dirigirse luego lateralmente a través de la unión del paladar óseo y el blando. Se procede entonces a realizar las osteotomías con una sierra oscilante. La primera separa el maxilar del malar, prosiguiendo medialmente por debajo del reborde orbitario (61), si bien otros autores despegan el suelo de la órbita para incluirlo también (62). Posteriormente se separa el hueso propio de la rama ascendente del maxilar y se secciona de adelante atrás el paladar óseo a través del suelo de la fosa nasal. Ya sólo queda separar mediante un escoplo curvo la tuberosidad del maxilar de la apófisis pterigoides reclinándose lateralmente el maxilar superior pediculado sobre la piel que lo recubre. Este abordaje expone bien la rinofaringe, pero sólo de forma limitada las extensiones del tumor a la fosa infratemporal. Finalmente, se repone el maxilar a su posición original, fijándolo con microplacas.

#### Abordaje transmandibular

El abordaje transmandibular provee por regla general un campo más amplio que los anteriormente citados. Sus principales indicaciones son los tumores parafaríngeos muy voluminosos que se extiendan al espacio masticador (63) y especialmente los tumores de la orofaringe extendidos a la pared lateral de la rinofaringe o viceversa (33,64). En este último caso puede ser necesaria una hemimandibulectomía, pues

Por el contrario, algo muy distinto ocurre cuando predominan los procedimientos intracraneales o en tumores muy extensos en pacientes previamente tratados. En los tumores infratemporales la mortalidad se sitúa entre el 5-20% (26,33), con cifras más bajas cuando no se incluyen actuaciones intracraneales.

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#### ABORDAJES INFRATEMPORALES

### DE LA FOSA INFRATEMPORAL Y DE LA RINOFARINGE

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## ESTRUCTURA DE LA PÁGINA. ( PAGE STRUCTURE ).

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#### Resumen

Presentamos 55 pacientes con tumores que invaden la fosa infratemporal originados en la nasofaringe, seno maxilar, orofaringe, parótida y la propia fosa infratemporal que fueron operados entre 1988 y 1997, realizándose para ello 59 intervenciones (4 pacientes precisaron ser reintervenidos). Los abordajes utilizados fueron: el abordaje infratemporal con translocación facial (15 casos), el abordaje subtemporal-preauricular (12 casos), el abordaje transmandibulartranscervical (10 casos), la maxilectomía extendida a la fosa infratemporal (12 casos, 2 de los cuales combinaban una resección craneofacial de etmoides), la vía infratemporal transcavernosa (4 casos), la vía infratemporal tipo C de Fisch (2 casos) y el abordaje transmaxilar (4 casos), siendo necesaria la realización de craniectomía en 20 casos. Histológicamente, 43 tumores eran malignos, mientras que 12 eran benignos. La mayor parte de las lesiones eran de un gran tamaño afectando a gran parte de la base del cráneo. Se realizó una extirpación completa del tumor en 43 de los casos, siendo la resección subtotal en 12 tumores. Se utilizaron colgajos locales para el cierre del defecto tras la exéresis, utilizando predominantemente el músculo temporal. Las complicaciones postoperatorias más frecuentes consistieron en infecciones de la herida quirúrgica, fístulas de L.C.R. y epífora como consecuencia de la manipulación de la vía lacrimal. Cinco pacientes (9,1%) fallecieron debido a complicaciones postoperatorias. En el momento actual 23 pacientes (41%) han fallecido por

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progresión del tumor, 2 se encuentran vivos con enfermedad local, 23 pacientes están libres de enfermedad (41%), 1 paciente falleció por otra causa y otro caso se perdió para el seguimiento.

PALABRAS CLAVE: Fosa infratemporal. Base de cráneo. Tumores nasofaríngeos. Abordajes quirúrgicos infratemporales.

Infratemporal approaches of the infratemporal fossa and the nasopharyux

#### **Summary**

Artículo 12

Fifty five patients with neoplasms involving the infratemporal fossa and originating in the nasopharynx, the maxillary sinus, the oropharynx, parotid gland and the ipsilateral infratemporal fossa were managed between 1988 and 1997, using 59 surgical procedures (4 patients underwent a new operation). The surgical approaches used were: the infratemporal fossa approach with facial translocation (15 cases), the subtemporal-preauricular infratemporal approach (12 cases), the transmandibular-transcervical approach (10 cases), the extended maxillectomy (12 cases, 2 of them combined with craneofacial resection), the transcavernous infratemporal approach (4 cases), the infratemporal approach type C (2 cases) and the transmaxillary approach (4 cases). Twenty patients required craniectomy. Forty three tumors were malignant and twelve bening neoplasms. Most of the lesions were large involving multiple areas of the skull base. Tumor excision was total in 43 and subtotal in 12 cases.Local flaps were utilized to sealing the cavity after resection, using temporal muscle flaps predomimantly. The most frequent postoperative complications were wound infections, cerebrospinal leaks and epiphora, due to the transection of the lacrimal duct. Five patients (9,1%) died as a result of postoperative complications. To date 23 patients(41%) has died from tumor progression, 2 patients are alive with local disease, 23 patients (41%) are alive without disease, 1 patient has died from other disease and 1 patient has been lost at the follow-up.

KEY WORDS: Infratemporal fossa. Skull base. Naso pharyngeal tumors. Infratemporal surgical approach.

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#### Introducción

La fosa infratemporal es una región anatómica de difícil acceso quirúrgico, para la que han sido descritas varias vías de abordaje. Por ello, los tumores que invaden esta zona suelen mostrar mal pronóstico. El origen de las neoplasias que invaden la fosa infratemporal es variado, encontrándose carcinomas de cavum, angiofibromas nasofaríngeos, tumores primarios de parótida, tumores de glándulas salivares menores, carcinomas de células escamosas cutáneos preauriculares, carcinomas epidermoides de orofaringe, tumores de seno maxilar. Algunos de estos tumores pueden ser tratados primariamente con radioterapia, pero en otros casos la cirugía es la única alternativa efectiva. Por otra parte, las recurrencias locales después de la radioterapia precisan abordajes quirúrgicos más agresivos, con el consiguiente aumento de la morbilidad. Gran parte de estos tumores muestran un patrón de extensión por contigüidad, con la excepción del carcinoma adenoide quístico que

frecuentemente presenta invasión perineural en dirección proximal, con un período de latencia en la aparición de las recidivas muy largo. Generalmente, cuando se hace el diagnóstico del tumor no está confinado sólo en una localización, sino que suele afectar a varias estructuras vecinas. Las regiones más comúnmente invadidas cuando el tumor afecta a la fosa infratemporal son la parte posterior de la fosa nasal, musculatura prevertebral, clivus, arteria carótida interna (ACI) y seno cavernoso. La invasión intracraneal se produce cuando el tumor penetra a través del seno esfenoidal, al erosionar el ala mayor del esfenoides en el suelo de la fosa media, o al introducirse por los diferentes agujeros de la base del cráneo, provocando la invasión secundaria del seno cavernoso y del ganglio de Gasser. El angiofibroma de cavum es el tumor benigno más frecuente de la nasofaringe y en el momento del diagnóstico buena parte de éstos invaden ampliamente la fosa infratemporal, con progresión intracraneal a través de la fisura orbitaria superior.

Se han descrito varias vías para abordar la porción lateral de la base del cráneo, las cuales pueden dividirse en vías transtemporales, transpetrosas y vías preauriculares. La realización de estos abordajes quirúrgicos, que si bien han permitido acceder a tumores considerados en muchos casos inoperables hace 20 años, conlleva una elevada morbilidad operatoria. Esto viene dado por la presencia en el campo quirúrgico de pares craneales cuya lesión provoca importantes déficits funcionales, la posibilidad de lesión de la carótida intrapetrosa, o el daño neurológico directo por la retracción cerebral en el caso de tumores intracraneales. Dentro de las vías de abordaje de la porción lateral de la base del cráneo y de la fosa infratemporal se incluyen el abordaje subtemporal-preauricular (23), el abordaje infratemporal con translocación facial (15), abordajes infratemporales tipo C (2,6), "maxillary swing" (10) y el abordaje transmandibular (16,19). El propósito de este trabajo es mostrar nuestra experiencia en la utilización de diferentes abordajes de la fosa infratemporal y los criterios de selección de los mismos.

#### Pacientes y métodos

Se estudian retrospectivamente 55 pacientes que presentaban tumores que primaria o secundariamente afectaban a la fosa infratemporal y fueron tratados quirúrgicamente mediante un abordaje infratemporal realizándose un total de 59 intervenciones, pues 4 pacientes precisaron ser reintervenidos por desarrollar recidivas locorregionales. Todos los casos fueron operados en el Servicio de O.R.L. del Hospital Central de Asturias entre julio de 1988 y julio de 1997. En el estudio se incluyen 40 hombres y 15 mujeres. Las edades se encontraban entre 8 y 74 años con una media de 49,7 años.

Según la distribución histológica (Tabla I) 43 tumores eran malignos, especialmente carcinomas epidermoides y recidivas de carcinomas indiferenciados de cavum (22 pacientes), carcinomas adenoides quísticos y adenocarcinomas (12 pacientes), sarcomas (7 pacientes), un melanoma y una enfermedad plasmocelular de Castleman. Los restantes 12 casos se trataban de tumores benignos, principalmente angiofibromas de cavum con extensión a la fosa infratemporal (5 casos) y un grupo heterogéneo de 7 pacientes.

#### TABLA I

Distribución histológica de los casos.

Histología

Nº de casos

**Tumores benignos** 

Angiofibroma de cavum	5
Adenoma pleomorfo	2
Displasia fibrosa	1
Fibromatosis juvenil	1
Meningioma	1
Poliposis infratemporal	1
Neurinoma	1
	12

Tumores malignos	Nº de casos
Adenocarcinomas	
Carc. Adenoide quístico	5
Adenocarc. sobre adenoma pleomorfo	2
Adenocarc. Polimorfo de ducto terminal	2
Adenocarcinoma	3
	12
Carcinomas	
Carc. epidermoide	15
Carc. indiferenciado	6
Carc. basocelular	1
	22
• Sarcomas	
Fibrohistiocitoma maligno	2
Angiosarcoma	1
Fibrosarcoma	1
Sarcoma mesenquimal	1
	5
Miscelánea	
Cordoma de clivus	2
Melanoma	1
Enf. de Castleman plasmolecular	1
Total general	55

Atendiendo a la localización primaria del tumor (Tabla II), 25 tumores estaban originados en el cavum, 11 se originaban en la fosa infratemporal, 11 también en el seno maxilar, 4 lo hacían en la orofaringe, 2 en el clivus, 1 tumor en el oído y el último era de origen cutáneo.

TABLA II

Distribución según la localización del tumor originaria del tumor.

Localización	Nº de casos	
Cavum	25	
Fosa infratemporal	11	
Seno maxilar	11	
Orofaringe	4	
Clivus	2	
Oído	1	
Piel	1	
Total general	55	

En 16 de los 55 casos incluidos en el estudio se trataba de recidivas de tumores previamente diagnosticados y tratados, principalmente carcinomas indiferenciados de cavum previamente radiados (6 casos). Dos pacientes que presentaban carcinomas epidermoides de cavum habían sido previamente radiados, mientras que 3 de los carcinomas adenoides quísticos habían sido previamente intervenidos. Los otros tumores recidivados que se incluyen en el estudio formaban un grupo variado de tumores benignos y malignos. La clínica de presentación de los tumores fue muy amplia (Tabla III), siendo los síntomas más comunes la obstrucción nasal e insuficiencia respiratoria nasal, cefalea, trismus, epistaxis, deformidad facial, parestesias trigeminales, diplopia y odinofagia. La exploración de los pares craneales en el momento del diagnóstico evidenció parálisis de los nervios oculomotores en 7 pacientes (especialmente paresia del VI par craneal), hipoestesias trigeminales en 13 pacientes, parálisis facial en 6 casos y del nervio hipogloso en 3 pacientes que presentaban invasión del espacio parafaríngeo y de la orofaringe.

TABLA III

Presentación clínica y signos exploratorios de los casos.

Signos	Nº de casos
Obstrucción nasal	27
Cefalea	20
Trismus	18
Epistaxis	14
Deformidad facial	14
Hipoestesia facial	12
Odinofagia	10
Diplopia	9
Hipoacusia	9
Epífora	8
Paresia facial	5

Exoftalmos	4
Inestabilidad	2
Sd. general	1

La heterogeneidad del grupo impide realizar una clasificación de los tumores según los estadíos TNM (primary tumor extent, node involvement, distant metastatic disease) de la UICC (Union International Contre le Cancer). La mayor parte de los tumores, tanto benignos como malignos presentaban una gran extensión afectando diversas áreas de la base del cráneo (Tabla IV). Así, se encontraban invadidas la fosa infratemporal (52), cavum (26), la parte posterior de la fosa nasal(24), duramadre (22), seno cavernoso y región paraselar (14), arteria carótida interna (10), clivus (7), y ápex petroso (7).

TABLA IV

Extensión anatómica de los tumores.

Extensión	Nº de casos
Fosa infratemporal	52
Seno maxilar	33
Cavum	26
Fosas nasales	24
Duramadre	22
Orbita	16
Seno esfenoidal	15
Seno cavernoso	14
Etmoides	10
Arteria carótida	10
Espacio parafaríngeo	10
Orofaringe	9
Apex petroso	7
Clivus	7
Ganglios linfáticos	5
Nervio facial	5
Bilateral	4
Piel	3
Lóbulo temporal	1

En 18 de los casos, áquellos en los que el tumor se encontraba en contacto o en proximidad de la arteria carótida interna según los datos ofrecidos por las pruebas de imagen (TC, RM), se realizó una evaluación preoperatoria de la suplencia vascular, para valorar el riesgo de infarto cerebral en el caso de precisarse la ligadura de la carótida intracraneal. La metodología utilizada en estos casos se basó en primer término en la realización de una angiografía carotídea con test de oclusión a través de la arteria femoral. Mediante esta prueba diagnóstica se valora el estado anatómico del polígono de Willis, la presencia de compresiones a nível de la ACI y la existencia de una adecuada red de

circulación colateral a través de la arteria comunicante anterior. Una vez valoradas las imágenes de extensión del tumor y la anatomía vascular de la base del cráneo se evalúa en los pacientes que presentan la ACI rodeada, comprimida o infiltrada por el tumor el riesgo de desarrollar infartos isquémicos en el caso de que fuese preciso la ligadura de la ACI. En la mayor parte de nuestra serie (10 pacientes) el examen fue realizado mediante electroencefalografía, primer método utilizado, y eco-doppler transcraneal con compresión carotídea. En la primera el análisis consiste en valorar los cambios en la frecuencia y amplitud de las ondas cerebrales con amplitudes mayores de 5 µV recogidas en las regiones fronto-central y temporo-central del hemisferio ipsilateral a la compresión carotídea (3). En los casos en los que se apreció una inadecuada suplencia vascular (lo cual ocurrió en los 5 pacientes de nuestro trabajo) a través de la arteria comunicante anterior se tradujo en un aplanamiento y enlentecimiento de las ondas procedentes de las zonas anteriormente citadas del hemisferio ipsilateral.

En 6 pacientes se realizó eco-doppler transcraneal. Mediante este sistema no invasivo de ultrasonidos es posible a través de la "ventana temporal" obtener información del flujo y la morfología tridimensional de la porción distal de la ACI, la arteria cerebral media (ACM) y las porciones proximales de las arterias cerebrales anteriores y posteriores, pudiendo evidenciarse la circulación colateral en el caso de existir una obstrucción superior al 50% del calibre de la ACI (1). La eficacia de este método se basa en gran parte en la habilidad, experiencia y conocimiento del explorador. Teniendo en cuenta que existen grandes variaciones interindividuales, los mejores resultados son obtenidos por la comparación de las velocidades y los pulsos en los ambos lados del cráneo del sujeto en condiciones de compresión y no compresión carotídea. Una reducción de más del 65% de la velocidad de flujo a través de la arteria cerebral media durante la oclusión manual de la carótida se acompaña de fenómenos neurológicos transitorios en cerca del 90% de los pacientes (8). Además, de cara a la obtención de la máxima cantidad de datos es conveniente la realización de un eco-doppler extracraneal. Hay que considerar en relación a este método otros inconvenientes que hacen que no sea aplicable a todos los pacientes, como el hecho de que del 5 al 15% de los individuos no puedan obtenerse los registros a través de la ventana temporal. Este porcentaje aumenta con la edad. Además, del 10 al 20% de los sujetos los datos de las arterias cerebrales anteriores o posteriores no pueden registrarse por variaciones en el polígono de Willis o cuestiones técnicas.

En nuestro servicio realizamos desde 1996 la combinación de angiografía selectiva con oclusión carotídea y posteriormente el SPECT (single photon emission computed tomography) con y sin compresión carotídea (20,17). La escintigrafía con 99mTC-HMPAO (99mTc-hexamethylpropyleneamine oxime) es un método semicuantitativo que permite detectar la hipoperfusión focal durante la realización del test de compresión carotídea, independientemente de la presencia de signos neurológicos de isquemia. Los datos obtenidos mediante esta prueba pueden predecir con un alto grado de seguridad la aparición de secuelas neurológicas tras la ligadura de la ACI (24). Las características metodológicas y técnicas utilizadas en todos nuestros pacientes (4 incluídos en este trabajo) pasan por la realización de 2 SPECT en días diferentes. El primero de ellos es una prueba basal, mientras que el segundo es el realizado tras la oclusión carotídea. En cada una de ellos se le administra al paciente i.v. 20mCi (740 MBq) de 99mTC-HMPAO. En el caso del SPECT postoclusión tras 15 minutos de compresión carotídea se le administra el contraste, manteniéndose la compresión durante otros 15 minutos. Veinte minutos después de cesar la interrupción del flujo carotídeo, comienza la adquisición de imágenes en cortes sagitales y coronales. La variable buscada es el porcentaje entre 2 razones. Por un lado la medida de la radioactividad en ROIs en el territorio de la ACM del lado del tumor durante el test de oclusión, frente a la radioactividad en el territorio de la ACM del lado contralateral durante el test de oclusión. Este cociente a su vez se tiene que comparar con otro, el resultante de la radioactividad en el territorio de la ACM del lado del tumor obtenido en el estudio pre-oclusión dividido entre la radioactividad de la región de la ACM del lado contralateral del tumor también en el estudio basal. La conclusión de esta prueba diagnóstica es que cuando el resultado obtenido es menor del 85% al comparar la señal en los territorios de la ACM durante el test de oclusión frente al SPECT basal existe un elevado riesgo de que se instauren déficits neurológicos permanentes tras la ligadura de la ACI. Dentro de los 4 estudios recogidos en nuestro trabajo no se presentaron resultados por debajo de este porcentaje.

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Después de realizadas las pruebas de valoración de circulación colateral en la base del cráneo, como ya se citó, 5 pacientes evidenciaban inadecuada suplencia arterial. Uno de ellos falleció en el postoperatorio como consecuencia de la rotura de la ACI, otro paciente fue intervenido no pudiendo resecarse totalmente el tumor por rodear el lecho de la ACI, encontrándose ésta muy fibrosada. Postoperatoriamente no fue radiado al tratarse de una neoplasia benigna no radiosensible. Actualmente se encuentra vivo con estabilización en el tamaño del tumor remanente en los controles de imagen. Los restantes casos fueron radiados tras la intervención por quedar restos de tumor en relación a la ACI. Este grupo de 3 pacientes fallecieron por progresión del tumor tras una supervivencia media de 16 meses.

Del resto de tumores en los que fue preciso estudiar la suplencia vascular, siendo ésta adecuada, en 3 de ellos (al no poder liberarse totalmente la ACI del tumor) fue preciso la ligadura de la carótida intrapetrosa y resección del segmento afecto. Un paciente falleció en el postoperatorio como consecuencia de complicaciones infecciosas. Los otros 2 pacientes fallecieron a los 58 y a los 30 meses como consecuencia de recidiva de su tumor.

Dentro de la preparación preoperatoria, a todos los pacientes se les administró un régimen de profilaxis antibiótica que consistió en 2 gr./i.v. de cefazolina 30 minutos antes de iniciarse la cirugía, repitiendo esta misma dosis 3 veces más cada 8 horas.

Se realizaron siete tipos de abordaje quirúrgico (Tabla V): el abordaje subtemporal-preauricular de la fosa infratemporal como fue descrito por Sekhar y cols. (23,22), el abordaje mediante translocación facial (15), el abordaje transmandibular-transcervical, el abordaje infratemporal transcavernoso (12,16), el abordaje infratemporal tipo C de Fisch, el abordaje transmaxilar y la maxilectomía extendida a la fosa infratemporal, asociando en 2 casos una resección craneofacial de etmoides. En 20 casos fue necesaria la realización de una craniectomía para extirpar las extensiones intracraneales del tumor (frontoorbitaria 1, frontotemporal 8, temporal 9 y transfrontal 2).

# TABLA V Abordajes quirúrgicos utilizados.

Abordaje quirúrgico	Nº de casos
Infratemporal con translocación facial	15
Subtemporal-preauricular	12
Subtemporar-preatmental Transmandibular-transcervical	10
Maxilectomía extendida a la fosa infratemporal	10
	4
Infratemporal transcavernosa	4
Transmaxilar	2
Infratemporal tipo C de Fisch Maxilectomía ampliada y resección craneofacial de etmoides	2
Total general	59

En tumores localizados de forma limitada en la pared lateral del cavum con progresión a la fosa infratemporal, y en los tumores originados en ella, se utilizó el abordaje subtemporal-preauricular. En este tipo de intervención la incisión que se utiliza es hemicoronal y preauricular, extendiéndola hasta el cuerpo del hioides si es necesario controlar los vasos en el cuello por estar prevista una

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actuación intracraneal o sobre la carótida. Se despega el colgajo cutáneo hacia adelante hasta alcanzar el reborde orbitario y se diseca el tronco del nervio facial, rechazándolo hacia abajo juntamente con la parótida. A continuación se realizan unas osteotomías en el arco zigomático, que se extirpa, reflejando hacia abajo el músculo temporal sobre su inserción en la apófisis coronoides. Si fuera necesario, estas osteotomías pueden incluir el reborde orbitario lateral y el resto del malar. Una vez liberada la parte lateral del cráneo, se aborda la fosa infratemporal medialmente a la mandíbula, siendo necesario muchas veces resecar el cóndilo y la apófisis coronoides por la limitación del campo quirúrgico que producen. Cuando el tumor presenta una invasión intracraneal se efectúa una craniectomía temporal y subtemporal baja. Aún cuando no se realice una craniectomía, se puede exponer mediante fresado el ala mayor del esfenoides en la fosa infratemporal todo el proyecto de la segunda y tercera ramas del trigémino, y si es necesario, abrir el seno esfenoidal fresando el hueso entre ambos nervios, o bien fresando por encima del nervio maxilar superior en la raiz pterigoidea hasta llegar al canal vidiano, por dentro del cual se sitúa el suelo del seno. La hendidura esfenoidal puede abordarse mediante fresado de la porción orbitaria y temporal del ala mayor del esfenoides.

Una vez finalizada la extirpación del tumor, se reponen los segmentos óseos resecados mediante osteosíntesis con miniplacas, colocándose el músculo temporal por debajo de la dura temporal si se ha hecho una craniectomía, o simplemente rellenando la cavidad operatoria y aislándola de la rinofaringe, si se ha resecado ésta.

En tumores con afectación más importante del cavum o progresión hacia la fosa nasal, invasión del esfenoides o del clivus se eligió el abordaje con translocación facial. La incisión que se realiza en ésta es hemicoronal, preauricular y cervical, por la parte lateral, y paralateronasal en su vertiente medial, conectando ambas incisiones a través de otra transconjuntival. El colgajo cutáneo superior se despega hacia adelante, mientras que el inferior se reclina hacia abajo, permitiendo una amplia exposición de las regiones frontotemporal y facial. Se realizan posteriormente unas osteotomías que aislan las paredes anterior (excepto la infraestructura), medial y parte de la superior del maxilar superior, por un lado, y por el otro el malar y el cigoma, que se extirpan provisionalmente. De esta forma se exponen amplia y directamente la región pterigoidea y la fosa infratemporal una vez que se reclina hacia abajo el músculo temporal. Después de resecada la región pterigoidea, se accede a la rinofaringe y el clivus, a la vez que una craniectomía subtemporal permite disecar el tumor en el suelo de la fosa media, en continuidad con la rinofaringe.

En aquellos tumores originados o extendidos al oído medio la vía de acceso elegida fue el abordaje infratemporal tipo C de Fisch. La incisión comienza en la línea del pelo a lo largo de la línea temporal, incurvándose hacia atrás y abajo unos 3 cm. por detrás del pabellón auricular, hasta llegar al extremo del hioides. Se secciona entonces el conducto auditivo externo y se despega el colgajo cutáneo hacia delante hasta descubrir todo el músculo temporal y arco zigomático. A continuación se pedicula el músculo temporal sobre su inserción mandibular y se secciona el arco cigomático por delante de la cavidad glenoidea y cerca del reborde orbitario. Se diseca a continuación el tronco del nervio facial, así como la carótida interna y la vena yugular interna en la parte alta del cuello. El siguiente paso consiste en resecar mediante fresado la mastoides, el hipotímpano y las paredes del conducto auditivo externo, juntamente con la membrana timpánica y la cadena osicular. Este paso puede omitirse si la invasión es más anterior. Se identifica en este punto la ACI medialmente a la trompa de Eustaquio, fresándose además la cavidad glenoidea hasta exponer la articulación temporomandibular, separándose o resecándose el cóndilo de la mandíbula. Una vez obtenida la exposición de esta zona, se procede de similar manera que en otros abordajes de la fosa infratemporal.

Cuando existía una extensión limitada al seno maxilar, fosa pterigopalatina y parte adyacente de la fosa infratemporal la vía utilizada fue la transmaxilar, la cual permite acceder al tumor directamente en el caso de que esté confinado a estas regiones. El abordaje transmaxilar con translocación facial anterior es una modificación personal (27) al sistema de translocaciones faciales ideado por Janecka

(15) . También aquí la intervención comienza con un "degloving" facial, exponiéndose toda la cara anterior del maxilar superior hasta el malar y la órbita, en la unión de la rama ascendente del maxilar con el hueso propio y en las partes inferior y posterior de la pared medial del maxilar. Con ello se liberan las paredes anterior, medial y parte de la superior del maxilar, extrayéndolas en bloque. La mucosa de la pared lateral de la fosa nasal junto con el cornete inferior se pedicula sobre su parte anterosuperior y se rechaza medialmente, accediéndose a la rinofaringe. Si se extirpa la pared lateral y posterior del seno maxilar se alcanzan las fosas pterigopalatina e infratemporal, pudiendo resecarse tumores también en esta localización, fundamentalmente cuando son benignos y no tienen una excesiva extensión en la fosa infratemporal. Posteriormente se repone el hueso por medio de microplacas.

En los casos en los que el tumor ocupaba las paredes posterior y lateral del seno maxilar con amplia extensión de la fosa infratemporal e incluso de la infraestructura orbitaria el abordaje de elección fue la maxilectomía extendida a la fosa infratemporal. En este tipo de operaciones se hace una incisión hemicoronal y preauricular, que se une a la incisión paralateronasal por medio de una incisión horizontal que pasa por el fondo de saco conjuntival, exponiéndose el músculo temporal. Se realizan a continuación osteotomías que aislan completamente el maxilar superior, realizándose una maxilectomía total, a lo que hay que añadir las osteotomías que liberan el malar temporalmente y la disección de la fosa infratemporal, una vez despegado el músculo temporal de sus inserciones superiores.

Una vez extirpada la pieza quirúrgica se pasa a reconstruir el defecto creado. Si se ha podido conservar el globo ocular, que es la situación más común, se debe alinear con el del lado opuesto, a fin de evitar la diplopia. Para ello se puede reconstruir el suelo de la órbita mediante una malla de titanio anclada por microtomillos a los márgenes orbitarios. El colgajo del músculo temporal, pediculado en su extremo inferior, se coloca por debajo, cumpliendo una triple misión. Por un lado oblitera la cavidad operatoria, lo que evita el hundimiento de la mejilla. Además se interpone entre el borde de la malla de titanio (cuando existe) y la piel, lo que evita la extrusión de la misma. Finalmente, sirve para reconstruir el paladar y la pared externa de la fosa nasal. Si se ha exenterado la órbita también permite la obliteración de la misma.

Los pacientes que mostraban invasión tanto de la nasofaringe como de la pared lateral de la orofaringe (4 carcinomas de orofaringe, 4 tumores de origen en cavum, 1 cordoma de clivus y 1 fibrohistiocitoma maligno) fueron intervenidos a través de un abordaje transmandibulartranscervical. Esta intervención comienza con una incisión translabial extendida a la región preauricular por debajo de la mandíbula, o bien una incisión cervical en U, despegando el colgajo sobre la mandíbula para entrar por el surco gíngivo-labial ("visor-flap"). A continuación se realiza una osteotomía en escalón de la mandíbula entre los incisivos centrales y se secciona la parte lateral del suelo de la boca hasta llegar al pilar anterior. Se identifican las carótidas, la yugular interna y últimos pares craneales. La retracción lateral de la mandíbula, de la lengua y estructuras suprahioideas en sentido opuesto facilita el abordaje de la rinofaringe o del compartimento lateral, según cual sea la ubicación del tumor, obteniéndose un colgajo con el hemivelo del paladar y parte del mucoperiostio del paladar óseo, que se reclina contralateralmente. Una vez extirpado el tumor y reconstruída la cavidad oral, se procede a la osteosíntesis de la mandíbula con miniplacas, si bien en los casos en los que existe infiltración de la mandíbula por el tumor es preciso la realización de una hemimandibulectomía. En nuestra serie se realizó mandibulotomía con osteosíntesis en 5 pacientes y hemimandibulectomía en los restantes. En 5 de estos casos se cerró el defecto quirúrgico mediante un colgajo miocutáneo de pectoral mayor.

El abordaje infratemporal transcavernoso se utilizó en los casos en los que existía extensión del tumor a la región paraselar, clivus y ápex petroso. La disección del seno cavernoso es el último paso del abordaje de la fosa infratemporal en sus diferentes modalidades, pudiendo hacerse tanto por una vía infratemporal tipo C, como a través de la vía subtemporal-preauricular, si bien es evidente que la craniectomía frontotemporal inherente a este último procedimiento facilita considerablemente la

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exposición y control del mismo. Una vez realizados los pasos previos del abordaje y exéresis de la fosa infratemporal y demás regiones afectadas por el tumor, se deja la porción de éste adherida al seno cavernoso, pasándose a su disección. Esta comienza mediante la identificación de la ACI proximal y distalmente en el seno. Una vez controlados los polos anterior y posterior del seno cavernoso, se identifican los nervios oculomotores entrando lateralmente en el seno, donde se diseca el tumor.

En el caso de que no sea posible preservar la ACI y mediante el estudio previo se prevea que tal situación puede tolerarse, se realiza una oclusión permanente de ella con balón y se extirpa. En estas circunstancias se liga la carótida antes de que entre en el canal carotídeo, insertando por encima un catéter provisto de un balón doble, que se hincha una vez sobrepasada la zona invadida de la arteria.

En los tumores con afectación intracraneal e invasión dural fue preciso la reparación de la misma mediante duramadre liofilizada (15 casos) o fascia temporal (2 casos), rellenando la vía de acceso al tumor con grasa autóloga (8 casos). En 38 pacientes se utilizó el músculo temporal para proteger el lecho de la ACI, aislar la cavidad craneal u obliterar la cavidad operatoria. En 2 casos en los que el defecto postquirúrgico fue muy extenso se realizaron colgajos libres paraescapulares con anastomosis microvascular. En 3 pacientes en los que la invasión orbitaria era extensa fue necesaria la exenteración orbitaria. En 5 casos que presentaban metástasis ganglionares la exéresis del tumor se acompañó de vaciamiento cervical. Aparte de las técnicas reconstructivas expuestas, en 4 pacientes se realizó reconstrucción del suelo orbitario con malla de titanio, y en uno en el que el defecto óseo tras la extirpación tumoral era extenso, se realizó reconstrucción con metacrilato. En 2 pacientes, que presentaban invasión del nervio facial extrapetroso, se realizaron injertos con ramas del plexo cervical superficial y en otro un injerto desde el ganglio geniculado a la 3ª porción del acueducto de Falopio.

#### Resultados.

Se realizó una exéresis total del tumor en 43 casos, no pudiendo ser completa en 12 pacientes. En éstos se evidenció en la valoración preoperatoria de la suplencia contralateral riesgo de sufrir complicaciones neurológicas (3 casos), mientras que en 2 casos de gran extensión bilateral (cordomas de clivus) fue necesario realizar más de un tiempo quirúrgico para intentar la resección completa del tumor. El resto de los tumores en los que la extirpación fue incompleta se debió a la invasión de estructuras intracraneales irresecables o a la imposibilidad de obtener márgenes suficientes.

Dentro de este grupo de 12 pacientes se realizó radioterapia postoperatoria mediante acelerador lineal o radiocirugía para tratar los pequeños remanentes tumorales en 9 de ellos. De aquéllos que no se radiaron, en uno se debió a fallecer en el postoperatorio, en otro a recibir quimioterapia por descubrírsele en el postoperatorio metástasis a distancia y en el último al tratarse de una patología benigna no radiosensible. De los pacientes que componían este grupo 9 han muerto (8 como consecuencia de progresión tumoral y uno en el postoperatorio), 1 caso se ha perdido para el seguimiento y 2 pacientes están vivos con tumor no presentando crecimiento en el seguimiento radiológico. Además de los citados, en otros 13 pacientes más se realizó tratamiento complementario con radioterapia postoperatoria.

Considerando las complicaciones postoperatorias (Tabla VI), la más frecuente fue la infección de la herida quirúrgica (15 casos), en 3 de las cuales se desarrolló una osteomielitis del segmento orbitocigomático. Aparecieron craneolicuorreas en 7 pacientes, remitiendo 5 con tratamiento postural, mientras que las restantes precisaron cierre mediante cirugía endoscópica nasal. En 2 pacientes se asoció la licuorrea a meningitis que se resolvió con antibioterapia. Se presentaron 6 casos de neumonía nosocomial. Se comprobó oftalmoplejía como consecuencia de la afectación de

los nervios oculomotores en 3 pacientes, además de aquéllos que la presentaban previamente. En otro paciente fue necesaria la realización de un colgajo libre microvascularizado para el cierre de una comunicación entre la cavidad oral y la región malar, debido a la osteomielitis del hueso malar. Cinco pacientes murieron en el postoperatorio como consecuencia de complicaciones, tres por el desarrollo de neumonías y sepsis secundarias, otro debido a la rotura de la ACI y el último debido a la aparición de alteraciones cerebrovasculares.

## TABLA VI Complicaciones postquirúrgicas.

Complicaciones	Nº de casos
Infección de herida quirúrgica	15
Craneolicuorrea	7
Epífora	7
Dehiscencia de la herida	7
Neumonía	6
Ectropión	4
Parálisis facial	4
Sepsis	4
Osteomielitis	3
Diplopia	3
Alt. Cerebrovascular	3
Incapacidad para la deambulación	3
Meningitis	2
Hidrocefalia	1
Enoftalmos	1
Rotura carotídea	1
Tromboembolismo pulmonar	1
Disfagia	1

Dentro de la morbilidad quirúrgica se incluyen parestesias faciales y linguales debido a la sección de las ramas maxilar y mandibular del V par craneal, lo cual ocurrió en 12 pacientes. Otro problema subyacente a la cirugía fue la disfunción de la articulación temporomandibular cuando se resecó el cóndilo mandibular. Un hecho constante fue la parálisis de las ramas frontales del nervio facial a pesar de la reanastomosis microquirúrgica. El defecto cosmético más llamativo fue la depresión de la región temporal causada por la rotación del músculo temporal, aunque en algunos casos se consiguió paliarla mediante el implante de grasa abdominal o la transposición de la mitad posterior del músculo.

Hasta la fecha, después de un seguimiento medio de 25 meses, en 28 se presentaron recidivas locorregionales o progresión del remanente tumoral (50,9%). De éstos, en 12 sólo se realizó tratamiento paliativo, 7 pacientes recibieron quimioterapia, 7 fueron sometidos a cirugía (en 4 casos utilizándose abordajes de la fosa infratemporal, estando éstos incluídos en el estudio), en 1 caso se realizó radioterapia únicamente y en otro paciente radioterapia combinada con quimioterapia. En 4 pacientes se desarrollaron metástasis a distancia, falleciendo todos en el plazo de 8 meses tras el

diagnóstico. En el momento actual (Tabla VII) han fallecido 29 pacientes (52,7%), 5 de ellos por complicaciones en el postoperatorio (9,1%) y otro por una enfermedad intercurrente. Los restantes 23 pacientes lo hicieron como consecuencia de la recidiva o progresión del tumor (41,8%).

Tabla VII Estado actual de la supervivencia en función de las recidivas.					
Estado Recidiva					
	No	Sí	Perdidos		
Libre de Tumor	20	3		23	
Vivo con tumor		2		2	
Muerte en postoperatorio	5			5	
Muerto por el tumor		23		23	
Muerto por otra causa	1		1	1	
Perdido			1	1	
Total general	26	28	1	55	

En el momento actual se encuentran libres de tumor, 23 casos (41,8%), mientras que 2 pacientes manifiestan recidiva o tumor residual (3,6%) (1 neurinoma y 1 carcinoma sobre tumor mixto habiendo un caso perdido para el seguimiento (1,8%).

TABLA VIII Recidiva tumoral y estado de la supervivencia en función de la distribución histológica y la localización primaria del tumor. (F.I.: Fosa infratemporal).

Histología	Recidiva				Estado			
	No	Sí	Perdido	Libre	Otra causa	Postoperat.	Muerto por tumor	Vivo con tu
Adenocare, de cavum	1	ì		ŀ	· · · · · · · · · · · · · · · · · · ·		1	
Adenocare, etmoidomaxilar		i					l	
Adenocare, polimorfo de cavum		2					2	
Adenoma pleomorfo (F.L)	2			2				
Angiofibroma de cavum	5			5				
Angiosarcona cervicoparotídeo (F.L.)		1					ι	
Care, adenoide quístico de cavum	2	3		1		1	3	
Care, basocolular	ŧ				ŀ			
Carc, epidermoide de orofaringe	2	2		I		1	2	
Care, epidermoide de seno maxilar	ŧ	3		2			2	
Care, escamoso de cavum	2	2		1		1	2	
Care, indiferenciado de cavum	4	2		3		1	2	
Care, sobre adenoma pleom, de cavim-		2					1	i
Care, transicional seno maxilar	2			Ţ		1		
Care, epidermoide de oído			1					
Cordona de clivus		2					2	
Displasia fibrosa (F.l.)	1			l				
Enf. de Castleman plasmocelular (F.L.)		-1		1				
Fibrohistiocitoma maligno (F.L)		2					2	
Fibromatosis juvenil (F.L)	- 1		1					
Fibrosarcoma de seno maxilar		- 1		1				
Melanoma F.I.		ı					ı	
Meningioma intraóseo (P.L.)	- 1			ι				
Poliposis infratemporal (F.I.)	1			ι				
Nenrinoma trigémino F.L.		ı						1
Sarcoma mesenquimal de bajo grado		1					i	
Total general	26	28	1	23	ī	5	23	2

En la Tabla VIII se detalla la relación de las recidivas y la supervivencia de los diferentes tipos de neoplasias que se estudian. Atendiendo al origen histológico de los cánceres estudiados, formado por carcinomas epidermoides, sarcomas y adenocarcinomas, la Figura 1 muestra la supervivencia acumulada según el método de Kaplan-Meier, comprobándose una mayor superviencia en el caso de los carcinomas epidermoides que presentan una fase de estabilización a los 2 años aproximadamente.

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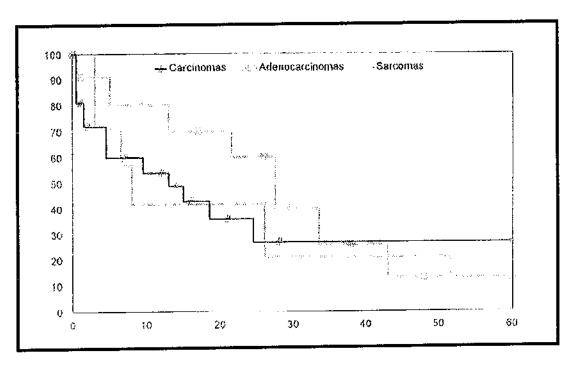


Fig. 1.- Curva de supervivencia de Kaplan-Meier considerando las estirpes histológicas. Se evidencia una supervivencia acumulada más elevada en el caso de los carcinomas epiteliales (27%), siendo inferior a la mitad en el caso de los sarcomas y adenocarcinomas (13%).

Considerando la localización primaria del tumor (Figura 2) se aprecia una supervivencia media similar para todas las localizaciones, si bien hay que considerar la falta de homogeneidad en el origen histológico dentro de cada una de ellas.

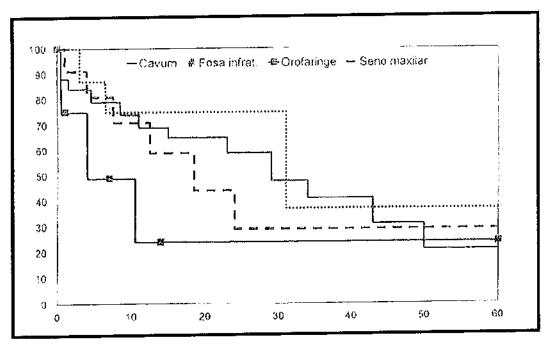


Fig. 2.- Curva de supervivencia de Kaplan-Meier según la localización primaria del tumor. Se evidencia una mayor supervivencia acumulada en los casos de los tumores originados en el cavum, lo cual puede estar relacionado con el mayor número de casos dentro de este grupo(25 tumores).

Discusión.

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Se han descrito numerosas vías de abordaje anteriores y laterales para abordar a tumores localizados en la fosa infratemporal durante los pasados años. Las vías de abordaje anteriores presentan el inconveniente de estar alejadas de la localización profunda de algunas neoplasias y la incapacidad de alcanzar las proyecciones laterales de las mismas, lo cual puede impedir la resección de las expansiones intracraneales, aunque pueden utilizarse con éxito en tumores benignos de reducidas dimensiones en la fosa infratemporal. La utilización del abordaje transmandibular-transcervical, con o sin mandibulectomía (16,19), es necesaria cuando los tumores de la región amigdalina se extienden a la fosa infratemporal y a la rinofaringe o cuando los carcinomas de cavum se propagan hacia la orofaringe. Debemos considerar en el planteamiento quirúrgico la probable necesidad de utilizar un colgajo miocutáneo, del pectoral mayor o del dorsal ancho, para la reconstrucción del campo operatorio.

Han sido descritas diversas vías que nos ofrecen un buen acceso a la porción lateral de la base del cráneo y que son variantes del abordaje subtemporal-preauricular. Estas permiten una adecuada exposición de la nasofaringe, fosa media, región paraselar, ápex petroso y fosa infratemporal (23,2,18). La exposición superior de la fosa media se consigue con la realización de una craniectomía y la retracción del lóbulo temporal, así como mediante el fresado del techo de la fosa infratemporal. En los casos donde existe invasión de la fosa media, especialmente cuando el tumor está rodeando a la ACI, las ventajas que ofrece una amplia exposición en sentido superior son evidentes. Por otra parte, el abordaje tipo C de Fisch 6), que requiere una petrosectomía subtotal, tiene su indicación en tumores del oído medio extendidos a la rinofaringe y la fosa infratemporal.

El abordaje infratemporal con translocación facial está orientado al tratamiento de tumores que se localicen en la región paracentral de la base del cráneo, especialmente cuando el tumor sea inicialmente extracraneal y afecta a la fosa nasal y a la rinofaringe. En estos casos permite al cirujano una gran exposición que no conseguiría con otros abordajes. En los casos que lo precisen se puede realizar una craniectomía temporal, con la que se alcanza el suelo de la fosa media y la región paraselar. Teniendo en cuenta estos hechos, este abordaje ha sido el elegido por nosotros a la hora de intervenir los tumores con una afectación importante de la nasofaringe, mientras que cuando la invasión del cavum era limitada se utilizó el abordaje subtemporal-preauricular. La utilización de estos abordajes provoca una depresión en la fosa temporal, que puede corregirse utilizando injertos autólogos de grasa, o con la colocación de prótesis de diversos materiales aloplásticos. Cuando se realiza una translocación facial existe la posibilidad de que se produzca una osteomielitis en el esqueleto facial y reabsorción ósea tardía, así como epífora por la obstrucción del conducto lacrimonasal. Este último hecho puede prevenirse mediante la cateterización de la vía lacrimal con una sonda de silicona que se mantendrá durante 4 semanas aproximadamente, asegurando de esta manera la repermeabilización de la vía lacrimonasal. Para más seguridad puede abocarse el saco lagrimal sobre la mucosa nasal, asegurando esta unión con una sutura con hilo monofilamento de 6/0. Estas medidas han permitido excelentes resultados en nuestra experiencia en la prevención de la epífora cuando se utilizan estas vías quirúrgicas.

La gran variedad de tipos histológicos en los tumores que afectan estas regiones, su escasa frecuencia, el pequeño número de casos y el corto seguimiento en las series publicadas hace difícil obtener una conclusión en cuanto a la evolución a largo plazo, si bien cabe suponer que debido al diagnóstico generalmente tardío el pronóstico de estos tumores es desfavorable.

El tumor benigno más frecuente que invade el suelo de la fosa media desde estructuras inferiores es el angiofibroma de cavum. En el momento de su presentación, el 15-20% de los pacientes evidencian radiológicamente ampliación de la fisura orbitaria superior y desplazamiento de la carótida intracavernosa. La craniectomía frontotemporal, seguida de rinotomía lateral (13) y el abordaje infratemporal tipo C (5) tienen frecuentemente la desventaja de resultar en resecciones incompletas. Por el contrario, el abordaje infratemporal con translocación facial no daña el hueso temporal y permite un amplio acceso al ápex orbitario, suelo de la fosa media, fosa infratemporal, cavidad nasal y nasofaringe, realizando la resección con gran seguridad. Esta seguridad puede verse aumentada si

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se lleva a cabo la embolización del tumor (4). Mediante esta vía hemos conseguido la extirpación completa del tumor en los 5 casos de nuestra serie con amplia invasión infratemporal e intracraneal, con escasa morbilidad postoperatoria.

La supervivencia a los 10 años en el carcinoma adenoide quístico de cualquier localización es del 22%25. En la serie publicada por Shotton y cols. (23), 5 de 13 pacientes que presentaban carcinomas adenoides quísticos de la base del cráneo y la nasofaringe seguidos entre 7 y 15 años no mostraron signos de recidiva. El período de seguimiento para los restantes 8 pacientes no superaba los 4 años, habiendo fallecido un paciente y estando otro vivo con tumor. Estos resultados coinciden los hechos señalados por Howard y Lund (11) y Witt (28) según los cuales el pronóstico de estos tumores cuando invaden la fosa infratemporal, fosa nasal y senos paranasales empeora mucho con respecto a aquellos originados en el paladar. Nuestra experiencia también sugiere unos resultados similares en el control de la enfermedad en la base del cráneo, presentando una tasa de recidivas y mortalidad del 60%. Es básico el control clínico de la evolución para detectar recidivas por progresión perineural, característica marcada de estos tumores.

El papel de la cirugía en el tratamiento de los carcinomas indiferenciados nasofaríngeos con crecimiento infratemporal no está bien clarificado. Los resultados de los abordajes infratemporales en 13 carcinomas nasofaríngeos recidivados tras radioterapia mostrados por Fisch y cols. (7), son esperanzadores para los tumores en estadíos T1 y T2, presentando 6 pacientes vivos y libres de tumor después de 2 años tras la cirugía, mientras que aquellos que se encontraban en estadíos más avanzados fallecieron. Cuando se consigue la resección completa del tumor, la recidiva local no es un hecho frecuente como ha ocurrido en nuestra serie (26). De cualquier forma, los pacientes con tumores muy indiferenciados y extensos evolucionan pobremente, debido al desarrollo de metástasis a distancia (22).

La mortalidad en nuestra serie debida a complicaciones postoperatorias fue del 9,1%. Uno de ellos fue un paciente con un extenso carcinoma epidermoide de rinofaringe que rodeaba la ACI y que había mostrado en el preoperatorio fracaso en las pruebas de suplencia carotídea. Se le extirpó la mayor parte del tumor para la realización de radioterapia complementaria postoperatoria, liberándose la porción lateral de la carótida intrapetrosa. El paciente presentó una hemorragia masiva una semana después de la cirugía, debido a la necrosis del músculo temporal utilizado en la reconstrucción para separar el cavum de la carótida intrapetrosa. Tres pacientes fallecieron al desarrollar neumonías por aspiración, infecciones locales y sepsis incontroladas. El otro paciente que falleció tras la cirugía presentó alteraciones cerebrovasculares que condujeron al coma, lo cual constituye una complicación a tener presente especialmente en aquellos casos que muestren como antecedente hipertensión arterial o dislipemias. En los tumores con extensión intracraneal, el peligro de rotura de la ACI contraindica la utilización de abordajes a través de las vías aerodigestivas que dejen los vasos expuestos a la flora bacteriana al final de la intervención. Cuando se exponen grandes vasos, éstos deben de protegerse con la interposición de colgajos vascularizados. Por ello, en la realización de estas intervenciones es fundamental la protección de las arterias temporales profundas que nutren el músculo temporal. Este ofrece una óptima defensa de la dura temporal, la arteria carótida interna y permite la obliteración de "espacios muertos" al final de la cirugía, evitando de esta forma el que puedan desarrollarse infecciones a ese nivel (9). La desinserción del músculo permite trasponerlo a localizaciones relativamente distantes, pero aún así esta movilización puede verse incrementada si se secciona la apófisis coronoides, pudiendo servir tanto de barrera protectora, como para la reconstrucción del suelo de la órbita o del paladar.

La infección de la herida quirúrgica fue una complicación frecuente en nuestra serie (25,4%), pero con la excepción del caso expuesto anteriormente, en general fue fácilmente controlable sin representar un problema clínico mayor.

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## MÉTODOS RECONSTRUCTIVOS EN CIRUGÍA TUMORAL DE BASE DE CRÁNEO

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### ESTRUCTURA DE LA PÁGINA. (PAGE STRUCTURE).

- Resumen.
- Pacientes y métodos. Conclusiones.
- Summary.
- Resultados.
- Bibliografía
- Introducción. Discusión.

#### Resumen

Objetivos: Describir la experiencia de los autores durante los últimos cinco años en el tratamiento quirúrgico de 37 pacientes con patología tumoral de base de cráneo, dedicando una atención especial a los métodos reconstructivos empleados, y resultados obtenidos en cuanto a supervivencia e incidencia de complicaciones graves.

Material y métodos: Un total de 37 pacientes con patología neoplásica de la base craneal fueron intervenidos quirúrgicamente entre octubre de 1992 y septiembre de 1997. Veinte pacientes presentaban tumores benignos o pseudotumores, y diecisiete tumores malignos. Catorce de ellos habían sido sometidos a procedimientos quirúrgicos previos sobre el tumor y cuatro habían recibido radioterapia. La mayor parte de las neoplasias afectaban el segmento anterior de la fosa craneal media (n= 18), o la fosa craneal anterior, en su sector lateral (n= 15) o en su sector central (n= 13). Veintitrés pacientes precisaron abordajes quirúrgicos combinados intra-extracraneales. Los abordajes más comúnmente utilizados han sido los transfrontoorbitarios (n= 18), el lateral preauricular infratemporal (n= 13), diversos tipos de maxilotomías (n= 11), rinotomía pediculada (n= 5), y translocación facial (n= 3).

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Describimos los defectos postquirúrgicos de los 37 pacientes en lo que respecta a la integridad o no de la duramadre, vía aerodigestiva superior, piel, esqueleto craneofacial, cavidades (maxilar, órbita, infratemporal), pares craneales y arteria carótida interna. Los métodos reconstructivos empleados incluyeron: colgajos locales (galea-pericráneo, 21 casos; fascia parietotemporal, 4), colgajos miofasciales (músculo temporal, 9 casos; galea-frontal 2 casos), miocutáneos (pectoral mayor, 2 casos) y colgajos libres microvasculares (dorsal ancho, 3 casos; recto abdominal, 1 caso). En 24 casos se reconstruyeron con injertos óseos autólogos (calota craneal) rebordes, paredes orbitarias y/o bóveda craneal. La fijación habitualmente empleada para los segmentos óseos movilizados e injertos fue mediante microosteosíntesis con placas y tornillos de titanio. En 13 pacientes se empleó el metilmetacrilato para defectos extensos craneales o relleno de fosa temporal.

Resultados: En 31 pacientes (84% de los casos) se consiguió resección completa del tumor. Un paciente falleció en el postoperatorio tardío (4 semanas) por hemorragia incoercible procedente de la arteria carótida interna. Catorce pacientes recibieron radioterapia postoperatoria. El seguimiento medio de los pacientes ha sido de 31 meses (rango 2-60 meses) con una supervivencia global del 80% (69% para los tumores malignos) y una supervivencia libre de enfermedad del 58% (44% para tumores malignos). Veinte pacientes (56%) presentaron complicaciones postquirúrgicas: neurológicas (11 pacientes), relacionadas con el abordaje (9 pacientes), de la herida quirúrgica (7 pacientes), fístula de líquido cefalorraquídeo (4 pacientes), y sistémicas (3 pacientes).

Conclusiones: Una metodología reconstructiva adecuada es imprescindible para conseguir resultados aceptables en términos de supervivencia y calidad de vida en pacientes con patología tumoral de base de cráneo.

PALABRAS CLAVE: Méto	odos reconstructivos.	Base craneal. Tumor.	Abordaje transfacial.
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#### Summary

In this article the authors describe their experience during the last five years with the surgical treatment of 37 patients presenting skull base neoplasms. Special attention is given to reconstructive techniques and the final results in terms of survival and major complications.

Methods and materials: Thirty-seven patiens with skull base neoplasms underwent surgical treatment between october, 1992 and september, 1997. Twenty patients presented with benign tumors or pseudotumor, and seventeen had malignant neoplasms. Fourteen patients underwent previous surgical procedures and four also received radiation therapy. Most tumors affected the middle cranial fossa at its anterior segment (n= 18) or the anterior cranial fossa at its lateral (n= 15) or central portion (n= 13). Twenty-three patients underwent combined intra-extracranial approaches. The most commonly used approaches were transfrontoorbital (n= 18), lateral preauricular-infratemporal (n= 13), different types of maxillotomies (n= 11), pedicled rhinotomy (n= 5) and facial translocation (n= 3). Postsurgical deffects in the 37 patients are described in detail, namely integrity of duramater, superior aerodigestive tract, skin, craniofacial skeleton, cavities (maxilla, orbit, infratemporal), cranial nerves, and internal carotid artery. Reconstructive techniques included: local flaps (galealpericranial, 21 cases; temporoparietalis fascia, 4), myofascial flaps (temporalis muscle, 9 cases; galeal-frontalis, 2 cases), myocutaneous (pectoralis major, 2 cases), and microvascular free flaps (lattissimus dorsi, 3 cases, rectus abdominis, 1 case). In 24 cases, autologous bone grafts (calvarial) were used to reconstruct orbital rims, walls or cranial vault defects. Osteotomized bone segments and grafts were usually fixed with titanium microplates and screws. Thirteen patiens underwent cranial vault or temporal fossa methyl-methacrylate reconstruction.

Results: In thirty-one cases (84%) complete resection of tumor was achieved. One patient died in the late postoperative period (4 weeks) due to internal carotid artery bleeding. Fourteen patients received postoperative radiation therapy. Medium follow-up has been 31 months (range 2-60 months); the overall survival rate was 80% (69% for malignant tumors) and the disease-free survival rate 58% (44% for malignant tumors). Twenty patients (56%) suffered postsurgical complications: neurologic (11 patients), approach-related (9 patients), surgical wound related (7 patients), cerebrospinal fluid fistula (4 patients) and systemic (3 patients).

Conclusions: Suitable reconstructive principles are essential to achieve fair results in terms of survival and life-quality in patients with skull base neoplasms.

KEY WORDS: Reconstructive techniques. Cranial base. Tumor. Transfacial approach.

#### Introducción

La cirugía tumoral de la base del cráneo ha experimentado en los últimos veinte años un espectacular avance. Las resecciones craneofaciales han pasado de ser cirugías heroicas, con alta morbimortalidad, a convertirse en procedimientos quirúrgicos reglados, con muy aceptables resultados en términos de supervivencia y morbimortalidad para los pacientes (10,12,14,28). Esto ha ido ligado a la mejora en los métodos diagnósticos (tomografía axial computarizada -TAC-, resonancia magnética nuclear -RMN-1, pronósticos (test de oclusión con balón, TAC con Xenon) y terapéuticos (neurorradiología intervencionista, instrumentación, monitorización neurofisiológica). Por otro lado, los diversos abordajes transfaciales, con antecedentes históricos más precoces han sido estandarizados y ampliados en los últimos años (2,8,13,25,26) siguiendo los principios de la moderna cirugía craneofacial establecidos por Paul Tessier (32) pudiendo conseguirse un desensamblaje completo transitorio de todo el esqueleto facial para facilitar las técnicas ablativas. Los límites de resecabilidad se han ampliado gracias a los citados avances, y a la posibilidad reconstructiva de transplantar tejidos distantes al lecho de la resección quirúrgica mediante técnicas de transferencia tisular microvascularizada (15,29,33). Por último, es innegable que la colaboración multidisciplinaria entre distintos especialistas a la hora de afrontar cada caso particular, con sus peculiaridades y dificultades específicas resectivas y reconstructivas ha mejorado sensiblemente la calidad de la planificación quirúrgica, de los procedimientos quirúrgicos en sí, y de los cuidados postoperatorios a los pacientes con esta patología (3), al sumarse conocimientos y habilidades en el estudio preoperatorio, durante la intervención quirúrgica y en los cuidados postoperatorios. Los principios de la cirugía oncológica de la base craneal, según Sekhar (14) incluyen:

- 1) Amplios abordajes intra-extracraneales;
- 2) Resección preferentemente en bloque del tumor;
- 3) Aislamiento de las fosas craneales anterior y media de la vía aérea;
- 4) Reconstrucción estética y funcional.

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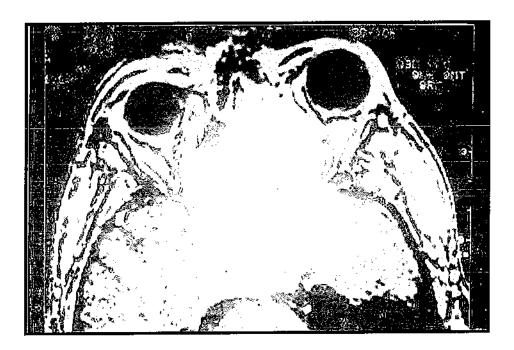


Fig. 1.- Resonancia nuclear magnética (RM) mostrando gran tumoración centrofacial con afectación masiva etmoidal, orbitaria bilateral, frontal y temporal derecha, de ambos senos cavernosos y clivus. El defecto tras su resección quirúrgica dejará en comunicación fosa craneal anterior, media y ambos senos cavernosos con la rinofaringe y senos paranasales.

El compartimento intracraneal resulta violado en estos pacientes, bien por el tumor en sí o por el procedimiento quirúrgico resectivo (Figura 1). Constituyen objetivos reconstructivos *primarios* el aislamiento de dicho compartimento de la vía aerodigestiva superior y el asegurar una adecuada vascularización cerebral, porque de ambos depende al vida del paciente. Es un objetivo *secundario*, aunque de gran relevancia para la calidad de vida del paciente su reconstrucción estética y funcional. La **reconstrucción primaria** es taxativa en estos procedimientos para asegurar la supervivencia, siendo el método reconstructivo ideal aquél que reduzca al máximo la incidencia de complicaciones, proporcionando un resultado funcional y estético superior, y no interfiriendo con las pruebas de imagen (TAC, RMN) postquirúrgicas.



Las técnicas reconstructivas empleadas se encaminan hacia la consecución de esos objetivos, aunque continúa siendo alta la morbilidad de esta cirugía en cuanto a incidencia de complicaciones (18,27), y secuelas estéticas o funcionales (3,33). Habitualmente los objetivos reconstructivos se consiguen mediante la reposición anatómica y fijación de los segmentos óseos craneofaciales movilizados (Figura 2), reparación dural, y empleo de colgajos locales: pericráneo, galea-pericráneo, galea-frontal, músculo temporal, fascia parietotemporal (11,30,35). Se emplean asimismo colgajos pediculados regionales (trapecio, dorsal ancho, esternocleidomastoideo) para defectos de partes blandas laterales (3). En casos de grandes defectos, complejos tridimensionalmente, con exposición de grandes superficies de duramadre reparada a cavidades sépticas, se emplean en la reconstrucción colgajos libres microvascularizados, generalmente recto abdominal y dorsal ancho (33).

Fig. 2.- Orbitotomía temporal que incluye los cuatro rebordes orbitarios.

#### Pacientes y métodos

Durante el período de estudio (octubre de 1992 a septiembre de 1997) fueron intervenidos quirúrgicamente un total de 37 pacientes (21 varones, 16 mujeres) con tumores de la base craneal, por nuestro equipo multidisciplinario. Catorce de ellos habían sido sometidos al menos a un procedimiento quirúrgico sobre el tumor; cuatro habían recibido radioterapia. Veinte pacientes presentaban tumores benignos o pseudotumores (54%) y diecisiete tumores malignos (46%). En veinte ocasiones se dispuso de diagnóstico histopatológico previo a la intervención quirúrgica, por las intervenciones anteriores o biopsia preoperatoria. El estudio preoperatorio incluyó TAC y RMN. En once pacientes se realizó angiografía, con embolización preoperatoria en ocho de ellos. En tres pacientes se realizó test de oclusión carotídea con balón.

Todos los pacientes fueron sometidos a tratamiento quirúrgico, bien a través de abordajes combinados intra-extracraneales (23 casos) o exclusivamente abordajes transfaciales (14 casos). Los abordajes intracraneales consistieron en 10 craniotomías frontotemporales, 7 bifrontales, 5 temporales y una frontal. Los abordajes transfaciales empleados quedan reflejados en la Tabla I.

TABLA I Abordajes transfaciales empleados en el tratamiento quirúrgico de pacientes con tumores de la base craneal.

	Nº de casos
Infratemporal preauricular	13
Transfrontoorbitocigomático	9
Lefort I con segmentación sagital	6
Transbasal extendido	6
Rinotomía pediculada	5
Transfrontoorbitario	3
HemiLefort I	3
Translocación facial	3
Subfrontal subcraneal	2
Maxilotomía pediculada a la mejilla	1
Transfrontonasal	1
Lefort I	1
Transpetroso	1

De entre los abordajes anteriores los más utilizados fueron, como abordajes superiores el transfrontoorbitocigomático (16), en nueve casos (combinando orbitotomías con orbitectomías por necesidades resectivas) y el transbasal extendido (26), en 6 casos; de entre los abordajes anteriores inferiores o transorales, el más usado fue la maxilotomía ampliada (24) u osteotomía Lefort I con segmentación sagital (23), en seis pacientes. El abordaje lateral más común fue el preauricular subtemporal-infratemporal de Sekhar (26), en trece casos. El abordaje anterolateral más utilizado fue

la translocación facial, con diferentes variantes (5).

TABLA II

Métodos reconstructivos (colgajos) empleados en 37 pacientes con tumores de la base craneal.

	Nº de casos
Galea-pericráneo	21
Músculo temporal	9
Fascia parietotemporal	4
Galea-frontal	2
Rotación-avance	5
Músculo pectoral mayor	2
Dorsal ancho (microvascularizado)	3
Recto abdominal (microvascularizado)	1

Los métodos reconstructivos empleados (Tabla II) incluyeron colgajos de galea pericráneo (n= 21) generalmente para reconstrucción de la fosa craneal anterior, obturación del seno frontal o recubrimiento de injertos para reconstrucción orbitaria (Figura 3).



Fig. 3.- Colgajo de galea-pericráneo frontal para reconstrucción de fosa craneal anterior.

Para los mismos fines se emplearon la fascia parietotemporal (n= 4) y el colgajo de galea-frontal (n= 2). En nueve ocasiones utilizamos el colgajo miofascial de músculo temporal para obliterar defectos variados: fosa craneal media, paladar, cavidad orbitaria, clivus, etc. (Figs. 4 y 5).

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Fig. 4.- Tomografía computarizada (TC) craneal mostrando angiofibroma de cavum que afecta fosas nasales, cavum, seno maxilar izquierdo, fosa infratemporal, clivus y afectación de intracraneal masiva incluyendo ambos senos cavernosos.

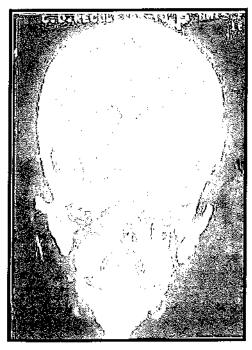


Fig. 5.- TC del paciente de la figura 4, mostrando el defecto en la región clival, un año después del tratamiento quirúrgico, obliterado mediante colgajo miofascual del músculo temporal.

Cinco pacientes precisaron colgajos de rotación-avance del cuero cabelludo para defectos cutáneos. Cuatro pacientes precisaron reconstrucción mediante colgajos libres microvascularizados para defectos extensos de la base craneal, empleándose en tres ocasiones el colgajo miocutáneo del músculo dorsal ancho y en una el del recto abdominal: un paciente con resección craneofacial anterior incluyendo exenteración orbitaria y maxilectomía (dorsal ancho), dos pacientes con resección craneofacial lateral (dorsal ancho), y una paciente con resección craneofacial anterior y lateral por meningioma (recto abdominal); en dos de los pacientes la reconstrucción fue primaria y en otros dos diferida, tras 2 y 4 años respectivamente de supervivencia libre de enfermedad después de sendas resecciones craneofaciales por neoplasias malignas.

En 24 pacientes se emplearon injertos óseos autólogos (generalmente, calota craneal de la cortical interna del hueso de craniotomía) para reconstrucción orbitaria de rebordes y paredes resecadas,

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glabela y pequeños defectos de la bóveda craneal; la reconstrucción de las paredes mediales orbitarias, así como de los rebordes inferior e interno se obviaron cuando se planificó radioterapia postoperatoria. Tanto los segmentos óseos faciales movilizados para el abordaje, como los injertos se fijan mediante microosteosíntesis de titanio con placas y tornillos sistemas 1.0 ó 1.5 mms o alambres. En 13 pacientes se empleó el metilmetacrilato para reconstrucción de defectos extensos de la bóveda craneal, o relleno de la fosa temporal. Tras reensamblar el esqueleto facial movilizado, realizar el sellado de la cavidad craneal y la reconstrucción orbitaria, se procedió a reinsertar los cantos internos (si se desinsertaron), mediante cantopexia transnasal. Cuando se precisó sección de la vía lacrimal, se realizó a nivel del saco o conducto lacrimonasal, reubicándose el mismo a la cavidad resectiva al final del procedimiento, preferentemente con tutorización añadida de los canalículos. En la mayor parte de pacientes que precisaron abordajes extensos, con gran desensamblaje del esqueleto facial y en aquellos con resecciones de la cavidad oral-orofaringe se empleó traqueostomía perioperatoria. En casos seleccionados, se empleó un drenaje lumbar de líquido cefalorraquídeo (LCR) intraoperatorio o postoperatorio, y en todos los casos profilaxis antibiótica.

#### Resultados

La edad media de los pacientes fue de 48 años (rango 16-72). Treinta y cuatro de los tumores afectaban a la región I -anterior- de la base craneal. Diecinueve a la zona II -antero lateral- y ocho a la zona III -póstero-lateral. Treinta y seis de las neoplasias presentaban afectación ósea de la base craneal, según se detalla en la Tabla III. Veintiocho tumores afectaban la fosa craneal anterior, quince en sus porciones laterales (17) y trece en su porción central. Dieciocho tumores presentaron afectación ósea de la fosa craneal media en su segmento anterior, y cinco en su segmento posterior. En quince casos existió afectación tumoral de la bóveda craneal, y en once del clivus.

TABLA III

Afectación ósea en 37 pacientes con tumores de la base craneal.

	Nº de casos
Bóveda craneal	15
Fosa craneal anterior (central)	13
Fosa craneal anterior (lateral)	15
Fosa craneal media (sector anterior)	18
Fosa craneal media (sector posterior)	5
Clivus	11
Fosa craneal posterior	2
Raquis	2

En treinta y un pacientes (84%) se consiguió resección completa macroscópica del tumor, aunque el estudio histopatológico reveló afectación microscópica de bordes en cinco de ellos (13.5%). En 4 pacientes (11%) se consiguió resección subtotal mayor del 80% y en 2 pacientes (5.5%) resección subtotal entre el 60 y el 80%. Un paciente falleció en el postoperatorio tardío (4 semanas) tras realizársele resección subtotal de una tumoración en el clivus, que resultó ser un fibrohisticcitoma maligno, a través de una maxilotomía ampliada, presentando una hemorragia incoercible, posiblemente originada en una carótida interna expuesta en la resección. Catorce pacientes recibieron radioterapia postoperatoria como tratamiento adyuvante.

En la Tabla IV aparecen los diagnósticos anatomopatológicos, siendo los más comunes meningioma (n= 8), carcinoma epidermoide (n= 4), adenocarcinoma (n= 3), cordoma (n= 3), angiofibroma (n= 2), osteoma (n= 2), y lesiones de células gigantes (2).

TABLA IV

Tipos histológicos en 37 pacientes con tumores de la base craneal.

Tumores benignos y pseudotumorales	Nº de casos
Meningioma	8
Osteoma	2
Angiofibroma	2
Tumor de células gigantes	1
Granuloma de células gigantes	1
Osteocondroma	1
Granuloma de células plasmáticas	1
Mucocele frontoetmoidal	1
Adenoma de hipófisis	1
Neurinoma	1
Diaplasia fibrosa	1
	20
Tumores malignos	Nº de casos
Carcinoma epidermoide	4
Cordoma	3
Adenocarcinoma	2
Condrosarcoma	1
Adenocarcinoma	2
Condrosarcoma	1
Adenocarcinoma (metastásico)	1
Carcinoma de células claras (metastásico)	1
	1
Carcinoma adenoide quistico	
Carcinoma adenoide quístico Hemangioendotelioma	1

17

El seguimiento medio de los pacientes ha sido de 31 meses (rango 2-60 meses). Veintinueve pacientes están vivos (**supervivencia** global del 80%), 21 de ellos libres de enfermedad (supervivencia libre de enfermedad del 58%). Cinco pacientes fallecieron por su enfermedad, y tres por causas ajenas. En el caso de los 16 tumores malignos seguidos durante una media de 30 meses

Sarcoma fusocelular

Carcinoma pobremente diferenciado

(rango 2-60 meses) la supervivencia global ha sido del 69%, y la supervivencia libre de enfermedad, del 44%.

La descripción de los defectos postquirúrgicos, agrupados según la clasificación de Urken (33) aparece en la Tabla V.

TABLA V

Defectos postquirúrgicos en 37 pacientes con tumores de la base craneal.

I. Duramadre         Íntegra       14         Reparada       8         Injertada       15         II. Mucosa       15         Nasal-nasofaríngea       22         Oral-orofaríngea       13         Esfenoidal       14         III. Piel       1         Cuero cabelludo       3         Frontal       2         Mediofacial       6         Tercio anterior facial       1         Cuello       1         Pabellón auricular       1         IV. Hueso       18         Bóveda craneal       18         Malar       19         Paladar       11         Suelo orbitario       13         Mandíbula       9         Temporal       13         V. Cavidades       13         Maxilar       9         Órbita       4         Fosa infratemporal       16         VI. Nervios       VII par (o ramas)       5         Lingual       4         XII par       3         IX par       2		Nº de casos
Reparada       8         Injertada       15         II. Mucosa       22         Nasal-nasofaríngea       22         Oral-orofaríngea       13         Esfenoidal       14         III. Piel       1         Cuero cabelludo       3         Frontal       2         Mediofacial       6         Tercio anterior facial       1         Cuello       1         Pabellón auricular       1         IV. Hueso       18         Bóveda craneal       18         Malar       19         Paladar       11         Suelo orbitario       13         Mandíbula       9         Temporal       13         V. Cavidades       Maxilar         Maxilar       9         Órbita       4         Fosa infratemporal       16         VI. Nervios       VII par (o ramas)       5         Lingual       4         XII par       3         IX par       1         X par       2	I, Duramadre	
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Nasal-nasofaríngea 22 Oral-orofaríngea 13 Esfenoidal 14 III. Piel Cuero cabelludo 3 Frontal 2 Mediofacial 6 Tercio anterior facial 1 Cuello 1 Pabellón auricular 1 IV. Hueso Bóveda craneal 18 Malar 19 Paladar 11 Suelo orbitario 13 Mandíbula 9 Temporal 13 V. Cavidades Maxilar 9 Órbita 4 Fosa infratemporal 16 VI. Nervios VII par (o ramas) 5 Lingual 4 XII par 3 IX par 2	Reparada	8
Nasal-nasofaringea 22 Oral-orofaringea 13 Esfenoidal 14  III. Piel Cuero cabelludo 3 Frontal 2 Mediofacial 6 Tercio anterior facial 1 Cuello 1 Pabellón auricular 1 IV. Hueso Bóveda craneal 18 Malar 19 Paladar 11 Suelo orbitario 13 Mandíbula 9 Temporal 13 V. Cavidades Maxilar 9 Órbita 4 Fosa infratemporal 16 VI. Nervios VII par (o ramas) 5 Lingual 4 XII par 1 X par 2	Injertada	15
Oral-orofaríngea 13 Esfenoidal 14  III. Piel Cuero cabelludo 3 Frontal 2 Mediofacial 6 Tercio anterior facial 1 Cuello 1 Pabellón auricular 1 IV. Hueso Bóveda craneal 18 Malar 19 Paladar 11 Suelo orbitario 13 Mandíbula 9 Temporal 13 V. Cavidades Maxilar 9 Órbita 4 Fosa infratemporal 16 VI. Nervios VII par (o ramas) 5 Lingual 4 XII par 1 X par 1 X par 2	II. Mucosa	
Esfenoidal 14  III. Piel Cuero cabelludo 3 Frontal 2 Mediofacial 6 Tercio anterior facial 1 Cuello 1 Pabellón auricular 1  IV. Hueso Bóveda craneal 18 Malar 19 Paladar 11 Suelo orbitario 13 Mandíbula 9 Temporal 13 V. Cavidades Maxilar 9 Órbita 4 Fosa infratemporal 16 VI. Nervios VII par (o ramas) 5 Lingual 4 XII par 3 IX par 1 X par 2	Nasal-nasofaringea	22
III. Piel Cuero cabelludo 3 Frontal 2 Mediofacial 6 Tercio anterior facial 1 Cuello 1 Pabellón auricular 1 IV. Hueso Bóveda craneal 18 Malar 19 Paladar 11 Suelo orbitario 13 Mandíbula 9 Temporal 13 V. Cavidades Maxilar 9 Órbita 4 Fosa infratemporal 16 VI. Nervios VII par (o ramas) 5 Lingual 4 XII par 3 IX par 1 X par 2	Oral-orofaríngea	13
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Frontal       2         Mediofacial       6         Tercio anterior facial       1         Cuello       1         Pabellón auricular       1         IV. Hueso       18         Bóveda craneal       18         Malar       19         Paladar       11         Suelo orbitario       13         Mandíbula       9         Temporal       13         V. Cavidades         Maxilar       9         Órbita       4         Fosa infratemporal       16         VI. Nervios         VII par (o ramas)       5         Lingual       4         XII par       3         IX par       1         X par       2	III. Piel	
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Tercio anterior facial Cuello Pabellón auricular IV. Hueso Bóveda craneal Malar Paladar Suelo orbitario Mandíbula Temporal V. Cavidades Maxilar Órbita Fosa infratemporal VI. Nervios VII par (o ramas) Lingual XII par X par X par	Frontal	2
Cuello 1 Pabellón auricular 1 IV. Hueso Bóveda craneal 18 Malar 19 Paladar 11 Suelo orbitario 13 Mandíbula 9 Temporal 13 V. Cavidades Maxilar 9 Órbita 4 Fosa infratemporal 16 VI. Nervios VII par (o ramas) 5 Lingual 4 XII par 3 IX par 1 X par 2	Mediofacial	6
Pabellón auricular  IV. Hueso  Bóveda craneal  Malar  Paladar  Suelo orbitario  Mandíbula  Temporal  V. Cavidades  Maxilar  Órbita  Fosa infratemporal  VI. Nervios  VII par (o ramas)  Lingual  XII par  IX par  X par	Tercio anterior facial	1
IV. Hueso         Bóveda craneal       18         Malar       19         Paladar       11         Suelo orbitario       13         Mandíbula       9         Temporal       13         V. Cavidades         Maxilar       9         Órbita       4         Fosa infratemporal       16         VI. Nervios         VII par (o ramas)       5         Lingual       4         XII par       3         IX par       1         X par       2	Cuello	1
Bóveda craneal       18         Malar       19         Paladar       11         Suelo orbitario       13         Mandíbula       9         Temporal       13         V. Cavidades         Maxilar       9         Órbita       4         Fosa infratemporal       16         VI. Nervios         VII par (o ramas)       5         Lingual       4         XII par       3         IX par       1         X par       2	Pabellón auricular	1
Malar       19         Paladar       11         Suelo orbitario       13         Mandíbula       9         Temporal       13         V. Cavidades         Maxilar       9         Órbita       4         Fosa infratemporal       16         VI. Nervios         VII par (o ramas)       5         Lingual       4         XII par       3         IX par       1         X par       2	IV. Hueso	
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Suelo orbitario 13  Mandíbula 9  Temporal 13  V. Cavidades  Maxilar 9  Órbita 4  Fosa infratemporal 16  VI. Nervios  VII par (o ramas) 5  Lingual 4  XII par 3  IX par 1  X par 2	Malar	19
Mandíbula       9         Temporal       13         V. Cavidades         Maxilar       9         Órbita       4         Fosa infratemporal       16         VI. Nervios       VII par (o ramas)         VII par (o ramas)       5         Lingual       4         XII par       3         IX par       1         X par       2	Paladar	11
Temporal 13  V. Cavidades  Maxilar 9  Órbita 4  Fosa infratemporal 16  VI. Nervios  VII par (o ramas) 5  Lingual 4  XII par 3  IX par 1  X par 2	Suelo orbitario	13
V. Cavidades  Maxilar 9 Órbita 4  Fosa infratemporal 16  VI. Nervios  VII par (o ramas) 5  Lingual 4  XII par 3  IX par 1  X par 2	Mandíbula	9
Maxilar 9 Órbita 4 Fosa infratemporal 16 VI. Nervios VII par (o ramas) 5 Lingual 4 XII par 3 IX par 1 X par 2	Temporal	13
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Fosa infratemporal 16 VI. Nervios VII par (o ramas) 5 Lingual 4 XII par 3 IX par 1 X par 2		9
VI. Nervios  VII par (o ramas) 5  Lingual 4  XII par 3  IX par 1  X par 2	Órbita	4
VII par (o ramas) 5 Lingual 4 XII par 3 IX par 1 X par 2	Fosa infratemporal	16
Lingual 4 XII par 3 IX par 1 X par 2	VI. Nervios	
XII par 3 IX par 1 X par 2	VII par (o ramas)	
IX par 1 X par 2	Lingual	4
X par 2	XII par	3
1	IX par	
	X par	
XI par 2	XI par	2

La mayor parte de los defectos postquirúrgicos incluyeron reparación dural mediante injerto (n= 15) o sutura (n= 8) estando la duramadre íntegra en 14 casos. Los defectos quirúrgicos generalmente se encontraban expuestos a la vía aerodigestiva superior (n= 26), bien fosa nasal-nasofaringe o senos frontales, cavidad oral-orofaringe (n= 13) y seno esfenoidal (n= 14). En seis pacientes el defecto incluyó resección cutánea. Las resecciones óseas más frecuentes incluyeron el hueso malar (n= 19), bóveda craneal (n= 18), hueso temporal (n= 13), suelo orbitario (n= 13), apófisis palatina del maxilar superior (n= 11), y hueso mandibular (n= 9), generalmente el cóndilo. Dieciséis pacientes precisaron mayor o menor grado de vaciamiento infratemporal, nueve maxilectomías y cuatro exenteración orbitaria. La resección de los pares craneales VII, IX, X, XI, XII y nervio lingual fue siempre por criterios oncológicos. Ningún paciente fue sometido a resección carotídea, aunque sí a exposición, disección y control de la carótida interna cervical en los abordajes laterales y anterolaterales, y a diversos grados de exposición de la carótida intrapetrosa según las necesidades del abordaje o resectivas.

Veinte pacientes (56%) presentaron **complicaciones postquirúrgicas** de mayor o menor entidad, que se reflejan en la Tabla VI agrupadas en neurológicas, de la herida quirúrgica, relacionadas con el abordaje, fístula de LCR y sistémicas (3,27).

TABLA VI

Complicaciones en 37 pacientes operados de tumores de la base craneal.

	Nº de casos
Neurológicas (11 pacientes)	
Agitación	5
Contusión cerebral	4
Convulsiones	3
Neumoencéfalo	2
Parálisis/paresia facial	2
Anopsia/hemianopsia	1
Hemiparesia	1
Edema cerebral	1
Abordaje (9 pacientes)	
Hipoacusia	3
Sordera	2
Retirada osteosíntesis	3
Dacriocistitis	2
Enoftalmos	3
Ptosis	1
Herida quirúrgica (7 pacientes)	
Dehiscencia	4
Infección orbitaria	3
Radionecrosis orbiotomías	2
Hemiparesia	1
Infección subcraneal	1

Absceso cerebral	1
Fístula de líquido cefalorraquídeo (4 pacientes)	
Sistemáticas (3 pacientes)	
Respiratorias	2
Metabólicas	1

De las complicaciones **neurológicas**, la contusión cerebral generalmente se correlaciona con la manipulación intraoperatoria (retracción) y no ha supuesto secuelas importantes, como tampoco la agitación y las convulsiones. Dos pacientes presentaron neumoencéfalo relevante postoperatorio, uno de los cuales precisó reparación quirúrgica secundaria de un pequeño defecto cutáneo frontal mediante un colgajo local tras sufrir un absceso cerebral. Una paciente con meningioma presentó hemianopsia superior definitiva en el postoperatorio de la intervención que incluyó destechamiento del canal óptico. Una paciente presentó una hemiparesia en el postoperatorio de una gran intervención resectiva; el déficit evolucionó favorablemente en semanas. Un paciente con un gran meningioma esfenoorbitario presentó edema cerebral postoperatorio que precisó manejo en cuidados intensivos durante una semana, recuperándose sin secuelas. Una paciente con un tumor en el peñasco presentó paresia facial de ramos superiores definitiva tras petrosectomía; un paciente con meningioma esfenoorbitario con invasión de fosa infratemporal e invasión cutánea presentó paresia del orbicular severa definitiva que precisó tarsorrafia externa.

Con respecto a las complicaciones ligadas al abordaje, la hipoacusia va ligada a la sección de la trompa de Eustaquio, en abordajes laterales; estos pacientes son candidatos a un drenaje transtimpánico. La cofosis fue secundaria a abordajes transpetrosos. En tres pacientes fue preciso retirar material de osteosíntesis, por infección o exposición. Dos pacientes presentaron dacriocistitis en el postoperatorio tardío de sendas translocaciones faciales: uno de ellos desarrolló una celulitis orbitaria preseptal con extensión a fosa infratemporal, precisando retirada de una plastia de metilmetacrilato de fosa temporal, y sufriendo como secuela enoftalmos por reabsorción de injertos en esa órbita, siendo sus vías lacrimales actualmente permeables (Figura 6); el otro paciente precisó dacriocistorinostomía. Otros dos pacientes con reconstrucción orbitaria de tres paredes presentaron enoftalmos moderado.



Fig. 6.- Aspecto postoperatorio tardío (6 meses tras la resección quirúrgica) de un paciente con angiofibroma de cavum y afectación intracraneal masiva -ver figuras 4 y 5-. Obsérvense el enoftalmos y colapso temporal consecuencia de la infección orbitaria postoperatoria sufrida.

Cuatro pacientes presentaron dehiscencia de la herida quirúrgica un tiempo variable tras la

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intervención primaria. Dos de ellos precisaron colgajos regionales (rotación-avance, pectoral mayor); los otros dos pacientes, necesitaron transferencia tisular microvascularizada (dorsal ancho) 2 y 4 años tras la cirugía respectivamente, para obturar los defectos tras sendas resecciones craneofaciales; uno de ellos había recibido radioterapia postoperatoria (65 Gy) y sufriendo asimismo pérdida de injertos óseos orbitomaxilares por radionecrosis (Figs. 7, 8 y 9).

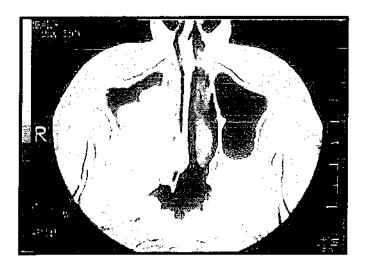


Fig. 7.- Tomografía computarizada mostrando carcinoma adenoide quístico pterigomandibular con invasión rinofaríngea.

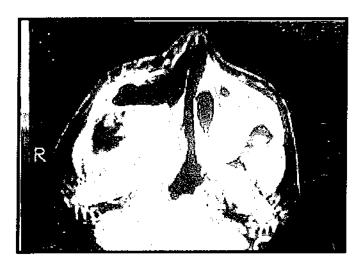
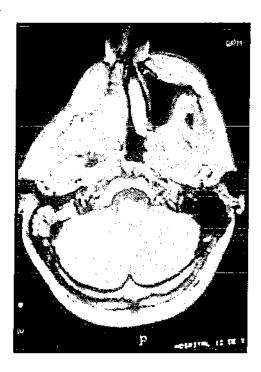


Fig. 8.- Tomografia computarizada postoperatoria (2 meses) del caso de la figura 7 mostrando el defecto quirúrgico obliterado con el músculo temporal. Obsérvese la orbitotomía expuesta a la vista aérea.

Fig. 9.- Resonancia nuclear magnética 2 años tras la intervención quirúrgica del paciente de las figuras 7 y 8. Tras la radioterapia, sufrió pérdida de la orbitotomía, con el consiguiente perjuicio estético.

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Cuatro pacientes presentaron infección postoperatoria: uno de ellos, un absceso cerebral 6 meses tras resección craneofacial anterior con resección cutánea, que no precisó tratamiento neuroquirúrgico, y sí cierre mediante colgajos locales (cuero cabelludo) de una dehiscencia frontoorbitaria; tres pacientes presentaron celulitis orbitarias preseptales, dos ya descritas (por dacriocistitis) y otra secundaria a infección de material de osteosíntesis.

La paciente con resección craneofacial anterior y lateral que precisó reconstrucción mediante colgajo libre recto abdominal sufrió infección subcraneal postquirúrgica que precisó retirada de orbitotomía.

Cuatro pacientes presentaron fístula o lóculo postoperatorio de líquido cefalorraquídeo, tres de los casos resueltos con manejo conservador, un paciente precisó derivación ventrículoperitoneal.

Tres pacientes sufrieron complicaciones sistémicas menores en el postoperatorio, sin gran trascendencia en su evolución clínica.

#### Discusión

En nuestra serie, es ligeramente superior la prevalencia de tumores benignos intervenidos, en comparación con los malignos, con un 54% de casos (Tabla IV). La relación neoplasias benignas/malignas encontrada en la literatura es muy diversa (10,12,14)y la incidencia de las distintas entidades histopatológicas muy heterogénea. Creemos interesante para su estudio y sistematización el empleo de una sectorización del tipo descrito por Irish y cols. (10), que empleamos para detallar las localizaciones tumorales. La zona I incluye fosa craneal anterior, clivus y foramen magnum; la zona II incluye fosa infratemporal y pterigopalatina con extensión a fosa craneal media a través de diversos forámenes; la zona III incluye el hueso temporal y zona anterior de la fosa posterior. El comportamiento de los tumores agrupados en dichas localizaciones, e incluso la incidencia de complicaciones resulta menos dispar analizados así (10). Meningioma y carcinoma epidermoide son los diagnósticos histopatológicos más frecuentes de tumor benigno y maligno, respectivamente.

El 35% de los pacientes habían sido sometidos a cirugías previas, lo que obviamente condicionó la planificación quirúrgica ablativa y reconstructiva, dificultándolas (2,30). La mayor parte de los tumores de nuestra casuística afectaban las zonas I y II de la clasificación antes descrita (Tabla III); aquellos asentados en la zona I fueron resecados mediante abordajes anteriores, bien superiores o

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transorales. El abordaje anterior superior preferido ha sido el transbasal ampliado de Sekhar (26), basado en el abordaje descrito por Derome (4) para las resecciones craneofaciales anteriores del sector central, y un abordaje transfrontal orbitocigomático (9,16) con grados diversos de orbitectomía, según los casos, para las resecciones craneofaciales anteriores laterales. El abordaje subfrontal subcraneal de Raveh (20), ampliamente utilizado por nosotros en traumatología facial ha sido empleado únicamente en dos ocasiones, para pequeños tumores localizados en el sector anterior central de la fosa craneal anterior. En seis pacientes se utilizó la maxilotomía ampliada (osteotomía Lefort I con segmentación sagital) como abordaje a clivus superior, medio e inferior, y regiones anteriores de la columna cervical alta, en su sector central (13,23,24). En un paciente se empleó una osteotomía Lefort I como acceso a un angiofibroma de cavum sin extensión infratemporal. La osteotomía hemiLefort I se utilizó en tres ocasiones, asociada a otros abordajes, con vascularización única a través de la arteria faríngea ascendente -sección por necesidades resectivas o embolización de la arteria palatinasin problemas de isquemia postoperatoria ni pérdidas dentarias. El abordaje lateral más comúnmente empleado ha sido el subtemporal-infratemporal de Sekhar (25), en trece ocasiones. El concepto de este abordaje tiene sus bases en los descritos por Obwegeser (19) y Fisch (7); permite, de forma elegante y con mínimas secuelas un correcto abordaje a la fosa infratemporal, fosa craneal media y región petroclival, con excelente posibilidad de control de las estructuras neurovasculares cervicales, así como de la carótida interna intrapetrosa, con posibilidad de acceso a cavum y clivus. Veintitrés pacientes precisaron abordajes combinados intra-extracraneales, generalmente por la extensión tumoral (resección dural en quince de ellos), no por ampliar el campo quirúrgico. Hemos preferido asociar la rinotomía pediculada a otros tipos de rinotomía lateral (34) que ofrecen un campo quirúrgico más limitado.

En la Tabla V se agrupan los defectos postquirúrgicos de los 37 pacientes según la clasificación de Urken (33). En la mayor parte de nuestros pacientes, el defecto dejaba comunicada duramadre injertada o reparada (23 pacientes) con la vía aerodigestiva superior (26 pacientes), sobre todo en aquellos pacientes con tumores de localización en el área I. La resección ósea incluyó en 19 casos el hueso malar y en 13 el suelo orbitario, con las consiguientes implicaciones reconstructivas (22). La cavidad residual más frecuente fue la fosa infratemporal.

El empleo de los colgajos locales (galea-pericráneo, fascia parietotemporal, músculo temporal) ha quedado, en nuestra experiencia frecuentemente condicionado no sólo por la extensión tumoral, sino por los procedimientos quirúrgicos previos (incisiones, resecciones), siendo de enorme importancia la planificación quirúrgica detallada en ese sentido (incisiones, viabilidad de colgajos, opciones reconstructivas). No obstante, son estos colgajos locales los métodos reconstructivos más frecuentemente empleados en este tipo de cirugía (2,21,30). El uso del músculo temporal en este sentido está con frecuencia comprometido por cirugías previas o afectación tumoral (meningiomas esfenoorbitarios). Los colgajos libres microvascularizados han sido muy útiles en el manejo de grandes defectos resectivos. Es importante, a la hora de elegir el método reconstructivo, considerar los tejidos disponibles, el volumen de espacio muerto extradural predecible (29), el estado de la duramadre, la extensión de la comunicación con la vía aerodigestiva superior, el pronóstico del paciente y la necesidad de radioterapia postoperatoria. En este sentido, siempre hemos reconstruido con injertos autólogos los rebordes supraorbitarios y glabela. La reconstrucción orbitaria ha sido completa (de todos los rebordes y paredes resecados) en el caso de tumores benignos (6,21), y ciertos tumores malignos con funcionalidad ocular conservada, evitando injertos en suelo-pared medial cuando se precisó radioterapia postoperatoria. Una plastia de metil-metacrilato (8%) hubo de ser retirada por infección. Los sistemas de microosteosíntesis utilizados para fijación ósea han presentado un bajo índice de complicaciones, no interfiriendo con las pruebas de imagen postoperatorias (31).

La mortalidad perioperatoria (3%) se encuentra en límites aceptables (27,28). La supervivencia global obtenida (80%) con un seguimiento medio corto (31 meses) coincide sensiblemente con los resultados obtenidos por otros autores (3,10,12,14), teniendo en cuenta la proporción de tumores malignos, los tipos histológicos y las localizaciones. Es interesante recalcar que incluso para los

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tumores malignos, este tipo de intervenciones no son hoy día un recurso desesperado de resultados inciertos para casos sin solución: la supervivencia obtenida a 5 años ha sido en algunas series hasta del 69% (12). En nuestra experiencia, hemos obtenido una supervivencia global para neoplasias malignas del 69% con un seguimiento medio de 30 meses; además, de los cinco pacientes con tumores malignos fallecidos, uno murió libre de enfermedad; en dos de los otros cuatro pacientes, que fallecieron por su enfermedad neoplásica, no existía evidencia de recidiva locorregional en el momento de su fallecimiento.

El porcentaje de pacientes con complicaciones postoperatorias (56%) aunque elevado, es similar al de otros autores (2,12,27). La mayor parte de las mencionadas complicaciones no han conllevado secuelas definitivas, o han podido ser solucionadas adecuadamente con métodos conservadores o procedimientos quirúrgicos secundarios. Es prioritario para aquellos equipos multidisciplinarios que tratan este tipo de tumores, trabajar en el sentido no sólo de mejora de la supervivencia de sus pacientes, sino de disminución en la tasa de complicaciones, y obtención de resultados reconstructivos superiores desde el punto de vista estético y funcional.

#### Conclusiones.

El tratamiento quirúrgico de los tumores de la base craneal ofrece unos resultados aceptables en términos de resecabilidad y supervivencia, con un apreciable índice de complicaciones. Una correcta reconstrucción primaria es imprescindible para la supervivencia postoperatoria, amplía los límites de resecabilidad tumoral, contribuye a una mejora de la supervivencia a largo plazo, reduce la incidencia de complicaciones, y proporciona una mejor calidad de vida postoperatoria en los pacientes con tumores de la base craneal.

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# Tumors of the Infratemporal Fossa

ABSTRACT—Neoplastic processes involving the infratemporal fossa may originate from the tissues in the region, but more often are the result of extension from neighboring structures. Metastatic lesions located in the region are rarely encountered. Because of its concealed localization, tumors may remain unnoticed for some time. Clinical signs and symptoms often arise late, are insidious, and may be mistakenly attributed to other structures. The close proximity of the area to the intracranial structures, the orbit, the paranasal sinuses, the nasopharynx, and the facial area demands careful planning of surgical excision and combined procedures may be called for. Modern imaging techniques have made three-dimensional visualization of the extent of the pathology possible. Treatment depends on the histopathology and staging of the tumor. Several surgical approaches have been developed over the years. Radical tumor excision with preservation of the quality of life remain the ultimate goal for those tumors where surgery is indicated. Experience over a decade with various pathologies is presented.

The infratemporal region, by virtue of its relatively concealed location, is inaccessible for clinical and endoscopic examination. Space-occupying lesions in the area, with the exception of those with an inherent rapid growth pattern, may continue to grow unnoticed for considerable period. When symptoms do appear they are insidious and may not draw attention until there is some impairment of function. Because of the relative infrequency of these lesions, there is paucity of information at the general practitioner and sometimes even at the specialist level.

As a result, the diagnosis is often delayed. Not uncommonly, attention is first drawn by radiological investigation carried out in an effort to seek further information. Although interest in the pathologies and surgical intervention in the area has long been known, the last decade has seen renewed interest. Some of the earliest publications on the surgical approaches to the area appeared in the last century. They were mainly directed to the relief of pain from sphenopalatine neuralgia, 2.3 but the morbidity of some of these approaches was unacceptable and they did not gain popularity. In 1928, Sewal

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described a transantral approach for the excision of the sphenopalatine ganglion, which was well received. This approach is still practiced to date, although for other indications. Newer and bolder surgical approaches were introduced in the 1960s by pioneers such as Conley. Barbosa, and Crockett. These approaches and others were perfected in the following years. Tumors in this region often spread to the surrounding spaces and may involve intra- and extracranial structures. This anatomical area has therefore become the focus of attention of several specialities including neurosurgery, maxillofacial surgery, otolaryngology, opthalmology, skull base surgery, and surgical oncologists. The purpose of this article is to present our experience over more than a decade with tumors of this region.

#### SURGICAL ANATOMY

The infratemporal fossa is the irregular retromaxillary space bounded above by the greater wing of the sphenoid medially and a part of the squama of the temporal bone laterally, bordered by the infratemporal crest. The medial boundary of the fossa is formed by the lateral surface of the lateral pterygoid plate of the sphenoid. This boundary is breached anterosuperiorly by the presence of the pterygomaxillary fissure through which the fossa communicates with the pterygopalatine fossa. Just posterior to the junction of the lateral pterygoid plate with the body of the sphenoid is the foramen ovale and posterolaterally few millimeters away is the foramen spinosum. The cartilagenous eustachean tube is immediately posteromedial. The average distance between the lateral pterygoid plate in adults at this point from the upper border of the zygomatic arch is 38.2 mm and represents the distance to the foramen ovale.89 The posterior margin of the medial pterygoid plate, which represents the lateral wall of the nasopharynx, is on an average 47.8 mm from the zygoma.8 The posterior wall of the maxilla forms the anterior surface of the space and at its superolateral corner communicates with the orbit via the inferior orbital fissure. Although the zygoma forms the bony lateral boundary of the fossa, the

Table 1. Tumors of Infratemporal Fossa

Report	Reported Series in the Literature			
	Cases	(Tumor)		
Conley (1964)	27	7 primary		
Shapshay et al. (1976)	フ	1 primary		
Shaheen (1982)	36	10 primary		
Johnson and Maran (1982)	12	4 primary		
Hertzanu and Mendelsohn (1984	) 16	8 primary		
Sekhar (1987)	18	not specified		
Lepkowski et al. (1991)	10	3 primary		
Vaillant (1994)	10	5 primary		
This series (1998)	33	13 primary		

**Table 2.** Primary Tumors of the Infratemporal Fossa (1985–1998)

Fibrosarcoma	1
Hemangioma	1
Hemangiopericytoma	1
Histocytosis x	1
Hodgkin's Lymphoma	1
Meningioma	2
Neurofibroma	1
Osteosarcoma	1
Rhabdomyosarcoma	2
Schwannoma	2

space is virtually closed laterally by the temporalis muscle as it descends to the coronoid process. Laterally, the fossa communicates with the temporal fossa between the zygomatic arch and the lower temple. Inferiorly, the space communicates with the neck, but is partially closed by the medial pterygoid muscle and its fascial covering. This muscle marks the boundary with the parapharyngeal space that communicates with the infratemporal fossa behind its posterior border. The internal carotid artery and the internal jugular vein are on a posterior plane and are not encountered in the space. The temporalis, lateral, and medial pterygoid muscles occupy the space from lateral to medial in that order. The space is traversed by the maxillary artery from lateral to medial and the mandibular nerve and its branches from above downwards. Anatomical variations in the course and branching pattern of these vessles and nerves occur not infrequently.10

#### **CLASSIFICATION**

The infratemporal fossa is usually involved by tumors extending from surrounding areas such as the

**Table 3.** Benign Tumors of the Infratemporal Fossa (1985–1998)

Hemangioma	1
Lipoma	†
Meningioma	2
Nasopharyngeal fibroma	5
Schwannoma	2

**Table 4.** Malignant Tumors of the Infratemporal Fossa (1985–1998)

1 t t t t	
Adenoidcystic carcinoma	/
Adenocarcinoma	4
Fibrosarcoma	1
Hemangiopericytoma	1
Histocytosis x	†
Hodgkin's lymphoma	1
Osteosarcoma	1
Rhabdomyosarcoma	2
Squamous cell carcinoma	4

paranasal sinuses, middle cranial fossa, the nasopharynx, the parotid gland, and the external ear canal. These tumors are termed contiguous. A smaller number of tumors originate from the tissues in the space itself and are called primary tumors. Metastasis to the area from tumors elsewhere is rare. This classification was suggested by Conley, 11 and is practical and universally accepted. Table 1 lists the documented series reported in the literature. 12-18 The number of primary tumors in each series is mentioned and comprise 25 to 30% of all tumors in the area. Of the 33 patients with tumors of the infratemporal fossa seen by us, 13 were primary neoplasms (Table 2).

#### PATIENTS AND METHODS

Thirty-three patients were treated between January 1985 and December 1998 for tumors involving the infratemporal fossa. Tables 3 and 4 show the benign and malignant tumors seen by us. All patients were White Caucasians. There were 13 males and 20 females. Their ages varied between a minimum of 7 to a maximum of 83 years. Clinical features of 14 illustrative cases, their histological diagnosis, the therapeutic approach and outcome is summarized in Table 5.

#### DISCUSSION

#### **Pathology**

Tumors of the infratemporal fossa present a wide spectrum of pathologies, benign and malignant. Adenoidcystic carcinoma is the most frequently encountered malignant tumor in the region. In addition to the one case reported here we encountered six more cases of adenoidcystic carcinoma where the tumor was contiguous and extended from the maxillary sinus, deep lobe of the parotid gland, or recurred in the area after excision of the primary in the ethmoid or the soft palate, making it the most common pathology. The indolent growth pattern of this tumor often leads to delayed diagnosis and symptoms could be traced upto 2 years before diagnosis in our patients. Shotton et al. 19 reported their experience of 13 cases of adenoidcystic carcinoma treated with type C infratemporal fossa approach. They considered that these tumors originate primarily in the nasopharynx and also put forward a classification of adenoidcystic carcinoma in this region. All the adenoidcystic carcinomas treated by us were stage III or IV and in two of the seven cases the tumor seemed to originate from the deep lobe of the parotid gland and in one case probably from ectopic salivary tissue. Perineural spread so characteristic of this tumor makes radical excision a delusion. In our experience, even after extensive surgical excision when dealing with this tumor in the infratemporal fossa, postoperative radiotherapy is essential. Extension to the lateral wall of the cavernous sinus via the foramen ovale used to be considered inoperable. Although neurosurgical developments in the last decade have made surgical excision of this extension a reality, it should be carefully weighed against the possibility of microscopic irradical excision as well as the ensuing morbidity.<sup>20</sup> Prognosis depends upon the tumor stage and presence of perineural or perivascular extension. Distant metastases are not uncommon and if solitary, surgical excision should be considered.

Two patients in this series were diagnosed rhabdomyosarcoma, both were histologically of alveolar type. Both underwent surgery after failed chemotherapy and were also irradiated postoperatively. The role of surgery in this tumor is in diagnosis and treatment. Radical surgery may be contemplated when total excision is possible.21 In recent years brachytherapy with after loading technique following surgery and followed by reconstruction a week later has been reported.<sup>22</sup> Close cooperation between the medical oncologist and the surgeon is essential to determine the timing of surgical intervention. Prognosis is dependant on the histologic type and is said to be worse in alveolar variety with 5year survival of as low as 9% as compared to betryoid, embryonal and spindle cell varieties, where survivals upto 86% at 5 years have been reported.23

The clinical course of the patient with histocytosis X was aggressive and dramatic. The presentation with preauricular swelling, trismus was suggestive of a space-occupying lesion in the region of infratemporal fossa, but subcutaneous nodules suggested a disseminated process. While the presence of a mass in the infratemporal fossa was confirmed on magnetic resonance imaging (MRI) scan, histopathology of one of the subcutaneous nodules showed appearance of histocytosis and a hematologist consultation was requested. However, the patient died of intracerebral hemorrhage before treatment could be started. It was considered as a malignant form of Letterer-Siwe syndrome. The exact etiology of this disease entity, which is seen more in children than adults, is unknown. Recent ultrastructural and immunohistochemical studies have identified the histocytic cells in Langerhans histocytosis lesions to be part of the Langerhans dendritic cell system, Although the Langerhans cells in the lesion are clonal, this does not define it as a neoplasm.24-26 This case exemplifies the importance of establishing a histologic diagnosis before any form of therapy.

The presenting symptoms of the two cases of meningiomas seen in this region were different in each case, namely facial swelling in one and hearing loss in the other. Extradural meningiomas occur as extracranial extension of intracranial tumor. One of our patients, Case 7 is an example of a secondary meningioma extending from the middle cranial fossa to the infratemporal fossa via the foramen ovale and eventually causing

Table 5. Primary Tumors of the Infratemporal Fossa

	ex— Age	Presenting Symptoms	Diagnosis	Approach—Therapy	Outcome
F	68	<del></del>	Meningioma	Refused surgery, External beam radiotherapy 44 Gy, 22 fractions	Stable follow-up 10 years
F	39	Heaviness of head, Difficulty in chewing on right side. Hypo- aesthesia right cheek. Tingling right half of tongue 6 months	Adenoid cystic carcinoma	Maxillary swing. Postop radiotherapy 62.5 Gy, 31 fractions	Died 14 months later of liver metastasis
F	13		Lipoma	Transoral via gingivolabia! sulcus	Total tumor removal. Full recovery
F	33	Moderate unilateral hearing loss. Right earache 6 years	Schwannoma	Preauricular transzygomatic	Full recovery. Follow-up 5 years
М	21	Slowly progressive trismus 5 months. Headache	Alveolar rhabdomyosarcoma	Preop chemotherapy less than 50% response. Extended maxillotomy. Postop radiotherapy 63 Gy, 30 fractions. Recurrence 3.5 years later. Total maxillectomy. Postop chemotherapy	Survived 5 years
F	83	Paraesthesia left nasal ala, upper lip, zygoma. Swelling left cheek. Hypoaesthesia left infraorbital area	Hodgkins lymphoma grade 1E	Radiotherapy 33 Gy, 11 fractions	Died 8 months later
F	29	Moderate unilateral hearing loss 3 months	Meningioma middle cranial fossa and infratemporal fossa	Staged preauricular, trans- cranial, transzygomatic. Postop radiotherapy 55 Gy, 27 fractions	Controlled asymptomatic
F	47	Right preauricular pain. Swelling under the right mandible 3 weeks. Right preauricular swelling. Subcutaneous swelling left arm, left infraclavicular area, left occupital area. Hypoaesthesia lower jaw. Mild trismus	Histocytosis X. Leterer Siwe disease. Atheromatous cyst right submandibular area	Haematologist consultation	Died 5 weeks later of intracerebral haemorrhage related to histocytosis
F	79	Slowly progressive trismus 2 years. Swelling right cheek	Adenocarcinoma	Preauricular, transzygomatic, transmandibular	Doing well NED Follow-up 3 years
М	43	Unilateral nasal obstruction 4 months	Schwannoma	Transmandibular + facial degloving	Temporary abducens. Paresis for 3 weeks. Complete recovery. No complaints. Follow-up 2 years
F	28	Sensation of pressure over the right upper jaw. Swelling right gingivolabial sulcus 5 months	Osteosarcoma	Transmandibular + facial degloving + composite free flap iliac crest	Doing well. Follow-up 18 months
М	46	Hemifacial pain. Epiphora. Hypoaesthesia cheek and chin 3 years	Fibrosarcoma. Extension to ethmoid, sphenoid, nasopharynx, orbit, middle cranial fossa	Preauricular, transcranial + transzygomatic + transmandibular + facial degloving. Rectus abdominis free flap. Postop radiotherapy 66 Gy, 33 fractions	Doing well
М	7	Unilateral, frontoparietal head- ache 1 month. Rhinorrhea	Alveolar rhabdomyosarcoma	Chemotherapy, radiotherapy, surgery, brachytherapy in other institution	Short follow-up
F	20	Pain right molar area. Submu- cosal buccal swelling	Malignant hemangiopericytoma	Preauricular transzygomatic + transmandibular + facial degloving + rectus abdominis free flap. Postop radiotherapy 66 Gy, 33 fractions	Metastates to thoracal and sacral spine. Radiotherapy 80 Gy once a week for 2 weeks Good palliation

conductive hearing loss as a result of eustachean tube malfunction. Part of the intracranial tumor had grown across the median line to involve the lateral wall of the opposite cavernous sinus. It was decided to radiate this postoperatievely. Case 1 can be regarded as primary extracranial meningioma, an uncommon entity. The origin of truely ectopic variety is thought to arise from arachnoid cells, which are normally present in the arachnoid membrane, subarachnoid space, and in association with dural vein and sinuses.27 These tumors have been reported in the nose, paranasal sinuses, orbits, temporal bone, scalp, infratemporal fossa, neck, and as far as the parotid gland.<sup>28-31</sup> Four major variants of the tumor have been described, namely the syncytial or meningotheliomatous, transitional, fibrous, and angioblastic. The last variety has an aggressive growth with a tendency to recurrence. Both tumors in this series were meningiotheliomatous. Differential diagnosis of a meningioma histopathologically from paraganglioma may be difficult. Case 1 was thought to be a paraganglioma, but finally the diagnosis of a meningioma was established on the basis of positive reaction to Vimentin and occasionally to S-100 protein. Paragangliomas, though rare, do occur and a case of catecholaminesecreating paraganglioma of the infratemporal fossa has been reported in the literature.32

Peripheral nerve tumors are known to occur frequently in the infratemporal fossa and are usually benign, 33,34 but malignant tumors of peripheral nerve sheath have been reported. 35 Their slow growth may produce symptoms pertaining to other organs and delay the diagnosis. They are invariably primary tumors. In one of our patients the presenting symptom of conductive hearing loss due to serous otitis was misleading and patient received treatment elsewhere for several years before a diagnosis of space-occupying lesion was made on computed tomography (CT) scan.

The patient with the large lipoma in Case 3 was of clinical interest because, although a diagnosis of lipoma had been made several years ago, sarcomatous change is known to occur and reports of liposarcomas in this region have appeared in the literature.<sup>36</sup> Lipoma is the most common mesenchymal tumor and some 13% occur in the head and neck, however, its occurrence in the infratemporal region is unusual. The histology of the tumor and the age of the patient were determining factors in the choice of the approach which, though unconventional, proved to be satisfactory with no resultant morbidity.

Hemangiopericytoma is a complex vascular tumor, which is supposed to arise from the pericyte. Histologically, it demonstrates great variability. Its lack of uniformity in appearance and growth, unpredictable clinical course, and biological behavior make therapeutic decision making difficult.<sup>37</sup> Intraoperative appearance in our patient was suggestive of its origin in the medial pterygoid muscle. This is a highly unusual localization. Only one case has so far been reported as originating from the

pterygopalatine fossa.<sup>38</sup> A decision to irradiate postoperatively our patient was taken after extensive discussion with the pathologist and radiotherapists. The overweighing argument was the uncertainty of the radicality of the excision margins because of the peculiar localization, the extent of the tumor and its histology. The biological behavior of this tumor, in our patient proved aggressive with metastases appearing in the thoracal and sacral spine within 6 months of treatment of the primary tumor. Symptomatic relief of pain was obtained by palliative radiotherapy to the metastases.

Fibrosarcoma is commonly seen in the extremities, but is a rare tumor in the infratemporal region. Of 29 fibrosarcomas in the head neck area treated in UCLA, only 2 (7%) had their origin in this area.<sup>39</sup> Tumor grade, tumor size, and surgical margin status are considered the most important prognostic factors. The only patient in this series with fibrosarcoma had extension to the sphenoid, ethmoid, nasopharynx, orbital, and middle cranial fossa and although, the tumor was macroscopically removed enbloc, we considered postoperative radiotherapy advisable, in keeping with the experience of larger series reported in the literature.<sup>40</sup>

A large variety of rare tumors of the infratemporal fossa, mostly mesenchymal in origin, have been reported in the literature, including giantcell tumors,41 hemangiomas,42,43 histiofibroma,44 synovial sarcoma,45 recurrent benign parotid tumors,46 and solitary fibrous tumors.47 An early diagnosis requires awareness on the part of the family physician as well as the specialist. Surgery plays a major role in their management. However, some of the benign tumors such as hemangiomas may be extensive and without symptoms. Clinical evaluation and judgement is essential before embarking on the treatment. While prognosis is related to histology and stage at presentation, most tumors can be successfully treated with preservation of function and aesthetics. The crucial problem in tumors with intracranial extension is the involvement of the cavernous sinus and although surgical intervention to this structure is possible, the histology of the disease process, radicality of proposed excision, ensuing morbidity after the procedure and the intraoperative risk of complications are some of the questions that need to be carefully considered.

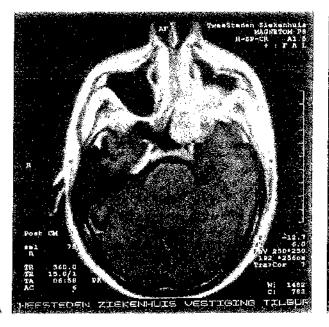
#### Diagnosis

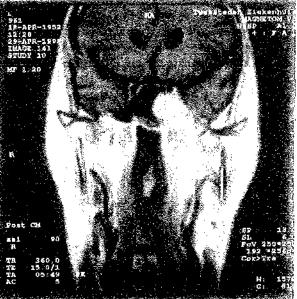
Histopathology of the tumor and assessment of tumorextension are the first essential parameters in the management. CT scan is essential for lesions that are bony in origin or where bony changes arise as a result of spread or expansion of the growth.<sup>48</sup> MRI scan with contrast can better evaluate the soft tissues and is helpful in evaluating intracranial extension or intramuscular infiltration.<sup>49</sup> It sometimes may be able to identify the tissue of origin of the tumor, but this is difficult in large

tumors and those with multiple extensions. A histologic diagnosis can be obtained by aspiration cytology in majority of cases, however, CT-guided, fine-needle aspiration may sometimes be needed in deep-seated lesions. 50.51 Biopsy is called for if cytology is not conclusive and is necessary in soft-tissue sarcomas. In one of our patients aspiration cytology had confirmed the presence of malignant cells, but it was the histologic picture of the cutaneous metastasis, which established the diagnosis of histocytosis x. The transantral and transoral route via the gingivolabial sulcus are the routes most frequently used for obtaining a biopsy. Angiography is often required in vascular tumors. The role of surgery in mesenchymal tumors is diagnostic and therapeutic. Surgical excision is also indicated in epithelial tumors.

#### Surgical Approaches

There are a variety of surgical approaches available and the surgeon has to choose the appropriate technique that will provide maximum exposure with minimal morbidity so as to preserve the quality of life. Table 6 presents the various surgical approaches available. Combined approaches usually offer the best solution in tumors with multiple extensions. Neurosurgical consultation and collaboration is essential in all cases where intracranial extension is suspected. One of the frequently encountered problems is the extension of the malignant process to the lateral wall of the cavernous sinus. If it is possible to excize this tumor extension, the surgical procedure can be extended intracranially. The





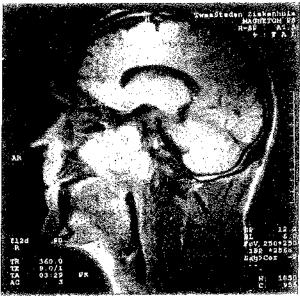
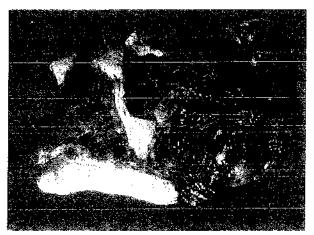


Figure 1. MRI axial (A), coronal (B), and (C) sagittal views demonstrating a space-occupying lesion in the ITF with extension superiorly to the sphenoid sinus and the floor of the middle cranial fossa, anteriorly up to the orbit and in the left maxillary sinus. The lateral nasopharyngeal wall is pushed medially.





**Figure 2.** (A, B) Lateral and inferior of views of the operative specimen of tumor. The main mass of the tumor is retromaxillar and extends into the maxillary sinus through the posterior wall, which is totally destroyed. The intracranial and sphenoid sinus extensions are removed en bloc.

histopathological nature of the disease is often the determining factor in the selection of the approach. However, if a total excision is not possible, then it is difficult to justify the neurovascular complications that may ensue and may compromise the quality of life of the patient. One of the significant contributions to the field of surgery of this region in this centrury was by Fisch, who combined the skills of otological and head neck surgery.<sup>52</sup> He advocated type C approach for this purpose.<sup>53</sup> However, there are some limitations to this technique. The hearing is permanently sacrificed in the ear on the side affected and in the hands of others there is a reasonable incidence of facial weakness. His procedure has therefore been modified by others.54 Sekhar et al.16 described a subtemporal preauricular infratemporal fossa approach for the purpose of excision of lesions in the regions of the sphenoid, clival bone, medial half of petrous temporal bone, infratemporal fossa, nasopharynx, retro- and parapharyngeal area, ethmoid, sphenoid and maxillary sinuses, and the intradural clivus-foramen magnum area.16 The conductive hearing apparatus, when not involved by pathology, is preserved. In our ex-

Table 6. Surgical Approaches to the Infratemporal Fossa

Approach	Author (Year)
Transoral	via superior gingivolabial sulcus
Transantral	Sewall (1926)
Transpalatinal	Kornfehl (1996)
Extended maxillotomy	Krause & Baker (1982)
Extended osteoplastic	
Maxillotomy	Catalano and Biller (1993)
Maxillary swing	Wei (1991) Hernandez (1986)
Transmandibular	Conley and Barbosa
	(1956–1961)
Transzygomatic	Barbosa (1961)
Facial translocation	Janecka (1990)
Transcranial	Sekhar (1987)

perience a combined middle fossa craniotomy with preauricular transzygomatic approach provides good access to the region and this can be combined with a transmandibular and facial degloving approach to obtain maximum exposure (Figs. 1a-c, 2a, 2b, and 3). Patients appreciate the absence of a facial scar. However, this should never should compromise adequate tumor excision. This approach is also suitable for surgical

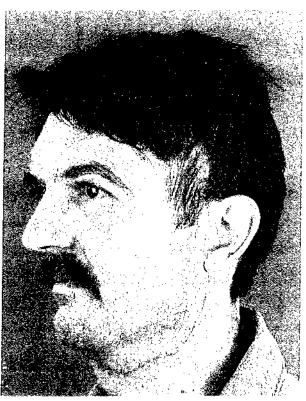


Figure 3. Postoperative appearance of patient,

exposure of the internal carotid artery and cavernous sinus. In dealing with tumors, subdural dissection medially with minimal retraction of the temporal lobe would allow access to the cavernous sinus. The working space provided by a paramedian mandibulotomy can be improved further by an additional mandibulotomy just below the intercondylar notch and above the entrance of the inferior alveolar vessles and nerve.55 Subluxation of the temporo-mandibular joint can further improve the access. The maxillary swing approach provides access to midline structures, but is unsuitable and inadequate for the purpose of approaching tumors of the infratemporal fossa. In situations where the tumor is fixed to the mandibular periosteum, segmental mandibulectomy is indicated. Control of the internal carotid artery and internal jugular vein from the neck and through the petrous bone provides dual control. Several other approaches to this region have been described and are listed in Table 5.56-61 Some of these provide limited exposure, others produce temporary morbidity, which is sometimes unacceptable to the patient. Even when the lateral wall of the nasopharynx is excised and a throughand-through defect into the nasopharynx exists, wounds heal well without fistulization after a temporalis muscle flap. The donor area defect is camouflaged easily. When tumor excision is complete, the use of free vascularized composite flaps provide immediate bulk and surfacing.

Postoperative complications in our series were minimal and transient and there was no operative mortality. In three patients with malignant tumors of the deep lobe of parotid, the facial nerve had to be sacrificed and a gold implant in the upper eyelid was inserted. Some patients experienced postoperative trismus, which improved on physiotherapy instituted soon after surgery, but occasionally this persists, especially if postoperative radiotherapy follows. All patients operated upon the infratemporal region undergo a middle-ear drainage and placement of a drainage tube.

There have been several reports of individual cases of neoplasms of the infratemporal fossa, but fewer series of primary tumors have been reported. In this article, we have presented a series of 13 primary tumors, which is so far the largest series in the literature. The pathology is varied and is discussed with reference to its implications in the management. Close cooperation not only within the surgical team but also with the radiologist and the pathologist is essential. A combination of surgical approaches that provide maximum access with minimum morbidity has been presented.

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# The use of stereotactic navigation guidance in minimally invasive transnasal nasopharyngectomy: a comparison with the conventional open transfacial approach

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Abstract. The purpose of this paper is to study the efficacy of applying stereotactic navigation guidance to nasopharyngectomy via a minimally invasive transnasal approach as compared with the conventional open transfacial approaches. The nasopharynx is the centre of the anterior skull base, which is remote from the surface of the facial skeleton. It is well known that there are several surgical approaches for access to resect tumours from the nasopharynx. However, the open techniques have been associated with much morbidity and only provide access to, and identification of, the ipsilateral internal carotid artery that forms the lateral boundary and resection limit of the nasopharynx. The coupling of stereotactic navigation guidance and a minimally invasive transnasal approach for nasopharyngectomy allows the surgeon to identify and protect the internal carotid artery bilaterally at the nasopharynx. This technique reduces operating time and morbidity to a minimum and yet is oncologically sound for resecting nasopharyngeal lesions. We compare 15 patients who underwent the stereotactic navigation guidance approach with 20 patients who received a conventional open transfacial approach.

The use of stereotaxis with a three-dimensional (3D) Cartesian coordination system for spatial localization was first developed in animal models by Horsley et al [1]. The first human stereotactic apparatus was invented by Spiegel et al in 1947 [2]. Since then, rapid advances in neuroscience and CT have made the development of stereotactic surgery possible in almost every field where precise spatial localization is required.

Nasopharyngectomy has been well established as a surgical treatment for recurrent and residual disease of nasopharyngeal carcinoma (NPC) [3-10]. The various surgical approaches described for nasopharyngectomy include trans oro-palatal [3, 4], maxillary swing [5, 11], intra-oral Le Fort I osteostomy [12] and mandibular swing [6]. A new technique [7] with transnasal approach has been developed in our institution by employing a mid-face degloving intra-oral incision [9, 13, 14]. Previous complications such as facial scar, trismus, ectropion, damage to the lingual nerve or infra-orbital nerve, palatal dehiscence, nasal

Material and methods

Hospital records of 35

Hospital records of 35 patients with recurrent NPC between March 1997 and June 2001 were studied. All patients were operated on by the first author under general anaesthesia and through a

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regurgitation, malocelusion, excessive blood loss and prolonged operating time and hospital stay could be avoided or reduced. Therefore the stereotactic navigation-guided transnasal approach has reduced the morbidity of the procedure to a minimum and improved the quality of life with the same survival [7, 15]. However, the limitation of this transnasal mid-face degloving technique [9] is the restricted access in identifying the internal carotid arteries that are located bilaterally in the paranasopharyngeal space. Stereotactic navigation guidance (SNG) [7] was applied successfully to locate and protect the internal carotid arteries and facilitate dissection and clearance of the tumour in the nasopharynx. This report compares the advantages of the image guidance transnasal technique [7] with the conventional open transfacial approaches [3-6].

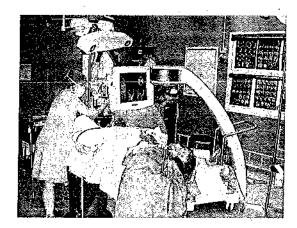


Figure 1. The stereotactic navigation guidance system (Vector Vision 2; Brain Lab, Heimstelten, Germany) in theatre.

tracheostomy tube. The technique of frameless SNG was performed on 15 patients using Vector Vision 2 (Brain LAB, Heimstetten, Germany) equipment (Figure 1). A standard mid-face degloving incision [9, 13, 14] is used to expose the nasal cavity and maxilla. Bilateral medial maxillectomy is then performed. The posterior nasal septum, bilateral inferior turbinate and middle turbinate are excised to expose the entire nasopharynx, including the paranasopharyngeal space (Figure 2). The internal carotid arteries are then located by the navigation probe before dissection of the tumour (Figures 3–7). The other 20 patients received open transfacial approaches.

#### Imaging protocol in stereotaxy

CT stereotactic localization is performed using a GE HiSpeed Advantage RP Scanner System (General Electric, Milwaukee, WI). Six temporary fiducial CT markers (containers filled with contrast medium) are placed over the patient's forehead at specific sites for stereotaxy. The head is placed in a neutral position with respect to the

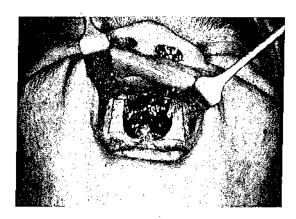


Figure 2. Retracted upper lip and bilateral medial maxillectomy allowing a minimally invasive transnasal approach to the nasopharynx.

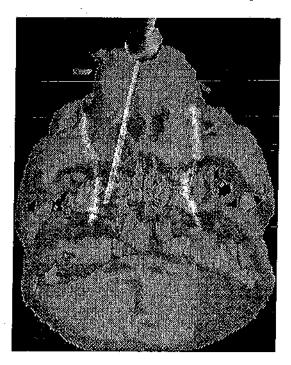


Figure 3. Computer generated three-dimensional image showing identification of the left internal carotid artery with the navigation probe.

craniocaudal axis [10, 11]. Scanning parameters include zero gantry tilt, 120 kV, 170 mA, 3 mm slice thickness with 1:1 pitch,  $512 \times 512$  matrix size and 48 cm  $\times$  48 cm scan field of view. The examination extends from the cranial fossae down to the base of the symphesis menti, including all the fiducial markers, the entire nasopharynx and the

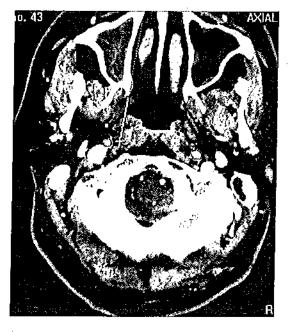


Figure 4. Axial CT image showing identification of the left internal carotid artery with the navigation probe,



Figure 5. Coronal CT image showing identification of the left internal carotid artery with the navigation probe.

distal common carotid arteries, the carotid bifurcations and the internal carotid arteries up to the foramen lacerum. Intravenous contrast medium is given as a bolus of 90 ml of Ultravist 240 (Schering, Germany by power injector at a rate of 2 ml sec<sup>-1</sup>. A typical study comprises 50-60 slices and can be completed within 1 min. The entire examination lasts about 5 min. The patient must keep their head still and avoid swallowing to reduce artefacts and registration errors. After CT scanning, the raw data are transferred to a designated SNG workstation and

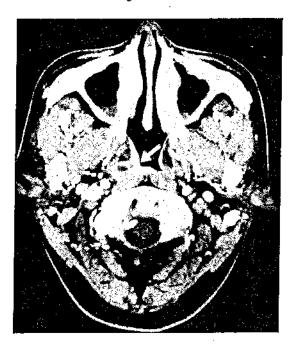


Figure 6. Contrast enhanced axial CT showing recurrence of nasopharyngeal carcinoma in the right nasopharynx (arrow) invading posterolaterally.

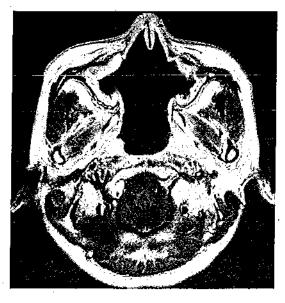


Figure 7. Arial  $T_1$  weighted MR1 image 3 months postoperative of nasopharyngectomy. Nasopharyngectomy was performed via the transnasal approach.

the images fused to give a set of stereotactically matched images.  $T_1$  weighted MRI with contrast medium (no gantry tilt) might also be carried out. Four patients in the transmasal group received both CT and MRI, however, the benefit obtained from MRI was not clinically obvious and therefore not applied to other patients to avoid prolonged imaging time and for better distribution of resources.

#### The stereotactic navigation technique

The SNG system consists of two major components. The first is a computer workstation for the capture of neuro-images, image fusion and subsequent surgical planning. The second is a pair of digital infrared cameras and a number of reflective reference markers attached to various instruments. The angle between the pair of infrared cameras is calibrated. The cameras are positioned to overlook the operating field. The workstation calculates the 3D position of the reflective markers based on the camera angle and location of the markers on the camera images. A set of reference markers is attached rigidly to the skull via a skull clamp during the operation (Figure 1). Coregistration of the navigation system takes about 15 min. A wireless navigation probe with reflective markers is used to register the location of the same set of CT markers in the operating room.

The error between the true position of the fiducial markers and the position as depicted on the computer screen is the fiducial registration error (FRE). This is defined as the root mean square distance between corresponding fiducial

points after registration. FRE, using the set up described, is typically between 0.8 mm and 1.2 mm. Registration of a set of fiducial markers allows the computer to determine a virtual 3D coordinate system that is used to match imaging data to the position of the patient's head on the operating table and to trace the position of the navigation probe in relation to neuro images during the operation (Figures 3-5).

During application of the navigation probe the target registration error (TRE) [16], which is the error in the position of an anatomical target, must be kept in mind. Therefore it is important for the surgeon to point at a known surface anatomical structure with the navigation probe and to visually correlate this with the computer screen to reaffirm that the whole system is functioning accurately and pointing at the correct anatomy before the probe is applied to the target anatomy and resecting the lesions.

#### Results

29 male and 6 female patients who received nasopharyngectomy for their recurrent NPC at Prince of Wales Hospital, The Chinese University of Hong Kong between March 1997 and June 2001 were studied. The patients' ages ranged from 26 years to 69 years, with a mean age of 55.5 years. Four surgical approaches were applied, namely transnasal, maxillary swing, mandibular swing and combined maxillary-mandibular swing. 15 transnasal approach operations were carried out using SNG, and 20 patients received an open transfacial approach without SNG.

There was no peri-operative mortality in the transnasal group and two cases of post-operative meningitis, resulting in death, in the open transfacial group. In one patient, the left internal carotid artery was damaged during dissection (open maxillary swing approach). The artery was ligated and the patient recovered uneventfully. Other parameters such as operating time, blood loss, hospital stay, ectropion, damage to nerves, palatal dehiscence, trismus, velopharyngeal incompetence and nasal regurgitation are compared and illustrated in Table 1.

#### Discussion

The nasopharynx is situated at the centre of the anterior skull base. The anatomical relations of the nasopharanynx include the clivus posteriorly, the posterior nasal cavity anteriorly and the carotid spaces laterally. Superiorly lies the sphenoid sinus, and the inferior boundary is defined by the level of the soft palate. Access to the nasopharynx for tumour resection has remained a challenge to surgeons owing to its deep

12ble 1. Comparison of or	verating time, b	lood loss, hosp	pital stay and incide	ence of other m	Lable 1. Comparison of operating time, blood loss, hospital stay and incidence of other morbidities associated with different surgical approaches to nasopharyngectomy	fferent surgic	al approaches	to nasopharynge	ctomy
Surgical approach	Average operation time (min)	Average blood loss (ml)	Post-operative hospital stay (days)	Ectropion	Nerve transection (lingual or infra-orbital without regeneration of sensation)	Palatai fistula	Trismus	Impaired	Nasal regurgitatio
Transnasal with stereotactic guidance $(n=15)$	185	216	11	0	0	0	0	1 (7.1%)	2 (14.3%)
Maxillary swing $(n=12)$ Mandibular swing $(n=5)$ Combined maxillary and mandibular $(n=3)$	240 387 585	1.398 1,596 1,270	32 54 63	9 (75%) 0 2 (66.7%)	6 (50%) 3 (60%) 2 (66.6%)	3 (25%) 1 (20%) 0	4 (33.3%) 2 (40%) 3 (100%)	2 (16.6%) 1 (20%) 2 (66.7%)	5 (41.6%) 1 (20%) 1 (33.3%)
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anatomical position and its proximity to major structures such as the internal carotid arteries.

NPC is a common malignancy in Hong Kong [17]. The treatment of primary disease is with radiotherapy, whereas surgery followed by post-operative intracavity brachytherapy has proven to be one of the choices in treating locally recurrent NPC so as to avoid the complications of high dose re-irradiation to the nasopharynx [3–9] and nearby structures.

Transfacial approaches (Figure 7) such as maxillary swing [5, 11] or mandibular swing [6] have been well described. However, these approaches involve major dissection, including splitting the face, upper or lower jaw, palate or floor of mouth, with transection of the infra-orbital or lingual nerves. All these tissues will have been heavily irradiated during primary treatment and carry a risk of radionecrosis if surgical trauma is inflicted for access to the nasopharynx. Wei et al [5] and King et al [8] reported an approximate 30% of palatal dehiscence in their series of nasopharyngectomy carried out via open transfacial approaches. King et al [8] also elaborated other morbidities associated with the open technique. In order to avoid inflicting surgical traumato the previously irradiated tissue, a transnasal technique has been described [7, 9]. The advantages of the transnasal technique are that it can completely avoid a facial scar and avoid splitting the facial skeleton and oral cavity, thus avoiding the risk of unhealing wounds or formation of surgical scar. Any formation of surgical scar, as caused by open techniques, in the soft palate or floor of mouth would impair their functional movements thus causing post-operative dysphagia, nasal regurgitation and a hypernasal speech. Any unhealed wounds in the palate will form a fistula or iatrogenic cleft palate that would cause the same side effects.

The essence of the transmasal technique is therefore to work above the palate and not interrupt its anatomical and functional integrity. The intra-oral mid-face degloving incision avoids a facial incision or scar. However, the transmasal approach [9] has a major disadvantage in that it does not allow the surgeon to locate directly the internal carotid artery as is possible in the open face technique.

The application of SNG in locating and protecting the internal carotid artery bilaterally has been successfully performed on 15 patients in this study. SNG has been employed in neuro-otological surgery [18–20]; its use in nasopharyngectomy for recurrent NPC has enabled us to dissect tumours safely from the internal carotid artery bilaterally, whereas the open transfacial approach would allow only the ipsilateral internal carotid artery to be identified. The operating time,

blood loss, hospital stay and other morbidities have been much reduced as compared with open transfacial approaches (Table 1).

Other important aspects of SNG are the initial high capital cost and the need for careful calibration to minimize the TRE [16] and enable accurate guidance and dissection.

#### Conclusion

The application of SNG in nasopharyngectomy for recurrent local NPC via a minimally invasive transnasal approach has allowed us to protect the internal carotid arteries, thus rendering the procedure a safe, less morbid and more cost effective technique than open transfacial approaches.

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# Nasopharyngectomy for Recurrent Nasopharyngeal Carcinoma: A Review of 31 Patients and Prognostic Factors

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Objectives/Hypothesis: Nasopharyngectomy is a well-established treatment option for recurrent nasopharyngeal carcinoma. Over a period of 4 years and 3 months, in a total of 43 patients, 45 nasopharyngectomies were performed. Thirty-one patients with follow-up ranging from 12 to 58 months were studied. Twenty-two patients (58%) survived; of these, 18 patients (82%) remained disease free. All patients who developed repeat recurrence or died (n = 12) had a high recurrent T-stage tumor, skull base involvement, multiple recurrences, positive surgical margins, or concurrent neck node metastasis. These factors are poor prognostic parameters and might mitigate the indications for aggressive salvage surgery. However, low recurrent T-stage tumor without neck metastasis carries a good prognosis. Modern minimally invasive surgery carries minimal morbidity. Study Design: A retrospective study was made to determine prognostic indicators in patients treated with salvage surgery for recurrent nasopharyngeal carcinoma. Methods: Medical records were analyzed for all patients who had received nasopharyngectomy for recurrent nasopharyngeal carcinoma from March 1997 to June 2001. They were followed up from March 1997 to January 2002. Recurrent T stage, nodal metastasis, surgical approach, surgical margins, and pathological nodal status, together with surgical mortality, morbidity, and the delivery of postoperative irradiation, were compared with survival. Results: In all, 43 patients underwent 45 nasopharyngectomies over a period of 4 years and 3 months. Patients with less than 1 year of follow-up were excluded. Four patients with residual disease, who represent a more favorable group, and five patients with planned debulking, nasopharyn-

gectomy, and postoperative stereotactic irradiation were also excluded. The study group comprised 25 men and 6 women (ratio of 4:1) with age ranging from 26 to 69 years (mean age, 49.5 y). In 28 patients (90.3%), the recurrence of nasopharyngeal carcinoma was their first recurrence; in 3 patients (9.7%), the recurrences were second recurrences. Twenty-two patients (71%) survived, achieving a mean survival of 28.5 months. Nine patients died with a mean interval of 7.8 months (range, 1-14 mo). Of the nine patients who died, six (67%) had T3 or T4 tumor, four (44.4%) had concurrent recurrent neck disease, and five (55.5%) had positive surgical margins. Two patients died of perioperative meningitis. Fifteen (83.3%) of the 18 disease-free survivors had a low recurrent T-stage tumor. Mean intervals for development of repeat recurrence or distant metastasis were 16 and 7.9 months, respectively. Conclusions: High recurrent T stage, skull base involvement, repeated recurrence before surgery, nodal metastasis, and positive surgical margins carry a poor prognosis. This is particularly evident with high T stage and concurrent nodal metastasis. However, patients with low T stage have a survival advantage and benefit most from surgical treatment. Key Words: Nasopharyngectomy, recurrent nasopharyngeal carcinoma, prognostic factors.

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#### INTRODUCTION

Radiotherapy remains the gold standard treatment strategy for nasopharyngeal carcinoma (NPC). However, approximately 19% to 56% of patients develop recurrent disease 5 years after their primary treatment. 1-3 Management of recurrence includes external-beam radiation, 4,5 stereotactic irradiation, brachytherapy,6-8 and surgery, 9-16 either alone or in various combinations.

Nasopharyngectomy is a well-established alternative treatment for local recurrent and residual NPC for which reconstruction has been simplified using a glabellar flap.17 It avoids the complications of repeat irradiation, which include osteoradionecrosis,4,18 radiation-induced

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TABLE !.

Distribution of Total 31 Patients in T Stage, Nodal Metastasis, Extracapsular Spread, Positive Margins, and Postoperative Irradiation.\*

T-Stage	No. of Patients	Node +	ECS	NP +ve	IBT	SI	СМ
T1	7	0	0	0	4	1	-0
<b>T2</b>	13	3	3	1	10	0	3
T3	2	2	2	2	1	1	2
<b>74</b>	9	1	. 1	6	2	3	1
Total	31	6	6	9	17	5	6

"Nine patients did not receive further postoperative irradiation.

Node + = nodal metastasis; ECS = extracapsular spread; NP +ve = positive margin at NP; IBT = intubation brachytherapy; SI = stereotactic irradiation; CM = clear margin at neck.

myelitis, 4,18 encephalopathy, 19,20 hypopituitarism, 21 and severe trismus.

Various approaches for nasopharyngectomy have been well described in the literature, but the recent development of a transnasal approach through a midfacial degloving incision 15 provides a means of minimally invasive treatment for appropriate patients with optimal tumor clearance, short hospital stay, minimal complications, excellent cosmesis, and high patient satisfaction. The use of stereotactic navigation further reduces the risk of inadvertent injury to vital structures such as the internal carotid arteries. 16,16 With such minimally invasive techniques, the role of surgery in the treatment of low T-stage recurrent NPC is becoming clearer.

The present study specifically analyzed the prognostic factors in all patients receiving surgical treatment for recurrent NPC, and by treating patients with a full spectrum of recurrent T-stage disease, selection bias was minimized. Thus, we were able to compare and predict the prognosis of high recurrent T-stage with low recurrent T-stage disease. In contrast, previous studies have all tended to concentrate on low recurrent T-stage disease.

#### PATIENTS AND METHODS

From March 1997 to June 2001, 45 nasopharyngectomies were performed in 43 patients by the first author (E.W.H.T.). Within this group, in 38 cases, nasopharyngectomy alone was performed, whereas in 7 cases, nasopharyngectomy with concurrent radical neck dissection was performed. Patients with distant metastasis were not offered surgery. Another series of 31 patients with nasopharyngectomy in our hospital has been reported separately in the literature. <sup>13</sup> Four patients who had residual disease with primary irradiation represented a more favorable group and were excluded. Likewise, five patients who had planned debulking nasopharyngectomy were excluded, rendering the present study more comparable with other studies reported in the literature. Patients with follow-up less than 1 year were also excluded. Therefore, in the current report, a total of 31 patients were studied.

In the present study, 31 patients with follow-up of at least 1 year with NPC recurrence were reviewed. The sex distribution was as follows: 25 men and 6 women (male-to-female ratio, 4:1). The age range was 26 to 69 years (mean age, 49.5 y). In all cases, T stage was calculated using the 1997 UICC staging system.<sup>22</sup>

Several surgical approaches were employed, including a transnasal procedure through a midfacial degloving incision  $^{15,23,24}$  (n = 17), maxillary swing  $^{11,25}$  (n = 10), and mandibular swing  $^{12}$  (n = 4). All of the patients were regularly reviewed

in the joint head and neck clinic. Pathological examination results, operative complications, disease surveillance, and survival were all documented.

#### RESULTS

The distribution of recurrent T stage (Table I) was reasonably even (T1 = 7, T2 = 13, T3 = 2, and T4 = 9). The main surgical complications (including two perioperative deaths) are shown in Table II.

Nine surgical specimens had microscopic invasion of the resection margins (Table I). Within these specimens, six were T4 and two were T3 tumors, with only one T2 tumor.

In contrast to previous studies, the encroachment of the tumor on neighboring vital structures did not preclude selection for surgery. These sites included the sphenoid sinus (n = 9) and carotid artery (n = 4). Three patients had surgery for second recurrence.

Twenty-two patients received postoperative radiotherapy. This was delivered by intubation brachytherapy (17 patients) or stereotactic irradiation (5 patients) depending on previous irradiation dose and the surgical margins (Table I).

#### Survivors

Twenty-two (71%) patients survived (Table III); 18 of these patients were disease-free survivors. The four patients surviving with disease had the following features.

TABLE II.
Showing the Major Morbidity in 31 Patients.

Complications ,	Percentage	No. of Patients
Hypernasality	42.9	13
Nasal regurgitation	25.8	8
Ectropion	. 22.6	7
Oro-palatal fistula	9.7	3
Trismus	19.4	6
Impaired swallowing ability	9.7	3
Middle ear effusion	77.4	24
Temporary infra-orbital numbness	22.6	7
Permanent infra-orbital numbness	12.9	4
Perioperative death (meningitis)	6.5	2

TABLE III.
Showing the Local Control, Freedom of Disease, and Overall Survival of Individual T Stage for All 31 Patients.

Recurrent T Stage	No.	Local Control	Disease Free	Survival
	7	7	7	7
•		(100%)	(100%)	(100%)
T2	13	11	8	10
		(84.6%)	(61.5%)	(76,9%)
Т3	2	1	0	Ō
		(50%)	(0%)	(0%)
T4	9	7	3	5
	•	(77.8%)	(33,3%)	(55.6%)
			exclude 2 perioperative death	

One patient (with T4N0 disease) had clear surgical margins in the nasopharyngectomy, whereas one patient (with T4N0 disease) had positive surgical margins. Two patients (one with T2N1 disease and one with T2N0 disease) had achieved clear surgical margins. The patient with T2N1 tumor developed both local recurrence and distant metastasis, and the patient with T2N0 disease developed local recurrence. Both were treated with palliative chemotherapy.

The patient who had T4N0 disease (positive clear margins) developed local recurrence with extensive intracranial extension and was given palliative care. The patient who had T4N0 disease (positive surgical margins) developed local recurrence and was treated with palliative chemotherapy. Therefore, this group of 4 patients survive with failure of disease control mainly locally in the nasopharynx.

#### Deaths

Nine patients (T4, n = 4; T3, n = 2; T2, n = 3) died with the mean survival being 7.8 months (range, 1-14 mo). Two died of perioperative meningitis. Six died of distant metastasis without further local failure. Therefore, distant metastasis was the main cause of death in this group (Table IV), common sites being bone, liver, and lung. One patient had both local recurrence and distant metastasis.

Six (67%) of the nine patients who died had T3 and T4 tumors, and four (44.4%) of the patients who died had NPC recurrence with concurrent neck node metastasis at first presentation. Therefore, four (66.7%) of six patients with concurrent neck disease died (Table V). Five (55.5%)

TABLE IV. The Mode of Death in Nine Patients.\* No. of Postoperative Internal Distant Local T Stage Patients Carotid Blowout Recurrence Metastasis Meningitis T2 3 0 0 0 3 **T3** 2 0 0 1 2 2 0 n

The common sites for distant metastasis are bone (n = 5), liver (n = 3) and lung (n = 3). T3 and T4 patients (n = 6) accounted for 66.7% of the patients who died.

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of these nine patients had positive (microscopic invasion) surgical margins in the nasopharynx. Therefore, five (55.6%) of nine patients with positive surgical margins died (Table V).

In a total of six patients with nodal metastasis, all displayed extracapsular spread but surgical margins in the neck were clear. Four (66.7%) of these patients died, the two surviving patients having T2N1M0 tumor with clear surgical margins both in the neck and in the nasopharynx (Table VI).

#### DISCUSSION

Nasopharyngectomy with adjuvant postoperative radiotherapy is a well-established treatment for low T-stage NPC recurrence with a reported 5-year disease-free survival rate of approximately 40%. 9.11-14 Although there have been several reports concerning outcome, all of these have either been of small sample size or their study groups have had a disproportionate emphasis on recurrent low T stage. To et al. 9 reported 9 cases of nasopharyngectomy with no mention of T stage. Fee et al. 10 reported a series of 15 cases, of which 10 cases were T1 or T2 with only 5 cases being greater than T3. In1995, Wei et al. 11 reported their series of 18 cases with tumor size in 16 cases being 1 to 3 cm and 9 of the cases having nasopharyngeal involvement but, again, not elaborating on the T staging. King et al. 13 reported 31 cases, of which 29 were stage T1 or T2, and Shu et al. 14 reported a

TABLE V.

The Status of Nodal Metastasis and Surgical Margins of 9
Patients Who Died.

T Stage	No.	N+ve	NP+ve
T1	0	0	. 0
T2	3	1	0
Т3	2	2	2
T4	4	1 .	3
Total	9	4.	5

Note: There were 4 patients with positive surgical margins in the alive group. Therefore 55.6% of the patients (5 out of 9) with positive margins died. Four (67%) out of 6 patients with concurrent neck disease died.

N+ve = nodal metastasis with extracapsular spread; NP+ve = posttive margin at nasopharynx.

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TABLE VI.

Showing the 6 Patients Who Had Radical Neck Dissection, Their T-stage, Nodal Status, Surgical Margins, and Survival.

T Stage	Surgical Margins at Neck	Surgical Margins at NP	Survival
T4N1	Negative	Positive	No
T3N2	Negative	Positive	No
T3N1	Negative	Positive	No
T2N1	Negative	Negative	No
T2N1	Negative	Negative	Yes
T2N1	Negative	Negative	Yes

series of 28 cases, of which 25 were T1 and T2 (Table VII). The present study reports 31 patients with 20 cases of T1 and T2 disease and 11 cases of T3 and T4 disease. Therefore, it is possible to study the prognostic features of patients who underwent nasopharyngectomy with different stages of disease. Surgical treatment of recurrent NPC with nasopharyngectomy can achieve tumor control with less morbidity than radiation therapy alone. The indications for surgical treatment have been made clearer with the development of stereotactic navigation guidance (to minimize damage to vital structures) with minimally invasive surgery through a transnasal approach using a midfacial degloving incision. <sup>15,16</sup>

Good tumor control requires adequate, clear surgical margins, and a tailored approach for each case dictated by tumor size and site facilitates the tumor removal. Choices include infratemporal, <sup>26</sup> transpalatal, <sup>9</sup> transmandibular, <sup>12</sup> LeFort I osteotomy, <sup>27</sup> transmaxillary, <sup>11,28</sup> and transmasal approaches. <sup>15</sup> However, the ability to achieve clearance is still dictated by T stage and involvement of vital anatomical structures.

In our group, 5 (16%) of 31 patients were found to have further local recurrence of NPC commencing 5 to 24 months (mean interval, 16 mo) after surgery. Eight patients (25.8%) (Tables III, IV, and VIIIA) developed distant metastasis in the follow-up period with a mean interval of 7.9 months after surgery.

Nine patients died with a mean postoperative interval of 7.8 months (range, 1-14 mo). Four (44.4%) of these patients had nodal metastasis on presentation and received concurrent nasopharyngectomy and radical neck

TABLE VIII.

Showing the Mean Interval of Survival, Development of Rerecurrence, Distant Metastasis, and Death Out of the Total 31 Patients.

	Overall Survivat	Developed Re-recurrence After Operation	Developed Distant Metastasis After Operation	Death
No. of patients	22	5	9	9
Percent of patients	71	16	29	29
Mean interval (mo)	28.5	16	7.9	7.8

'One patient had both local and distant metastasis. Two patients had perioperative death.

dissection with all of them having extracapsular spread in the neck. Thus, of the total of six patients with nodal metastasis, four patients (66.7%) died with a mean interval of 9 months. Conversely, only two (33.3%) of the six patients with nodal metastasis have survived. Both had T2N1 tumor, and clear surgical margins were achieved both in the nasopharynx and in the neck. The reported 5-year survival of isolated neck recurrence treated with radical neck dissection ranges from 25% to 55%.  $^{9,28}$  The T-stage distribution of these six patients who had concurrent neck metastasis was as follows: T4 = 1, T3 = 2, and T2 = 3. Although concurrent neck disease has been discussed in the literature, its impact on survival has not been mentioned.  $^{13}$ 

Five (55.5%) of the nine patients who died had positive surgical margins of the nasopharynx. Of these 5 patients, all had T3 or T4 recurrent tumors.

At the time of writing, 22 (71%) of the 31 patients were still alive with a mean survival of 28.5 months. Eighteen (82%) of these patients were disease free, and among these 18 patients, 7 patients had T1 recurrence, 8 patients had T2, no patient had T3, and 3 patients had T4 (Table VIII; Fig. 1). The paradoxical poor survival for patients with T3 recurrence was due to concurrent neck nodal metastasis.

#### CONCLUSION

The present retrospective study indicates that nasopharyngectomy for locally recurrent NPC carries a poor prognosis when associated with high recurrent T stage,

TABLE VII.

Showing the Number of Low T Stage Recurrent Local NPC and Survival Rate as Reported in the Literature.

	No. of Cases	T1 & T2	T3 & T4	Disease-free Survival Rate
Tu et al., 1988	9	-		44% at 5 yr
Fee et al., 1991	15	10	5	20% at 4.5 yr
Wei et al., 1995	18	16	2	42% at 3.5 yr
King et al., 2000	31	29	2	42% at 5 yr
Shu et al., 2000	28	25	3	32.1% at 4.3 yr
To et al., 2002	31	20	11	58% at 2.4 yr
Present series				

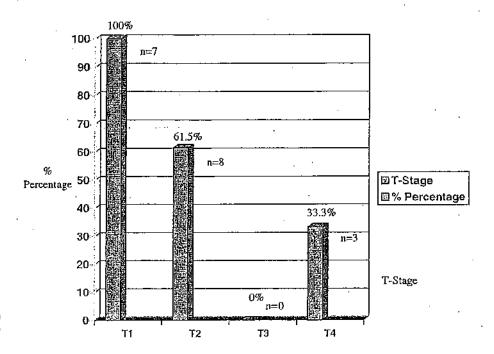


Fig. 1. Bar chart showing the 18 (58%) patients with disease free survival rate in relation to their T stage.

skull base involvement, repeated recurrence prior to surgery, nodal metastasis, and positive surgical margins, suggesting that aggressive surgical treatment does not benefit this group of patients. The prognosis for patients with high T stage but without nodal metastasis or positive surgical margins is still favorable and makes surgery a worthy modality. The worst prognostic indicators are combined high recurrent T stage and concurrent neck metastasis.

With the development of new surgical approaches and the technology of stereotactic navigation guidance, surgical treatment for low-stage local recurrent or residual NPC has become safer with less morbidity and has made surgery a more attractive option in the salvage of appropriately selected cases of recurrent NPC.

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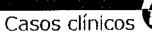
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# Artículos Monográficos

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#### Premio Página del Residente

Casos Clínicos presentados

Osteotomía de Le Fort I para el abordaje de osteoma centrofacial.

E. Torres Carranza, A. García-Perla García, R. Belmonte Caro, L. Ruiz Laza, P. Infante Cossío, J.L. Gutiérrez Pérez: Servicio de Cirugia Maxilofacial H.U. Virgen del Rocio de Sevilla. España.

#### INTRODUCCIÓN

A la luz de todas las pruebas realizadas se llegó al diagnóstico de osteoma nasoetmoidal acompañado de mucocele en seno maxilar derecho reactivo a la obstrucción del ostium de drenaje del mismo por el osteoma. Dada la situación clínica progresiva se decide intervención quirúrgica por parte de la unidad de Cirugía Craneofacial del Servicio de Cirugía Maxilofacial del H. U. V. Rocio de Sevilla.

El paciente es colocado en decúbito supino, y se le realiza intubación orotraqueal. Se incide el fondo de vestíbulo superior desde primer molar superior derecho al izquierdo y se expone, subperiósticamente, el maxilar superior procediendo a marcar el trazo de la osteotomía del Le Fort I. Se preforman cuatro miniplacas de titanio y se colocan a ambos lados del reborde piriforme y en los arbotantes máxilo-malares, asegurando con ello la correcta reposición de los fragmentos al acabar la intervención. Se retiran las miniplacas y se procede a realizar una osteotomía de Le Fort I según técnica habitual, finalizando con la realización de la «down-fracture» del maxilar superior.

En este momento procedemos al abordaje del osteoma, que estaba anclado al etmoides por un pedículo óseo, invadía fosa nasal derecha y cerraba el orificio de drenaje del seno maxilar (Fig. 4). Se extirpa el mucocele que ocupa seno maxilar derecho y liberamos el osteoma con un escoplo fino y lo extraemos con ligeros movimientos de rotación a derecha e izquierda. La pieza extirpada medía aproximadamente 3 cm de longitud y 4 cm de altura (Fig. 5). Una vez retirado el osteoma exploramos el lecho quirúrgico observando que no quedan restos de tumor y realizamos hemostasia. Se deja drenaje desde seno maxilar a orificio nasal derecho. Seguidamente reposicionamos el maxilar en su lugar original fijándolo con las miniplacas que

preformamos al inicio de la intervención. Finalmente suturamos la incisión vestibular. En la revisión postoperatoria a los seis meses no se aprecian secuelas oclusales ni complicaciones derivadas del abordaje quirúrgico empleado.

#### CASO CLÍNICO

Paciente mujer de 51 años de edad que acude a urgencias por un cuadro de seis meses de evolución de obstrucción nasal.

No presenta ningún antecedente personal de interés exceptuando un cuadro de algias faciales de repetición, compatible con cuadro de sinusitis, de carácter esporádico y que ceden con la analgesia

Se le realiza de forma rutinaria una radiografía simple de cara en proyección anteroposterior y lateral (Fig. 1) donde se objetiva una lesión centrofacial de densidad osteocondensante. Tras el hallazgo se cita en consulta para proseguir con las pruebas complementarias que lleven al diagnóstico de la misma. Se le realiza una tomografía axial computerizada (Fig. 2) así como una resonancia magnética con cortes axiales y coronales (Fig. 3) observándose esta tumoración a nivel etmoldal derecho que invade fosas nasales y oblitera el ostium de drenaje del seno maxilar derecho y que se acompaña de otra lesión de consistencia blanda en el interior de dicho seno. El estudio previo a la intervención quirúrgica se completó con una rinoscopia.

#### DISCUSIÓN

Los osteomas son tumores osteogénicos benignos, encapsulados, de crecimiento lento, que asientan en huesos de cráneo y de cara, apareciendo como una lesión redondeada, lobulada y adaptada a la cavidad que lo contiene anciándose a estructuras subyacentes por un pedículo áseo 1-4

Histológicamente está formado tanto por hueso compacto como trabecular así como componentes vasculares y conectivos con ausencia de células malignas.1,4-6

El origen de los osteomas es muy diverso y controvertido relacionándose con factores embriológicos, con factores hormonales, siendo más frecuente en mujeres en la pubertad y posmenopáusicas, con factores traumáticos, con factores infecciosos o congénitos.4,6 Se postula que en áreas donde entran en contacto tejidos de diferente origen embrionario aumenta el riesgo de desarrollar un osteoma. La causa traumática se propuso tras observar que en algunas series, hasta en un 30% de los casos existía un antecedente de traumatismo facial, sobre todo en la pubertad, que estimularía el crecimiento óseo en la zona del traumatismo, pero la relación de incidencia de traumatismo y osteoma hace improbable esta teoría. La infección crónica ha sido sugerida como posible causa de desarrollo de osteoma ya que parece estimular la proliferación de osteoblastos, pero la alta tasa de sinusitis crónica comparada con el escaso porcentaje de pacientes que desarrollan osteoma hace que se considere la infección como un fenómeno secundario más que una causa primaria.4,6

La incidencia de osteomas está en torno al 1-3% de la población. 7 En la mayoría de las series de la literatura es mas frecuente en hombres que en mujeres 2:1. Pueden ocurrir a cualquier edad pero se encuentran más entre la segunda y quinta década de la vida6. Los osteomas craneofaciales se suelen localizar en senos paranasales siendo la localización más frecuente el seno frontal, seguido por el etmoidal, maxilar y esfenoidal. 4 La localización en hueso maxilar y en mandibula no es rara. 2,3 La afectación orbitaria de los osteomas es poco frecuente y cuando lo hacen es por extensión directa desde senos paranasales. 6 También se han descrito en hueso temporal, 8,9 así

como en zonas extracraneales.

Son tumores usualmente asintomáticos, que pueden tardar años en hacerse sintomáticos, siendo en un 1% identificado en radiografía simple y en un 3% en TC como hallazgo casual. Cuando dan clínica lo suelen hacer antes los de localización etmoidal que los frontales, dado que los primeros tienen menos espacio para la expansión del osteoma. Su tamaño es muy variable llegando incluso a grandes proporciones, habiéndose descrito en la literatura osteomas de 4 cm de longitud por 3,5 cm de altura.3,5,10,11 La clínica se suele presentar como complicación del crecimiento del mismo,4 pudiendo dar cuadros dramáticos como en el caso del asiento en el canal auditivo interno,9 o cuando invaden órbita o la fosa craneal.10 En el caso de los etmoidales pueden crecer hacia arriba invadiendo fosa craneal, lateralmente hacia la orbita, medialmente hacia fosas nasales, caudalmente hacia seno maxilar y la sintomatología derivaría de la afectación de dichas estructuras. Aparecen síntomas del tipo de anosmia, licuorrea, cefaleas, obstrucción del conducto nasolacrimal con epifora, proptosis, diplopia, amaurosis fugaz, ceguera transitoria, celulitis orbitarias, obstrucción nasal, sinusitis, dolor, deformidad estética, etc. en función de las zonas afectas. La afectación craneal y oftálmica es poco frecuente.6,11,12 Se ha descrito su asociación con mucoceles secundarios a obstrucciones de ostium de drenaje de senos paranasales. La asociación de múltiples osteomas faciales junto a poliposis intestinal de origen familiar y carcinomas epidermoides en la piel se corresponde con el Síndrome de Gardner.6 Entre los posibles diagnósticos diferenciales de lesiones osteocondensantes podríamos considerar los osteosarcomas, osteocondromas, osteoblastomas periósticos, lipoma perióstico osificado, miositis osificante y exóstosis. Radiológicamente tiene densidad homogénea, con márgenes bien definidos y sin imágenes de invasión cortical o destrucción ósea (Figs. 1 y 2).2,6 En lo que se refiere al pronóstico de estas lesiones no se han descrito transformaciones sarcomatosas de las mismas y la recurrencia es rara.

El tratamiento es controvertido y varia en función de la clínica y la velocidad de crecimiento. Así, los asintomáticos pueden ser manejados de forma conservadora con revisiones cada año para observar el crecimiento del mismo. En el caso de lesiones sintomáticas o aquellas asintomáticas pero de rápida evolución se deben extirpar, intentando no dañar estructuras vecinas, y recurriendo para ello a los métodos habituales de cirugía abierta o bien a métodos endoscópicos.3,6,10 La elección del abordaje más adecuado en cada caso es esencial para unos buenos resultados quirúrgicos globales. Inicialmente dependerá de la localización anatómica exacta y extensión tridimensional de la lesión, así como de la naturaleza de la misma. Las opciones posibles dependerán en definitiva del estatus global del paciente, la planificación reconstructiva y la

experiencia del equipo quirúrgico.13

Abordaje vía endoscópica

La vía clásica del abordaje endoscópico es la transnasal-transeptal-transesfenoidal. Las restricciones para la instrumentación la relegan en la actualidad a procedimientos diagnósticos o resecciones de lesiones pequeñas y accesibles, en las que no es necesario un control exhaustivo del campo quirúrgico. Presenta ventajas en lo que se refiere escasa morbilidad de estructuras adyacentes y minimas secuelas estéticas, así como un rápido postoperatorio, si bien necesita un equipo quirúrgico experimentado en esta técnica. Se debe prestar especial atención a las posibles complicaciones, tales como problemas visuales y fístulas de líquido cefaloraquídeo.3,10 En este caso se descartó esta vía por imposibilidad técnica dado el tamaño tumoral. Vías de abordaje abiertas

Viene dada por la localización del osteoma. Se plantean tres vías de abordaje, una transcraneal, una transfacial y una intraoral, cada una con unas ventajas y desventajas así como una morbilidad asociada. 10 Los abordajes transfaciales pueden ser combinados entre sí o con abordajes intracraneales, de forma simultánea o diferida, existiendo por lo tanto múltiples posibilidades. Podemos establecer unos princípios básicos para la elección del abordaje más adecuado: 2,13

- Elegir el camino más corto hacia el objetivo, sorteando las estructuras nobles, considerando siempre la posibilidad de una futura cirugía.
- Realizar las osteotomías craneofaciales necesarias para evitar una excesiva retracción

cerebral y conseguir una adecuada exposición de la lesión que permita una resección lo más completa posible. Las osteotomías deben procurar fragmentos óseos lo más amplios posibles y se debe practicar con la osteosíntesis preformada para asegurar una correcta reposición anatómica. · Buscar el mejor resultado estético posible.

Transcraneal

La incisión coronal es la más ampliamente empleada, siguiendo un trayecto festoneado de oreja a oreja lo que permite que se cubra posteriormente por pelo.

Osteotomía transfrontal

También llamado de Derome13 es la vía transcraneal clásica en la que se practica una craneotomía bifrontal que permite acceder a fosa cerebral anterior. Presenta el inconveniente de que la exposición de campo puede ser limitada y la necesidad de retracción prolongada del cerebro puede conflevar secuelas graves; también pueden presentarse complicaciones del tipo de fístulas de líquido cefalorraquídeo, anosmia por lesión del nervio olfatorio, o lesión del nervio supraorbitario.14 Este abordaje se puede ampliar asociando a la craneotomía una osteotomía fronto-orbitaria de todo el reborde supraorbitario y ambos techos de las órbitas en una barra ósea. El ángulo de ataque queda así ampliado, con lo que las posibilidades del abordaje aumentan y se minimiza la retracción de los lóbulos frontales. En la reconstrucción resulta crítica una adecuada reposición dural y el aislamiento de la fosa craneal anterior que se puede realizar con un colgajo de pericráneo vascularizado por los pedículos supraorbitarios.

Osteotomía subcraneal

Popularizado por Raveh. Consiste en una osteotomía fronto-naso-orbitaria que se extiende lateralmente hasta los nervios ópticos.

Transfacial

Puede emplearse sola o en combinación con las anteriores.

Abordaje transetmoidal

Utilizando la incisión paralateronasal de Moure o la ampliada de Weber-Ferguson con sus diferentes variantes, que no son otras que el ampliar la línea de incisión al surco subpalpebral, supraciliar e incluso unirse a la coronal en la llamada incisión de Labayle y que permiten un abordaje al esqueleto centrofacial para poder realizar las osteotomías necesarias.

Uno de los problemas de la rinotomía lateral o de la lateral ampliada de Weber-Ferguson es que, pese a dejar secuelas estéticas mínimas, sí pueden llegar a ser invalidantes según las particularidades del paciente, 2, 15, 16 así como los problemas asociados con la vía lacrimal. Abordaje transnasomaxilar

Incisión de Weber-Ferguson y sus modificaciones para practicar una osteotomía tipo Le Fort II. Intraoral

De elección en nuestro caso dado los requerimientos estéticos del paciente y la accesibilidad de la

lesión. Entre las posibles opciones tenemos el abordaje transpalatino que se descarta por la inaccesibilidad desde ahí a la lesión.

El abordaje via Cadwell-Luc del seno maxilar dadas las dimensiones del osteoma se presumía insuficiente.

En la técnica de degloving mediofacial las osteotomías se realizan mediante incisiones intraorales en el fondo de vestíbulo e intranasales, siendo ésta su principal ventaja, ya que evita cicatrices cutáneas. El degloving modificado con sección del septum y osteotomía nasal lateral permite una buena visualización de las fosas nasales, senos paranasales y nasofaringe.17

La hemimaxilotomía pediculada es una variante técnica de la maxilotomía descrita por Hernández Altemir donde se practica una osteotomía tipo Le Fort I unilateral, quedando el fragmento óseo unido a un colgajo de mejilla obtenido mediante un abordaje de Weber-Ferguson con la consecuente secuela estética.

En el caso en cuestión, se prefirió usar una maxilotomía con osteotomía tipo Le Fort I según la técnica convencional, 15,16 ya que es una técnica especialmente útil en grandes tumores centrofaciales de localización precribal. Esta osteotomía conseguía un buen campo, lograba buena visibilidad y permitía su ampliación realizando en caso necesario una segmentación sagital del maxilar superior. La curación tras la intervención es relativamente rápida, con escasas complicaciones y unos resultados estéticos y funcionales excelentes. La posible maloclusión posterior se evitaba con el uso de las miniplacas preformadas. Las otras complicaciones descritas en la literatura son la hemorragia nasal, enfisema cervical o la más infrecuente isquemia maxilar.16

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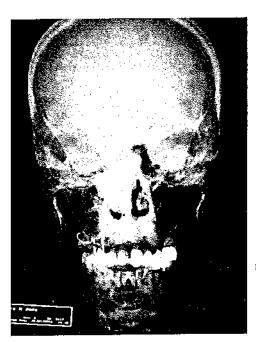
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#### **FIGURAS**



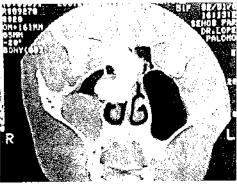
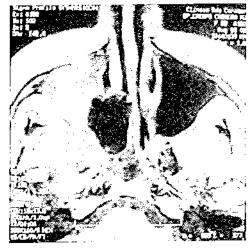


Figura 01:Radiografia simple de craneo en proyección PA prequirúrgica.

Figura 02: TC en cortes coronales.



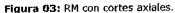




Figura 04: Exposición de la lesión a través de abordaje intraoral.

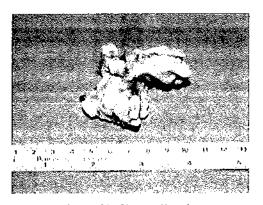


Figura 05: Pieza extirpada.



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#### ORIGINAL PAPER

# Nasal cheek flap in ethmoidal and skull base tumour surgery: results and complications

Il lembo naso-genieno nella chirurgia dei tumori dell'etmoide e della base cranica: risultati e complicazioni

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Key words

Paranasal sinuses • Ethmoidal neoplasms • Surgical treatment • Nasal cheek flap

Parole chiave

Seni paranasali • Tumori etmoldali • Trattamento chirurgico • Lembo naso-genieno

#### Summary|

Surgery is the treatment of choice for the management of malignant nasal/ethmoidal tumours, followed, in most cases, by external radiotherapy. Two main procedures are adopted to resect these tumours depending upon stage and extension; ethmoidectomy and medial maxillectomy, via a transfacial approach, or craniofacial resection with a combined transcranial and transfacial approach. The nasal cheek flap technique allows complete nasal swing thus obtaining a wide access to both the nasal fossae and the ethmoidal labyrinth. Furthermore, this approach can also be used in the management of small intracranial tumours extended through the skull base to the nasal cavity, paranasal sinuses, upper and middle clivus. We have used the nasal cheek flap since 1992 with good aesthetic and functional results. Aim of the present study was to analyse personal experience, focusing on complications, aesthetic results and self-evaluation expressed by the patients.

#### Riassunto

La chirurgia è il trattamento di scelta delle neoplasie maligne naso-etmoidali, seguita per lo più dalla radioterapia. Principalmente vengono utilizzate due tecniche chirurgiche per l'asportazione di questi tumori: l'etmoidectomia e la maxillectomia mediale per via transfacciale, e la resezione cranio-facciale per via combinata transcranica e transfacciale. La tecnica del lembo nasogenieno permette una completa mobilizzazione del naso, che consente un ampio accesso alle cavità nasali ed al labirinto etmoidale. Inoltre, questo approccio può essere utilizzato per l'asportazione di piccoli tumori intracranici, estesi attraverso la base cranica alle cavità nasali, ai seni paranasali e al clivo. Dal 1992 noi utilizziamo il lembo nasogenieno con ottimi risultati funzionali ed estetici. Scopo del presente studio è l'analisi dell'esperienza personale, in particolare per quanto riguarda le complicazioni, i risultati estetici e l'autovalutazione eseguita dai pazienti.

#### Introduction

Surgery is the treatment of choice for the management of malignant nasal/ethnoidal tumours followed, in most cases, by external radiotherapy.

Two main procedures are adopted to resect these tumours, the choice depending upon staging and extension: ethmoidectomy and medial maxiflectomy, via a transfacial approach, or craniofacial resection through combined transcranial and transfacial approaches <sup>2 3</sup>.

The rationale of both procedures allows the achievement of the complete monobloc resection of the tumour with adequate margins 4.5.

The transfacial approach can excise more or less uninvolved portions of the normal facial skeleton, which may reveal functional and aesthetic morbidity. In the last 20 years, Curioni et al. introduced and standardized the principle of "splitting face", namely, resection of the affected bone only 6.

The nasal cheek flap technique (NCF) allows complete nasal swing thus obtaining a wide access to both the nasal fossae and the ethmoidal labyrinth 7. Good exposure of the surgical field is obtained with this approach, thus allowing easy separation of the specimen and monobloc resection of the tumour.

Furthermore, this approach can also be used for the management of small intracranial tumours extended through the skull base to the nasal cavity, paranasal sinuses, upper and middle clivus (e.g. meningiomas, small clival chordomas, etc.)<sup>8</sup>.

We have used the nasal cheek flap since 1992 with good aesthetic and functional results.

Aim of the present study was to analyse personal experience, focusing on complications, aesthetic results and self-evaluation expressed by the patients.

#### Material and methods

Between 1992 and 2002, 95 consecutive patients with nasal/ethmoidal or skull base tumours underwent surgical resection using NCF as part of the procedure.

Of these patients, 71 (57 male, 14 female, age range 41-69 years, mean 57), were diagnosed with nasal/ethmoidal malignant tumours, extending or not to the anterior cranial fossa (Fig. 1a, b) (Table I); 33 patients underwent anterior cranio-facial resection (ACFR), of whom 7 associated with orbital exenter-

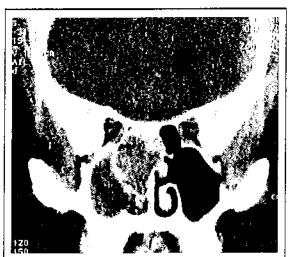


Fig. ta. CT scan of naso-sinusal tumour: axial image.

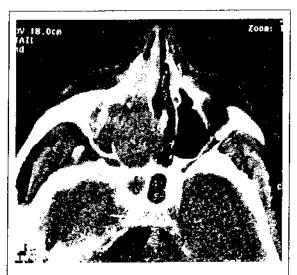


Fig. 1b, CT scan of a naso-sinusal tumour: coronal image.

<b>Table I.</b> Characteristics of patients with nasal/ethmoidal turnours.	malignant
No. patients	71
Age (yrs)	
Range	41-69
Mean	57
Sex	
Male	57
Female	14
Pathological condition	
Adenocarcinoma	49
Squamous cell carcinoma	6
Adenoid cystic carcinoma	8
Melanoma	6
Estesioneuroblastoma	2
Surgery	
Anterior craniofacial resection	26
Anterior craniofacial resection +	
exenteratio orbitae	7
Ethmoidectomy + medial maxillectomy	38
External radiotherapy	
Yes	56
No	15
Extent of invasion	
Apex of the orbit	
Yes	7
No	64
Dura	
Yes	8

ation (ACFR/OE), 38 patients underwent ethmoidectomy and medial maxillectomy via the NCF only.

63

4 67

No

Yes

No

Brain

Another 14 patients underwent NCF for resection of large recurrences of inverted papilloma; 8 of these patients had previously been operated endoscopically and 6 via the external approach.

In 7 cases, the papilloma involved both nasal fossae, in 4 cases the nasal septum, and in 3 cases, histological examination of the specimen revealed malignant transformation.

Eleven patients were diagnosed with skull base tumours. Resection was performed via the NCF in 10 cases; in 1 case, the patient underwent anterior cranio-facial resection (olfactory groove meningioma).

The histological examination of specimens revealed 5 chordomas, 3 craniopharyngiomas, 3 meningiomas.

Of the 75 patients with malignancies, 57 (76%) were submitted to external post-operative radiotherapy.

Six patients affected by melanoma had chemotherapy with Dacarbazine.

A total of 38 patients with a malignant tumour, resected via the NCF approach only, underwent topical chemotherapy with 5-FU, according to Kneft's protocol?

All patients underwent a meticulous endoscopic follow-up, including computed tomography (CT) scan or magnetic resonance imaging (MRI), when required (range  $12 \rightarrow 81$  months).

#### Surgical technique

With the NCF technique, 3 skin incisions are made:

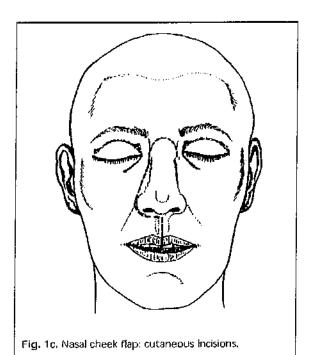
- a) a lateral rhinotomy on the tumour side, which can be extended below to incise the nasal vestibule or the upper lip;
- b) a glabellar incision;
- c) a short contra-lateral incision reaching the medial chantus level (Fig. 1c).

The osteotomic lines are then drawn and preplating is carried out using titanium mini-plates.

The osteotomies are performed using a sagittal saw on the lateral rhinotomy side and completed contralaterally with a rhinoplastic basal osteotomy (Silver's osteotome) (Fig. 2).

The nasal septum is then sectioned with a straight osteotome or scissors, having previously cut the nasal mucosa underlying the osteotomies.

Caution is mandatory when performing these inci-



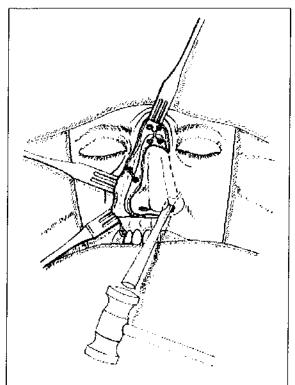


Fig. 2. Nasal cheek flap: osteotomic lines and pre-plating,

sions in order to maintain a safe distance from the tumour margins.

The nasal swing allows wide exposure of both the nasal fossae and ethmoidal labyrinth (Fig. 3).

After tumour resection, the nose is repositioned and fixed with the miniplates.

The nasal cavity is then packed with a double balloon catheter and medicated strips of gauze.

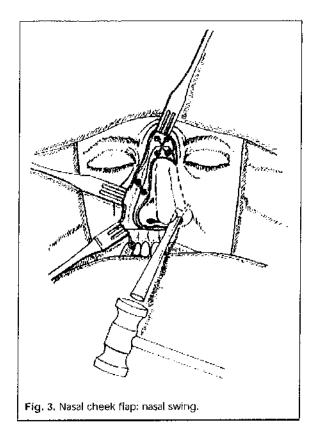
#### Self-evaluation of aesthetic results

Patients were asked to complete a short validated questionnaire when attending for follow-up examination (range 6-24 months post-operatively).

The questionnaire focused on aesthetic and functional domains, with multiple choice answers (Table II). The questionnaire was analysed according to Aaronson et al. criteria <sup>10</sup>.

Questions 1-2 and 3-4-5 were grouped on 2 scales evaluating the aesthetic and functional results, respectively. The total sum of the scores obtained was then divided by the number of items on the scale.

The results were recalculated on a 0-100 scale for better comprehension, with 100, the best result and 0 the worst.



#### Results

One patient who underwent ACFR died in the early post-operative period of myocardial infarction. Actuarial cumulative survival for all patients with malignant tumour is 53.4% at follow-up  $20 \rightarrow 98$  months.

In patients who underwent ACFR or ACFR/OE, the actuarial survival is 46.4%. Two patients with local recurrences are alive, one patient died of a second primary tumour (bladder cancer), 10 patients died of

local recurrence of the disease and 2 died due to distant metastases. In patients who underwent ethmoidectomy and medial maxillectomy, the survival is 57.5%. Three patients are alive with disease (one with local recurrence, 2 with distant metastases); 2 patients died from other causes (myocardial infarction and colon cancer). 10 patients died of the disease, 6 of local recurrence, 4 of distant metastases (3 melanomas, 1 adenoidocystic cancer).

All patients suffering from inverted papilloma are still alive.

Complications included 3 cases of stenoses of the nasal vestibule (slight in 2 cases, closed in the other) and a widening of the nasal ala in 2 cases. A change in the orbital contour occurred in 2 patients and another patient developed dehiscence of the skin wound. Aesthetic results were not good in 3 of the patients with nasal pyramid cyphoscoliosis, being less evident in 2 patients and evident in the other.

Three patients had epiphora, intermittent in 2 cases, severe in the other. All 3 patients underwent dacry-ocystorhinostomy. One patient complained of transitory diplopia.

Of the 95 patients, 35 had massive nasal crusting, removal of which was necessary. This condition was more frequent in patients who underwent radiotherapy (24/56) (Table III).

Results emerging from the self-evaluation questionnaire revealed good aesthetic outcomes: 82.738 (range  $0 \rightarrow 100$ , SD 18.613), whereas questions regarding functional outcomes were less good, with a high standard deviation: 66.751 (range  $0 \rightarrow 100$ , SD 31.576) (Table IV).

#### Discussion

Surgical resection is considered the main treatment for all tumours of the nasal cavity and paranasal sinuses since tumour extent plays a major role in the choice of surgical approach <sup>11</sup> <sup>12</sup>. In our opinion, the

You are kindly asked to indicate all the symptoms you had in the la	st seven days	n ɗays		
	PN	VP	A	М
a) Not liking one's physical appearance				
b) Difficulty in physical contacts with family members and friends				
c) Difficulty in breathing through the nose				
d) Olfactory difficulties				
e) Testing difficulties				

	17/95
Death (myocardial infarction)	1
CSF leakage	2
Stenosis of nasal vestibule	3
Change in facial contour	3
Dehiscence of skin wound	1
Transient dyplopia	3
Change in orbit contour	2
Widening of nasal ala	2
Massive nasal crusting	35/95
Non-irradiated patients	11/39
Irradiated patients	24/56

Scale A	
N.	95
Mean	82.7381
SD	18.6139
Min	0
Vlax	100
Scale <b>B</b>	
٧.	95
√lean	66.75
SD	31.57
din	0
л А	100

transfacial approach should always allow good exposure of the operating field. In fact, adequate exposure reduces the risk of unsatisfactory margins, especially when resection is performed only through the transfacial approach.

Furthermore, we consider it important to carry out resection attempting to spare the relatively uninvolved portions of the normal facial skeleton <sup>13</sup>.

The NCF technique provides satisfactory surgical resection, thus avoiding aesthetic morbidity or disfigurement due to loss of skeleton support <sup>14</sup>.

When carrying out the procedure, which must be meticulous and delicate, caution must be taken with the following points:

 a) Anterior extension of the tumour: scrupulous assessment avoids cutting the bone too close to the tumour. Radiologic investigations (CT scan, MRI) and endoscopy are usually sufficient to define anterior advancement of the cancer, even if the tumour rarely reaches anterior structures. Only in one case was the tumour larger than expected, with an extension reaching the frontal sinus. The time elapsing (1 month) between the CT scan and surgical treatment, associated with high spread of the tumour, would account for this finding. Therefore, the operation had to be extended with craniofacial resection, including the nasal bones and the anterior part of the frontal bone.

- b) Osteotomies should be performed using an ultrafine saw to reduce bone loss. We rarely use a fine Linderman burr.
- c) Preplating allows easy and correct replacement of the nose. We normally perform preplating with the use of miniplates and screws (Leibingher mini series).

Surgical exposure obtained with the NCF is usually sufficient for resection of nasal/ethmoidal and small clival tumours (upper and medium clivus). We use the transfacial approach for tumours limited to the anterior ethmoid, not reaching the fovea ethmoidalis, the frontal sinus or the posterior part of the orbit. However, when the posterior ethmoid, frontal or sphenoidal sinuses, the orbital apex and, obviously, the lamina cribra are involved, ACFR is always performed. In order to better divide the specimen in the posterior ethmoid, we always excise the vertical lamina of the ethmoid even in tumours not reaching the midline. NCF offers excellent exposure and thus sectioning of the superior and middle turbinates is quite easy.

The lamina papiracea is easily resected mono- or bilaterally, depending upon tumour extension, as also the medial periorbit, when involved. On the other hand, if the tumour has invaded the apex of the orbit, thus reaching the optic nerve, we always perform a craniofacial resection with orbital exenteratio, resecting, intracranially, the optic nerve in the prechiasmatic area.

The naso-lacrymal duct is always excised and the sac marsupialised to the nasal mucosa in order to reduce post-operative epiphora.

The naso-maxillary muco-osteo-cutaneous flap has always been found to be very resistant even to radio-therapy. In all cases but one, we no longer experienced cutaneous dehiscence and necroses of the medial canthus; these were common when extensive resections of the nasal bones and upper process of the maxillary bone were carried out <sup>15</sup>.

In one case presenting cancer recurrence in the lamina cribra following the transfacial approach, the NCF was raised combined with anterior craniofacial resection. The aesthetic result was equally good.

The technique offers excellent aesthetic outcomes, as shown in the present analysis. No scars are evident

and good restoration of the facial contour is also achieved (Figs. 4-6).



Fig. 4. Nasal cheek flap: aesthetic outcome one year later (anterior view).



Fig. 5. Nasal cheek flap: aesthetic outcome one year later (lateral view).



Fig. 6. Nasal cheek flap: aesthetic outcome one year later (superior view).

When scarifying part of the nasal bone or the superior process of the maxilla, reconstruction can be guaranteed using a double plaque between the dorsum of the nose and the glabella (Fig. 7).

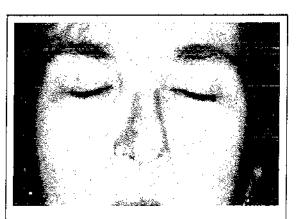


Fig. 7. Nasal cheek flap; bad aesthetic outcome two years later,

On the other hand, with complete exenteratio of the upper part of the nasal cavity only satisfactory functional results are obtained.

Of the 67 patients submitted to surgery, only 14 had complications, 7 severe and 7 slight. In our opinion, this is a good percentage, bearing in mind the entity of the resection carried out.

Correct realignment of the bony segments and care to avoid excessive packing of the nasal cavity, which in one case caused widening of the nasal ala, greatly contribute to reducing complications.

We gently pack the cavity with ribbon gauze and a slightly inflated double balloon catheter.

The most frequent complication is crusting of the nasal cavity. This is often severe and causes a foul smell in the first post-operative year, especially in irradiated patients <sup>15-19</sup>. Patients benefit from normal or hypertonic saline irrigations and moisturizing solutions. A well-humidified bedroom is also very useful. We invite these patients to have their naso-sinusal cavities cleaned monthly in the clinic, with the aid of endoscopy.

Crusts may also cause transient epiphora, which we encounter in approximately 8% of such patients, as crusts may plug the lacrimal sac even if it is marsupialized to the nasal mucosa.

Endoscopic follow-up is easily achieved, allowing early detection of recurrences and the possibility, when necessary, to commence topical chemotherapy with 5-FU.

#### Conclusions

The key principles of oncological cranio-maxillo-facial surgery are: performing monobloc resection with safe margins, avoiding major endocranical complications and obtaining good aesthetic results.

The "dismantling and reassembling" techniques have greatly contributed towards these aims.

In our experience, the NCF approach for nasal/ethmoidal and small clival tumours is easy to perform and easily extendible. We have achieved good aesthetic long-term results with few complications, both in limited and extended resections. Therefore, for these reasons, we systematically use this transfacial approach.

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# **门** 万万数据资源系统

### 国外医学(耳鼻咽喉科学分册)

OTOLARYNGOLOGY FOREIGN MEDICAL SCIENCES 2005 Vol.29 No.4 P.234-236

数字化期刊

# 上颌骨翻转术在鼻咽部和其周围肿瘤切除中的运用

#### 韩德民 朱瑾 韦霖

要:鼻咽部、鼻咽旁间隙及其毗邻区域位于头颅的正中部位,后面即脑干和颈 椎的上段.因此以上部位的手术,只能考虑采用头颅的上、侧、下方和前面进路.本文 总结曾经采用的手术进路的优缺点,并对从前外侧进路到达鼻咽部和咽旁间隙的上 颌骨翻转术的进展、手术步骤、可能的并发症及其防治方法进行介绍与回顾.

关键词:上颌骨(Maxilla);鼻咽肿瘤(Nasopharyngeal Neoplasms)

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# CRUCIA oraly maxilatedal 2º edición TOMOTI



## Caoffulo 38:

THE CORES CONTINUES.

Las lesiones orbitarias son múltiples y varia3. Pueden originarse a partir de los conte1-los orbitarios, de estructuras adyacentes
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gicas de resección y reconstrucción.

El síntoma cardinal es la proptosis (Tabla acompañada de dolor, diplopia, edema, rimeo y alteraciones en la visión. La propos no está limitada a los tumores orbitarios. Enfermedad tiroidea, pseudotumores, malmaciones arteriovenosas, enfermedades del ágeno, infecciones, prolapso de conteni- intracraneales y malformaciones congé-

And Same Control to the Same

Pasada en la localización de los tumores, ran clasificado en tres categorías con diferae sintomatología:

" mores y Parología cervicolacial

- Intraconales (dentro del cono muscular):
   Causan pérdida precoz de la visión y
  diplopia por presión o infiltración del
  nervio óptico, óculomotores y musculatura extrínseca. Pueden desplazar el
  globo ocular produciendo proptosis axial.
- Extraconales (fuera del cono muscular):
   Causan proptosis precoz no axial. La alteración de la visión y de la movilidad se deben a infiltración tumoral de los músculos o deformidad del globo ocular.
- Intracanaliculares (dentro del canal óptico): causan pérdida precoz de la visión y mínima proptosis.

2. The man parameters

Tras una exhaustiva exploración clínica, donde podremos descubrir síntomas y signos sugerentes de patología orbitaria, seguiremos nuestro estudio con campimetría, test de ducción, TC y RM. Las nuevas técnicas de imagen han disminuido la necesidad de las biopsias orbitarias.

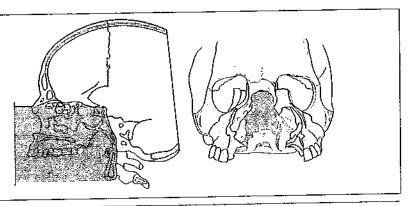
2. To Themisters and in the mass

La TC aporta una buena visualización de las estructuras orbitarias por el contraste entre el hueso, el músculo y la grasa periorbitaria; los planos con más frecuencia usados son el axial y el coronal.

P#15







5. Despegamiento mediofacial para abordaje al nível III y IV.

eringe con potencial riesgo de infección; enstrucción difficil del defecto quirúrgico la base craneal con riesgo de fístula de estado cefaloraquídeo.

#### Abordajes transmaxilares.

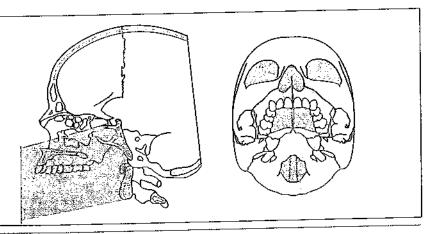
Maxilotomía ampliada: Archer fue el prito en emplear la osteotomía de Le Fort I to abordaje transfacial a la base del cráta segmentación sagital del Le Fort I tolía el campo quirúrgico. Es actualmente tes empleada. Después de realizar una incien el fondo vestibular superior y marcar steotomía, se adaptan los sitemas de ostetesis. La técnica es la común a un Le Fort el segmentación sagital al que se añade una incisión en la línea media del paladar blando. El maxilar es descendido y desplazado lateralemente. Los límites del abordaje pueden ser ampliados realizándose una turbinectomía o resección de las pterigoides (Fig. 6).

b) OTROS: Hemimaxilotomía pediculada a la mejilla descrita por Hernández Altemir y modificada por Brusati y la hemimaxilotomía pediculada a la mucosa palatina (Fig. 7).

#### - NIVEL VI:

Abordaje transmandibular. Este abordaje consiste en una mandibulotomía parasagital, en la cual la mandíbula es movilizada lateral e inferiormente al ser separada del





5. Abordaje transmaxilar a los niveles IV y V.

nores y Patología cervicolacial

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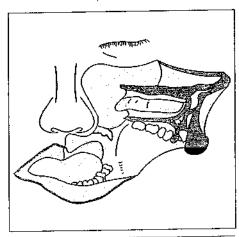


Fig. 7. Hemimaxilotomía pediculada a la mucosa palati-

suelo de la boca dejando expuesta la región prevertebral. Para aumentar la exposición del clivus se puede realizar sólo una división del paladar biando o bien levantar dos colgajos mucosos palatinos y realizar una osteotomía del paladar óseo. Este abordaje permite sólo un acceso a la región central.

English granist and field hands among a son land a series.

Los abordajes quirúrgicos inicial y comúnmente más empleados son los abordajes transcraneales. La mayoría de ellos necesitan técnicas intradurales, proporcionan un campo reducido y profundo, y precisan una importante retracción cerebral, resección o manipulación de los nervios craneales con las consiguientes lesiones neurológicas (parálisis facial y sordera). Entre las técnicas intradurales se encuentran el abordaje fronto-temporal o pterional, el abordaje subtemporal, y el abordaje suboccipital. Los abordajes extradurales se emplean con una menor frecuencia, siendo muy variados. Entre ellos el abordaje transtroclear, el abordaje translaberíntico, el abordaje transpetroso, el abordaje infratemporal y el abordaje transtemporal-transesfenoidal.

El abordaje a la fosa infratemporal descrito por Fisch precisa: la resección del cóndilo mandibular y la coronoides con la consiguiente disfunción de la articulación témporomandibular, la sección de la rama mandibular del trigémino, la movilización del nervio facial y ocasiona sordera unilateral.

Otras vías laterales al *clivus* son los abordajes transcervicales. Estas vías precisan la movilización de los vasos carotídeos extracraneales y el sacrificio de los nervios cervicales altos. Se han realizado modificaciones a esta técnica intentando facilitar el abordaje asociando una labiomandibulotomía, pero aún así el *clivus* superior se encuentra lejos del campo; por otro lado se pierde la ventaja del campo estéril.

Actualmente los abordajes laterales más empleados son el abordaje témporo-cigomático y el abordaje subtemporal e infratemporal-preauricular.

#### Abordaje témporo-cigomático

Este abordaje lateral permite el acceso a la fosa craneal media. Consiste en una osteotomía del hueso cigomático, una desinserción del músculo temporal a nível de la coronoides y una craneotomía temporal (Fig. 8).

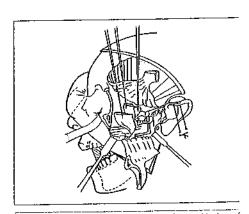


Fig. 8. Abordaje témporo-cigomálico a la porción lateral de la base del cráneo.

TECHNIQUES IN CEVANDOFACIAL. SURCERY

MANTHESAMER

FOREWORDS BY DANIEL MARCHAC AND FERNANDO ORTIZ MONASTERIO

# AESTHETIC CRANIOFACIAL SURGERY

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cosa must not coincide with the palatine alveolus Hernandez-Altemir, can be obtained with modifications as needed. In the unilateral facial approach, exthe contralateral side, over the dorsum, and below the tachment. The vertical incision of the vestibular mu-Access to the retromaxillary area, as described by ternal skin incisions are necessary around the nose on eyelid, hinging open the maxilla on its soft tissue atosteotomy.

initial incision. The incision through the palate begins bital rim, above the medial canthus and through the tween the lateral and central incisor on the side of the directly behind the lateral incisor on that side and ows the entire maxilla to be hinged out on a subcu-The osteotomies may vary, but most commonly extend through the zygoma, along the edge of the ornasal bone, down through the hinged alveolus begoes through the pterygomaxillary junction. This altaneous pedicle (Fig. 1.10)

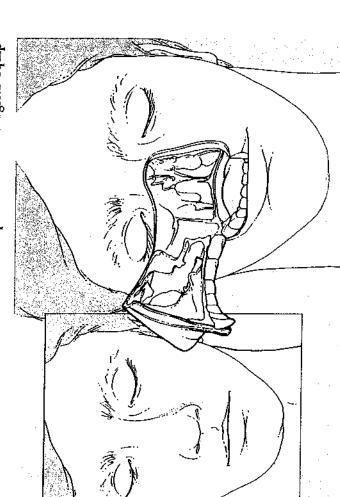
Fig. 1.10 This approach to Hernandez-Altemir, gives tumor resection. The maxgood intrafacial access for the retromaxillary region, are made as needed, and illa is hinged open on a pedicle of the facial soft tissues after osteotomies which was described by through to the pterygothe palate is incised maxillary junction.

base of the cranium, orbit, pterygomaxillary area, Such wide exposure of the retromaxillary area offers the opportunity to reach such structures as the nasal area, cavum, clavius, sphenoid sinus, and temgeous in tumor resection as well as in reconstruction poral zygomatic region. This is particularly advantaof traumatic and certain congenital deformities.

# SPLIT LAMELLAR TECHNIOUE

tive position of the internal table (Fig. 1.11). This able translocation of the external table against the nainterlamellar osteotomy has led to improved aesthetic This osteotomy introduces a new technique in which ternal bony lamella. This osteotomy allows a quantifithe facial skeleton is split between the internal and exresults in the orthomorphic reconstruction of congenital deformities.

us from performing over 400 orbitofacial osteotomies The split orbitofacial osteotomy was developed by and from technical improvements in surgical equip-



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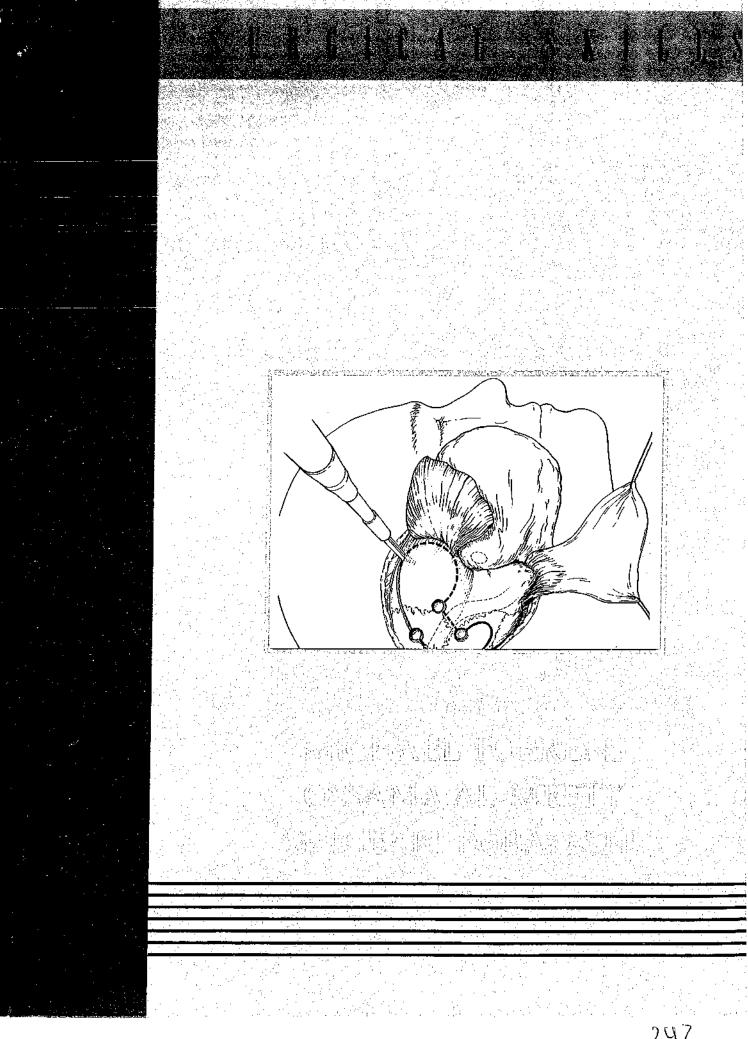
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28 AESTHETIC CRANIOFACIAL SURGERY



# OPERATIVE SKULL BASE SURGERY

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# Facial Translocation Approach to the Skull Base

Ivo P. Janecka

rgical approaches to the skull base are designed to permit the operative manipulain of cranial base anatomy and pathology. Detailed knowledge of normal anatomy well as developmental variations permit the distinction of pathologic processes ring surgery, which is one of the principles of surgical oncology. A number of jectives must be reached in order to fulfill the goal of surgical therapy: control of a oplastic process or repair of congenital/traumatic deformity.

The intimate relationship of the skull base to the cranial as well as facial structures guires tissue displacement of one or both of these compartments to reach the sired section of the skull base. It is important to consider the effects of surgery on a normal but surgically manipulated tissues in order to select the most optimal proach. Any operative tissue displacement produces alterations in the anatomy of physiology of affected structures. Such changes have variable consequences rending on whether they occur in the neurocranium or the facial viscerocranium. The example, facial swelling is usually self-limiting with minimal long-term consequences for the patient. Similar edema, however, may be very deleterious when it olves the neurocranium.

The current underlying principle of skull base approaches is to minimize brain raction while maximizing skull base visualization. This concept facilitates three-tensional tumor resection, tumor margin verification, and functional reconstruction with appropriate aesthetic concerns.

n general, surgical treatment of lesions located anterior to the neuraxis should be through an anterior approach. This requires selection of a transfacial approach ause of the anteroinferior anatomic relationship of the facial viscerocranium to cranial base.

his chapter is adapted with permission from Janecka (1993) and Janecka (1996).

The advantages of transfacial approaches include the following:

- 1. Facial anatomy has developed through the embryonic fusion of nasofrontal, maxillary, and mandibular processes. Normally, the fusion takes place in the midline of in the paramedian region, thus logically presenting optimal lines of "separation" of facial units for a surgical approach, permitting the least traumatic displacement.
- 2. The primary blood supply to the "facial units" is through the external carotid system, which also has a lateral-to-medial direction of flow, thus ensuring viability or displaced surgical units.
- The midface contains multiple "hollow" anatomic spaces (oronasal cavity nasopharynx, paranasal sinuses), which facilitate the relative ease of surgical access to the central skull base.
- 4. Displacement of facial units for an approach to the central cranial base offers much greater tolerance to postoperative surgical swelling, as opposed to similar displacement of the contents of the neurocranium.
- Re-establishment of the normal anatomy, following repositioning of the facial
  units during the reconstructive phase of surgery, has a high degree of functional as
  well as aesthetic achievement.

However, transfacial approaches also have certain disadvantages, such as:

- 1. Contamination of the surgical wound with oropharyngeal bacterial flora.
- 2. The need for facial incisions with subsequent scar development.
- 3. Emotional considerations for the patient related to "surgical facial disassembly."
- 4. The potential need for supplementary airway management (postoperative endotracheal intubation, temporary tracheostomy).

In the past, several surgeons worked on achieving additional exposure of the craniofacial region for oncologic reasons, including Barbosa (1961) for lateral exposure of the maxilla and Altemir (1986) for the nasomaxillary area.

### **Patient Selection**

To be considered for transfacial surgery, the patient must have a pathologic entity located at the anterolateral cranial base or the craniovertebral junction, judged to be best treated with surgery. This would include benign and malignant tumors as well as congenital and post-traumatic deformities.

Also necessary is adequate imaging to define the extent of the pathologic process as well as to show the key neighboring anatomic structures and the potential for their preservation. This may include computed tomography (CT), magnetic resonance imaging (MRI) (static and dynamic), and four-vessel angiography. Numerous questions need to be answered by the imaging studies: the true extent of the lesion, its relationship to the key anatomic structures (e.g., vessels, dura, brain stem, cranial nerves), and the potential expendability of such structures during surgical resection.

A patient would not be considered for this type of surgery if the lesion (e.g., lymphoma, most metastatic lesions) is best treated by nonsurgical modalities, or if there is an active infection in the oronasopharynx.

The timing of surgery is guided by the nature of the pathologic process and the urgency for its treatment, as well as the patient's overall medical status. In general malignant processes are treated expeditiously. Benign tumors and congenital deformities are treated electively.

A preoperative biopsy for tissue diagnosis will differentiate the neoplasms into surgical and nonsurgical categories. Those patients with malignant tumors for which

transfacial surgery is not recommended are usually offered radiotherapy, chemotherapy, or both. External beam radiotherapy may be supplemented with brachytherapy. Some benign lesions may be followed with scans to assess their growth potential, if the surgical treatment has a high likelihood of worsening the patient's deficit.

Transfacial approaches create potential risks to the function and aesthetics of the following structures: skin, dentition, maxillofacial skeleton, mucosal lining of the apper airway, paranasal sinuses, eustachian tubes, superior pharyngeal constrictor muscles, soft and hard palate, and tongue. From the neurovascular point of view, the reations of the upper cervical and petrous segments of the internal carotid arteries well as cranial nerves V<sub>3</sub> (especially the lingual nerve), XII, and V<sub>2</sub> (and the vidam nerve) must be recognized. Furthermore, the vertebral arteries are at potential risk, especially in congenital anomalies of the craniovertebral junction with an associated asymmetry. If they are exposed during surgery, these vessels should be covered with vascularized tissue to prevent the likelihood of subsequent vessel rupture.

The potential postoperative risks are related to the quality of wound healing, avolving the dura as well as the wall of the oropharynx. Cerebrospinal fluid (CSF) takage and breakdown of the wound closure are highly undesirable and require attensive treatment.

# Preoperative Planning

EM patients are given a broad-spectrum antibiotic (a third-generation cephalosporin ach as Rocephin), which is started within I hour prior to surgery and continued for approximately 48 hours postoperatively or until the spinal drain is removed. Most extients are not given an anticonvulsant except when a basal subfrontal approach is added to the procedure. Preoperative oral irrigation with a clindamycin solution may be used to reduce microbial flora.

# Surgical Technique

### Anesthetic Technique

Anesthesia is usually induced with pentobarbital and maintained with enflurane. Dral endotracheal intubation is usually satisfactory (a contoured Rey tube is preferred). In rare cases, preliminary tracheostomy is performed. Neurophysiologic montoring includes monitoring of cranial nerve XII (by tongue electromyography) as rell as monitoring of brain stem evoked potentials. All patients have arterial as well as central venous pressure lines. Elective hypotension is not used. All patients have a precordial stethoscope to alert the anesthesiology team to venous air embolism. When dural transgression is anticipated, a spinal drain is inserted.

### **Patient Positioning**

Most patients are positioned supine on the operating table with the head resting in a headrest. Occasionally, rigid head fixation is used. An alternative position is a right lateral position (for right-handed surgeons) for a limited midline lesion that is approached transorally. The advantage of this position is gravity-dependent drainage tway from the immediate surgical field.

### **Draping**

Complete preparation of the face and neck is performed with Betadine, and the oropharynx is irrigated with diluted Betadine solution. This area is then draped. In addition, the lateral thigh is prepared and draped as a fascia lata donor site.

### **Operative Technique**

Modular craniofacial disassembly is the principle of the facial translocation approach to the skull base (Fig. 8-1). It is based on creation of composite facial units that are designed along key neurovascular anatomy and aesthetic lines. The individual units merge into larger composites without compromising their function. It is possible to attach eponyms to the technical variations of facial translocation for ease of communication and comparison. Thus, we can recognize "mini," "standard," "expanded" (vertically, medially, posteriorly), "bilateral," etc. facial translocation procedures. Complementary craniotomies or craniectomies are added to these approaches as necessary to assist with three-dimensional tumor resection.

Mini facial translocation—central is designed to reach the medial orbit, sphenoid and ethmoid sinus, and inferior clivus. The port of entry is through the displaced ipsilateral nasal bone and the nasal process of the maxilla (with an attached medial canthal ligament, the lacrimal duct, and skin). The skin incision is made along the lateral aspect of the nose and the inferior aspect of the eyebrow with triangular design at the level of the medial canthal ligament. Osteotomies create a rectangular pattern with the lateral extent being just medial to the infraorbital nerve. Rigid fixation is accomplished with microplating (Fig. 8-2).

Mini facial translocation—lateral opens the infratemporal fossa. The incisions run from the inner canthus horizontally to the preauricular area and then vertically in front of the ear. The head of the mandible is either displaced or resected following a temporary removal of zygomatic arch and malar eminence (Fig. 8-3).

Standard facial translocation achieves surgical access to anterolateral skull base. It was originally described by Janecka et al. (1990). The ipsilateral facial skin (including the lower eyelid) is displaced laterally and inferiorly with the underlying maxilla (with or without the hard palate). The nasal incision may extend inferiorly to include an upper lip split. Superior incision continues from the nose to the inferior fornix of the lower eyelid, through the lateral canthus horizontally to the preauricu-

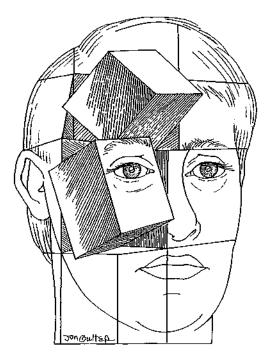


Figure 8-1. Modular craniofacial disassembly.

lar area. In some cases (more anterior tumors) it is possible to conclude this incision about 1.5 cm beyond the lateral canthus after identifying and preserving the most anterior frontal branch of the facial nerve. This point then serves as the point of rotation of displaced tissue, which gives sufficient surgical space for access to some paracentral tumors. When the entire extent of the horizontal temple incision is needed, the frontal branches of the facial nerve are identified with a nerve stimulator, placed in silicone tubings, and transected. During reconstruction these transected tubings are reconnected and the continuity of the facial nerve branches is reestablished. Osteotomies correlate to Le Fort 1 and 2 or the midpalatal lines when the entire maxilla is being displaced. The infra-orbital nerve is electively sectioned along the floor of the orbit, tagged, and repaired at the end of the procedure. Rigid fixation is achieved with mini- and microplates. With this technique of facial translocation, good exposure of the anterolateral skull base is achieved, especially when the infratemporal fossa is involved as well (Fig. 8-4).

Extended facial translocation—medial incorporates the standard translocation unit plus the nose and the medial one-half of the opposite face (up to the infraorbital nerve). It can be rotated at the Le Fort 1 level or include the ipsilateral palate and upper lip split. The skin incisions are similar to the standard technique except the paramasal incision is made on the contralateral side. The surgical exposure includes the ipsilateral infratemporal fossa and central and paracentral skull base bilaterally. The entire clivus is accessible as are the optic nerves, both precavernous internal tarotid arteries, and the nasopharynx. The wide communication with the infratemporal fossa allows the placement of the temporalis muscle flap for vascularized reconstruction of the skull base defect. Bony fixation of craniofacial osteotomies is sone with miniplates and a lag screw for the palate. The occlusal plane is re-established with the help of an orthognathic split. In addition a palatal split is attached to the maxillary dentition for additional stability and protection of the palatal incition. Temporary silicone intranasal stents are inserted as are bilateral lacrimal stents Fig. 8-5).

Extended facial translocation—medial and inferior includes the above procedure with an inferior extension via a mandibular split (Fig. 8-6). The lower lip incision is performed in a zigzag fashion to conform to the tension lines of the skin with an extension horizontally into the upper neck. Mandibular osteotomy is performed just medial to the mental foramen. Usually an interdental space is found wide enough to permit placement of a reciprocating saw for the osteotomy. This is performed in a step fashion, which then permits more stable reconstructive reapproximation of the hone. Prior to the osteotomy it is wise to select an appropriate miniplate for eventual fixation, contour it to the mandible, and create drill holes. This assists in the postoperative re-establishment of a normal occlusion. This extended translocation procedure adds a significant inferior cranial as well as upper cervical surgical access.

Extended facial translocation—posterior incorporates the ear, temporal bone, and posterior fossa into its surgical access. The horizontal temple incision of the standard translocation is extended posteriorly just above the external ear and curves inferiorly over the occipital bone to the neck. This provides access to the anterior as well as posterior aspect of the temporal bone with control of the key neurovascular structures (Fig. 8-7).

Bilateral facial translocation combines complete right and left basic translocation units with or without palatal split. The exposure incorporates both infratemporal fossae, and the central and the entire paracentral skull base. Both distal cervical internal carotid arteries (ICAs) are in view as is the full clivus. The palatal split permits a reach to the level of C2-C3. If further inferior extension is needed, a mandibular split can be added so a vertical reach to C3-C4 is accomplished. A sin-

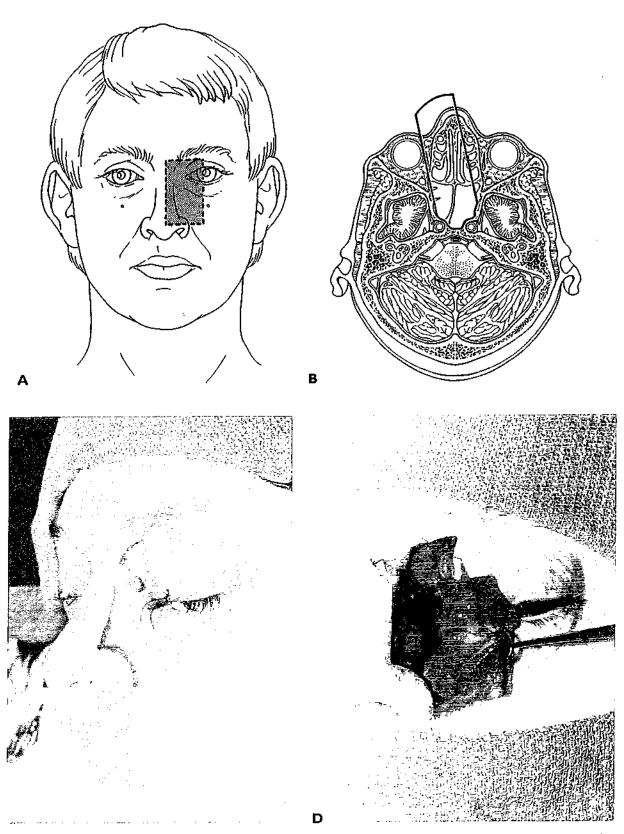


Figure 8-2. (A) Schema of mini facial translocation—central. (B) Axial outline of surgical field. (C) Clinical example—outline of skin incision. (D) Composite tissue flap (skin, bone, mucosa including the medial canthal ligament) is reflected laterally. (Figure continues.)

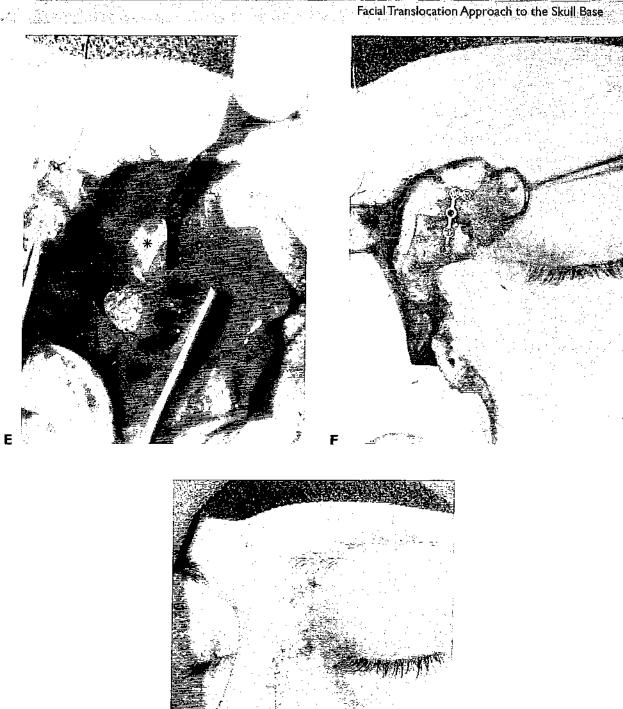


Figure 8-2 (Continued). (E) Close-up of intraorbital osteoma (\*) reached with this approach. (F) Replacement of composite flap and bone stabilization with microplates. (G) Wound closure.

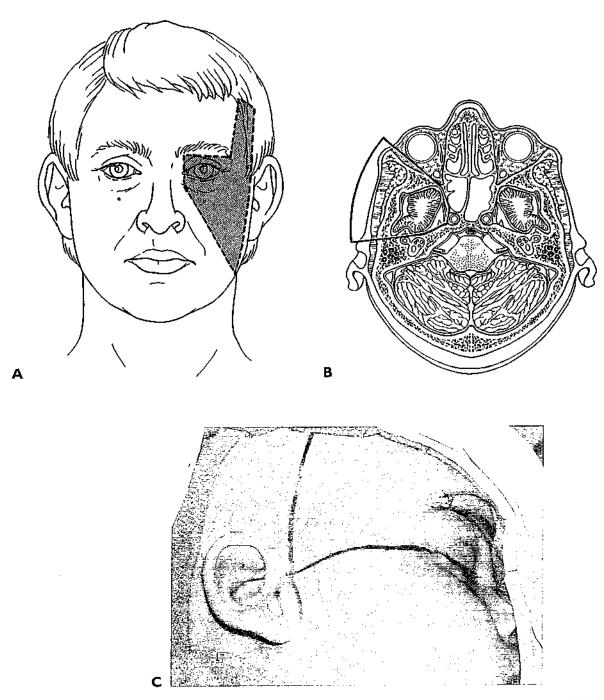


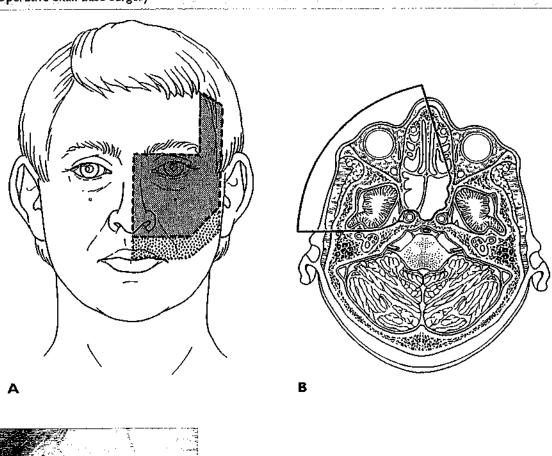
Figure 8-3. (A) Schema of mini facial translocation—lateral. (B) Outline of surgical field. (C) Clinical example—skin incisions. (Figure continues.)







gure 8-3 (Continued). (D) Coronal CT demonstrating cystic mass (encephalocele; arrow) in the ght infratemporal fossa with extension to the orbital fissure. (E) Surgical view of right temporal infratemporal fossa with arrow pointing to the cystic mass exiting from right middle fossa. FPatient's postoperative appearance at 6 months.





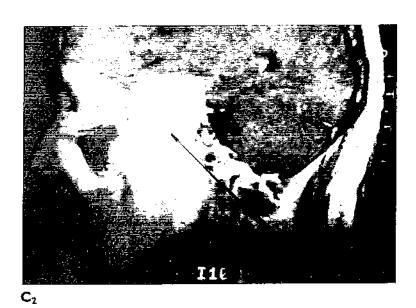
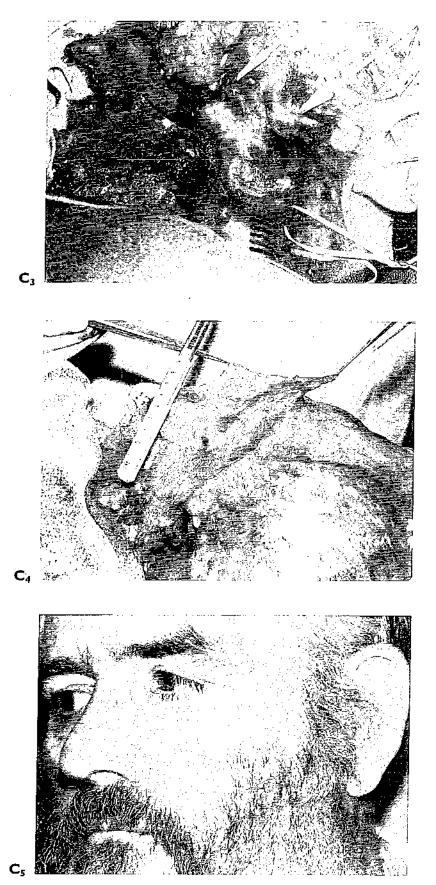


Figure 8-4. (A) Schema of standard facial translocation with palatal extension (dotted). (B) Outline of surgical field. ( $C_1$ ) Clinical example (translocation without palatal split)—skin incisions. ( $C_2$ ) Composite slide of patient's lateral photograph and lateral MRI demonstrating (pointer) a transcranial neurofibroma. (Figure continues.)



Fure 8-4 (Continued). ( $C_3$ ) Surgical view of left temporal and infratemporal fossae with exposure of a tumor (arrows). ( $C_4$ ) Medial rotation of left temporalis muscle used for reconstruction. 5) Patient's appearance 1 year postoperatively. (Figure continues.)

# 128 Operative Skull Base Surgery

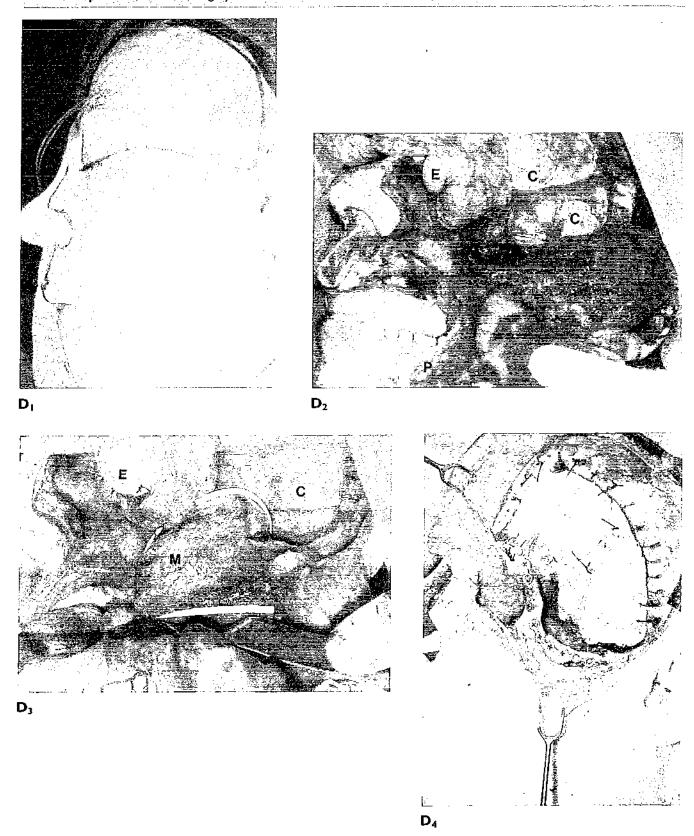
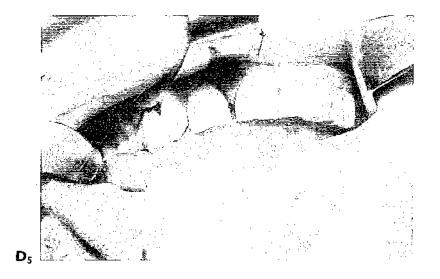
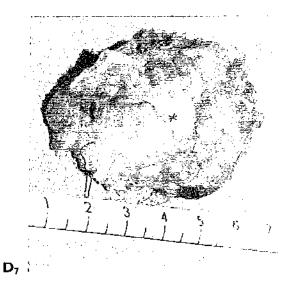


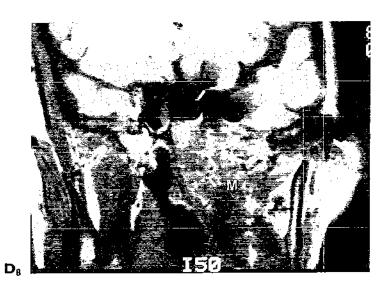
Figure 8-4 (Continued).  $(D_1)$  Clinical example (translocation with palatal split)—skin incisions.  $(D_2)$  Surgical view; frontotemporal craniotomy (C); eye (E); translocated left palate (P).  $(D_3)$  Transferred left temporalis muscle (M) into the surgical defect; eye (E); craniotomy (C).  $(D_4)$  Bony fixation; facial skeleton (miniplates); craniotomy (sutures). (Figure continues.)







que 8-4 (Continued). ( $D_5$ ) Re-established occlusion at the end of surgery. ( $D_6$ ) Coronal MRI emonstrating patient's tumor (T) in left nasopharynx and middle fossa. ( $D_7$ ) Surgical specimen cludes left lateral and posterior nasopharynx, foramen lacerum, and contents of infratemporal ssa; left eustachian tube (\*). (Figure continues.)





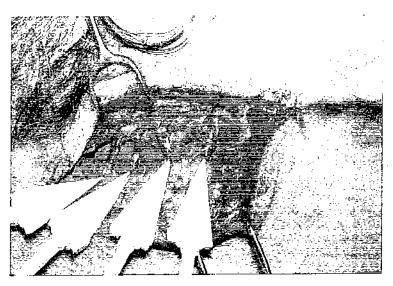


Figure 8-4 (Continued).  $(D_8)$  Coronal MRI demonstrating the temporalis muscle (M) transferred into the surgical defect.  $(D_9)$  Axial MRI demonstrating the transferred temporalis muscle (M); the central signal void in the muscle represents its tendon.  $(E_1)$  Clinical example—isolation and placement of silicone tubings around frontalis branches of left facial nerve above the zygomatic arch (arrows). (Figure continues.)

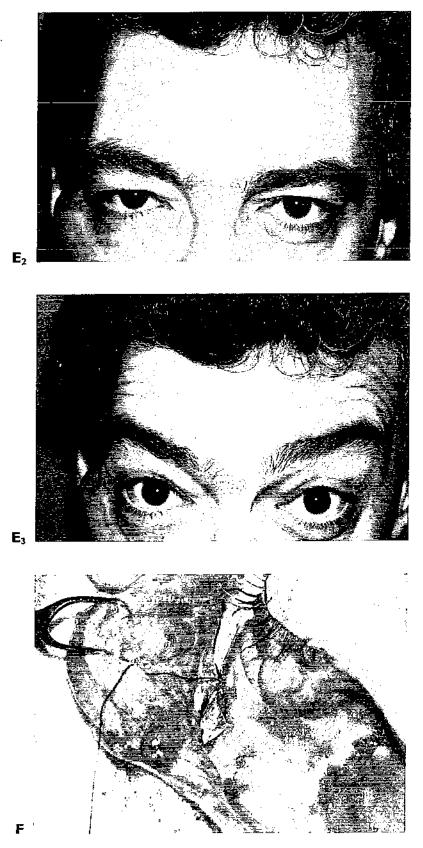
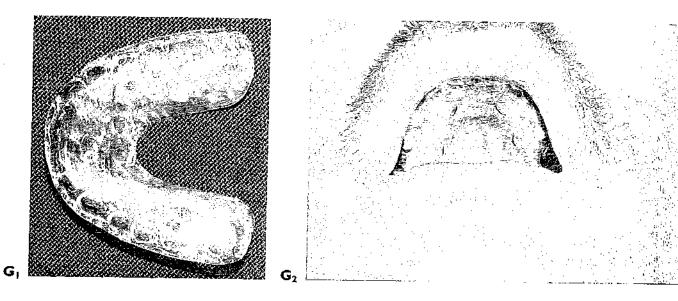


Figure 8-4 (Continued). ( $E_2$ ) Patient's postoperative (I year) forehead appearance in repose. ( $E_3$ ) Forehead movement at I year following repair of frontalis branches of the left facial nerve. (F) Repair of left infraorbital nerve at the completion of facial translocation. (Figure continues.)



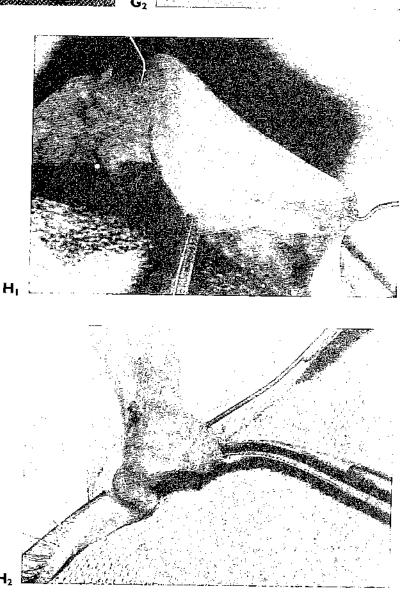


Figure 8-4 (Continued).  $(G_1)$  Occlusal splint used intraoperatively to re-establish patient's occlusion following palatal split.  $(G_2)$  Another type of occlusal split with palatal extension.  $(H_1)$  Lower lid fornix demonstrating level of transection.  $(H_2)$  Left lower lid with a probe in the lacrimal drainage system; probe is seen entering inferior canaliculus and exiting via nasolacrimal duct (held by a clamp). (Figure continues.)

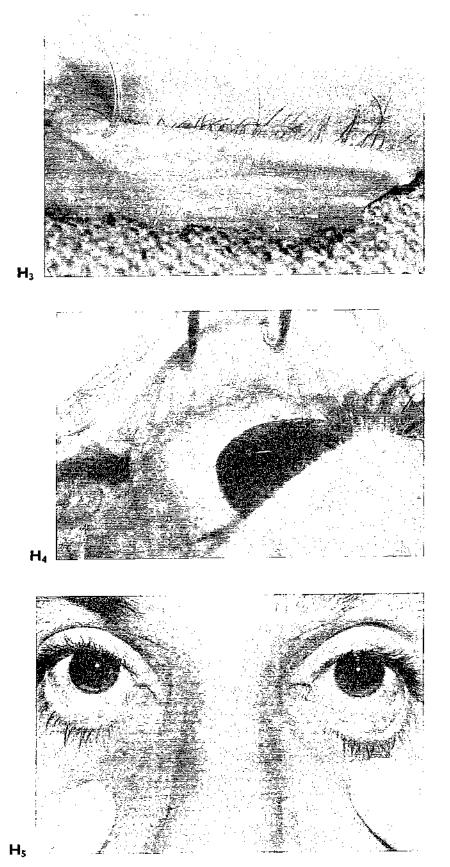


Figure 8-4 (Continued). ( $H_3$ ) Close-up of right lower lid with a lacrimal stent in the inferior canaliculus, ( $H_4$ ) Suturing of conjunctiva of the left inferior fornix; lacrimal stent is seen between superior and inferior canaliculus; dark lens protects the cornea. ( $H_5$ ) Patient's appearance 3 months postoperatively following extended facial translocation (medial); lacrimal stents are visible in both eyes between superior and inferior canaliculi.

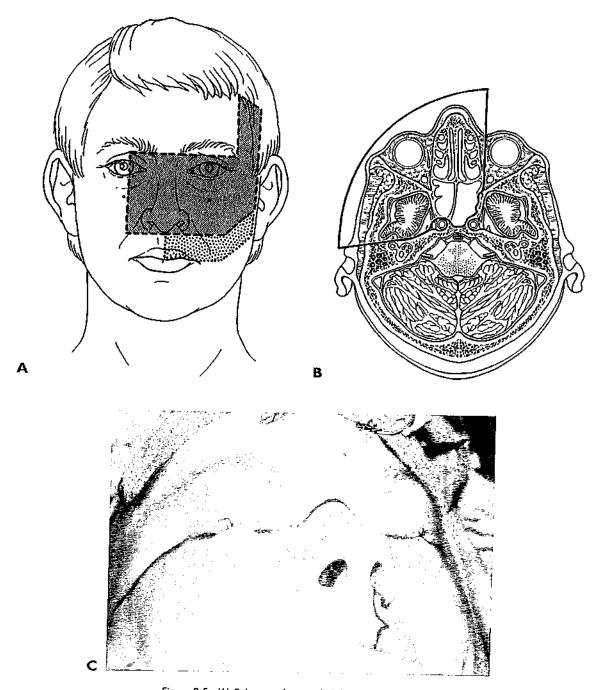


Figure 8-5. (A) Schema of extended facial translocation—medial with palatal extension (dotted). (B) Outline of surgical field. (C) Clinical example—outline of skin incisions. (Figure continues.)

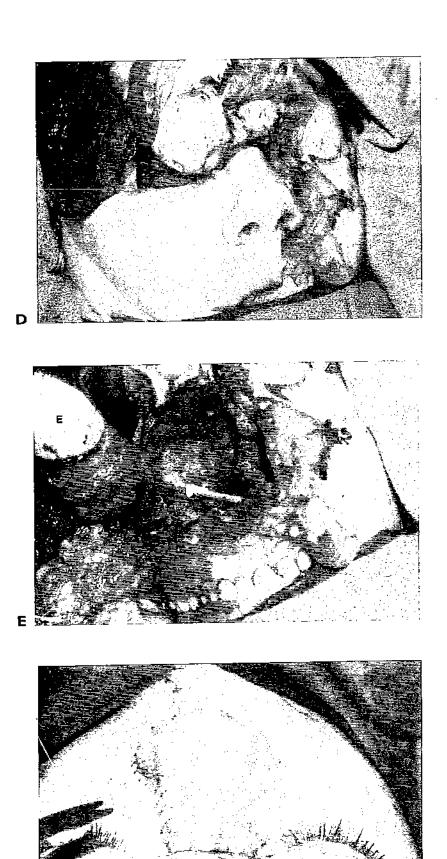


Figure 8-5 (Continued). (D) Incisions performed. (E) Close-up of surgical view following resection of fibrous dysplasia; arrow is at the clival dura; right eye (E). (F) Surgical closure; superior view. (Figure continues.)



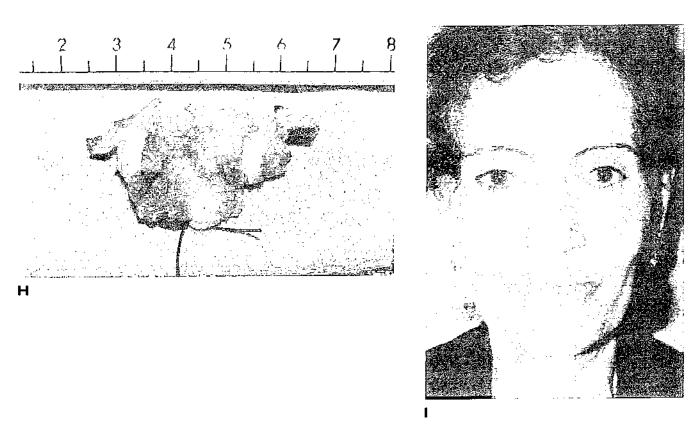


Figure 8-5 (Continued). (G) Surgical exposure of another patient (nasopharyngeal cancer). (H) Surgical specimen including both lateral walls and the posterior wall of nasopharynx; eustachian tube cartilages are prominently white at 3 and 9 o'clock. (I) Patient's appearance I year postoperatively.

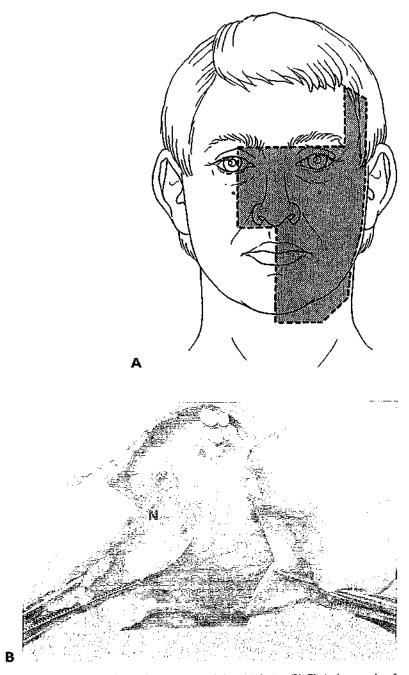


Figure 8-6. (A) Schema of extended facial translocation—medial and inferior. (B) Clinical example of right parasymphyseal mandibular split used in inferior extension of facial translocation; right mental nerve (N).

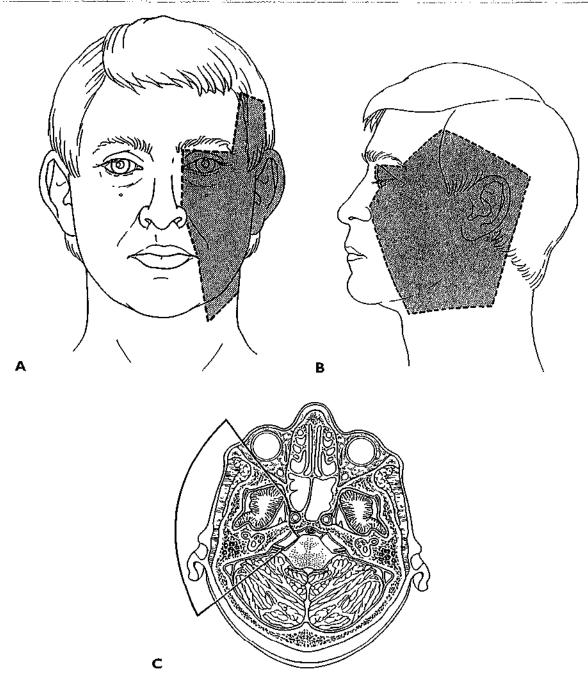
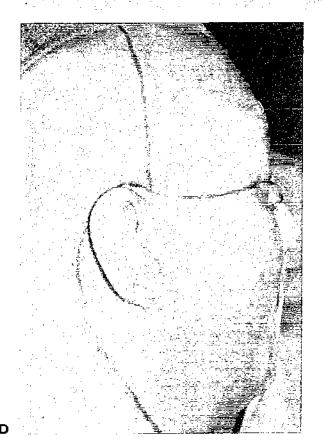


Figure 8-7. (A) Schema of extended facial translocation—posterior. (B) Side view. (C) Outline of surgical field. (Figure continues.)

gle temporalis muscle flap is sufficient for the coverage of the surgical defect at the skull base (Fig. 8-8).

# **Closure Techniques**

Following extirpation of the lesion at the cranial base, the dura is repaired or examined for intactness. If a suture repair is performed, fibrin glue is also used to reinforce the dural closure. A separate segment of fascia lata or pericranium may be applied directly to this suture line.





gure 8-7 (Continued). (D) Clinical example—skin incisions. (E) Surgical view following resection of accomplete moid carcinoma; internal carotid artery: (A) decompressed to the precavernous segtent; facial nerve at geniculate ganglion (G) prior to nerve grafting; nerve graft (N).

Following large resection with dural or vessel exposure, an ipsilateral temporalis suscle flap is transferred into the wound from the temporal fossa and laid into the entral and paracentral skull base. The attached deep temporalis fascia permits cirumferential suturing of this muscle-fascia unit to the surrounding soft and bony tisces under moderate tension, thus preventing postoperative gravity-dependent dislacement of the temporalis muscle. (The temporal fossa donor defect may be filled with an abdominal fat graft or later with an implant.) The remnant of nasopharyneal mucosa with the underlining pharyngeal constrictor muscle may then be placed wer this temporalis muscle. If pharyngeal mucosa is not available, it is reasonable to eave the temporalis muscle exposed to the nasopharynx. Usually within several weeks, nucosal coverage develops from the periphery of the nasopharynx. It is important, owever, to suture the periphery of the muscle to the surrounding structures to nsure support and to seal the surgical site.

The compound vascularized facial segments are repositioned. The dental occlusal fane is re-established with a prefabricated occlusal splint fashioned preoperatively om the patient's dental models. The lateral orbital and central nasal osteotomies re stabilized with miniplates. Large orbital defects are reconstructed with titanium tesh (Fig. 8-9). A horizontal lag screw is placed at the region of the nasal spine above the roots of the central incisor teeth) for anterior palatal stabilization.

### pecialized Instrumentation for Facial Osteotomies

Timmer Micro 100 reciprocating saw is used. It offers 1-mm-thick blades in short and long versions, ideal for facial osteotomies. For drilling, the Midas Rex system is

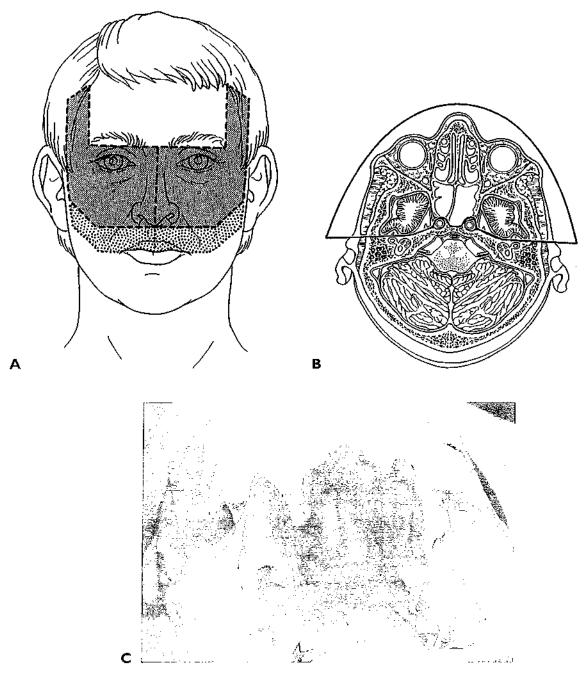


Figure 8-8. (A) Schema of bilateral facial translocation; dotted area includes palatal split. (B) Outline of surgical field in an axial plane. (C) Clinical example—facial/palatal split. (Figure continues.)

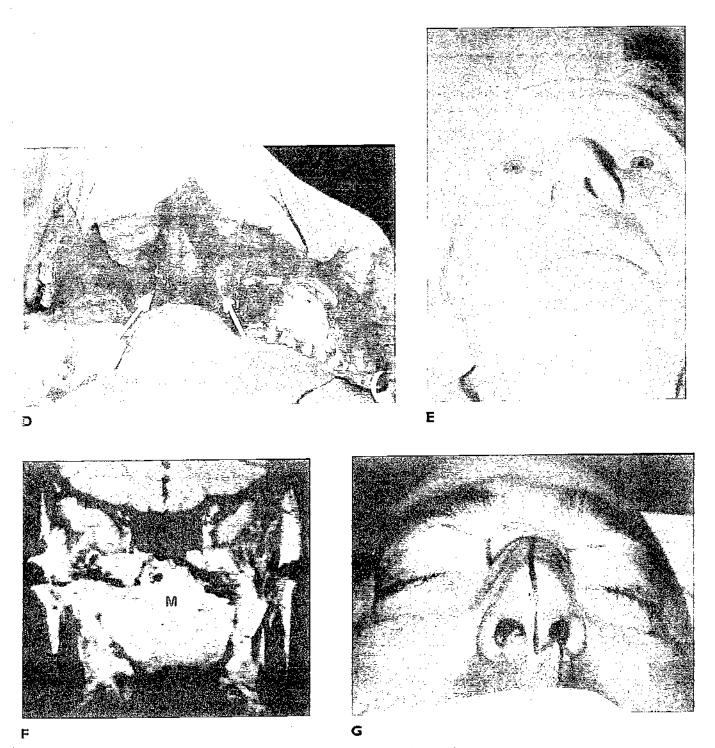
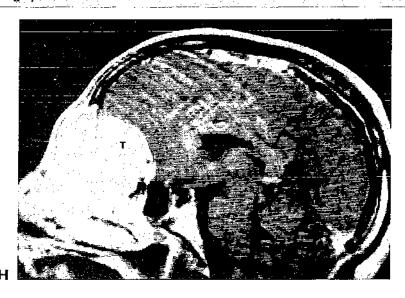
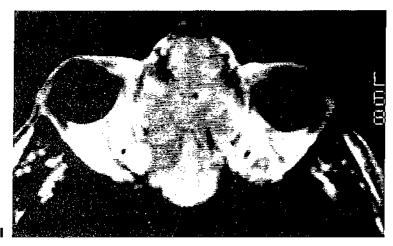


Figure 8-8 (Continued). (D) Extent of surgical exposure; arrows delineate nasopharyngeal cancer; displaced facial segments (with palatal halves with dentition) are lateral. (E) Postoperative result at I year. (F) Coronal postoperative MRI demonstrating transferred right temporalis muscle (M) into the surgical defect; notice the extent of the reach across the midline. (G) Another patient—skin incisions. (Figure continues.)





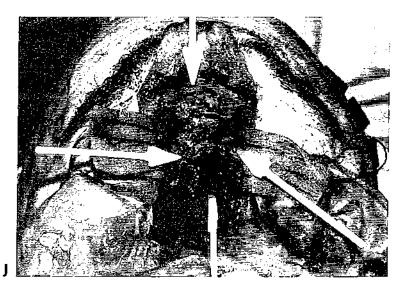
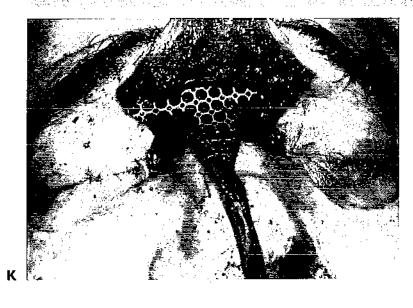
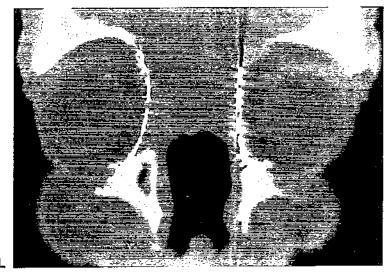


Figure 8-8 (Continued). (H) Sagittal MRI demonstrating extensive transcranial meningioma (T) with signs of an increased intracranial pressure. (I) Axial MRI showing tumor encroaching on both orbits. (J) Surgical exposure; arrows outline meningioma. (Figure continues.)





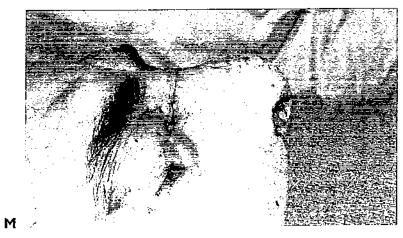


Figure 8-8 (Continued). (K) Bony defect was reconstructed with metal mesh. (L) Coronal CT demonstrating reconstruction of both medial orbital walls with metal mesh. (M) Lateral view of wound dissure and reconstruction of nasal projection.

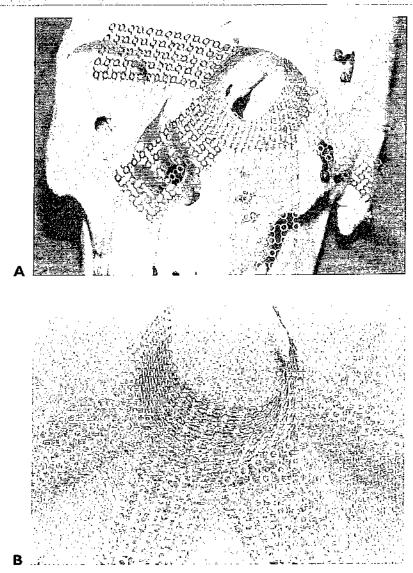
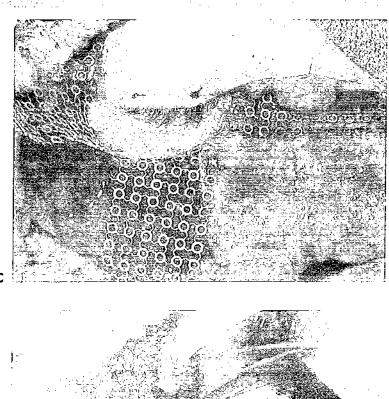


Figure 8-9. (A) Intraoperative formation of orbital reconstructive plate on skull model. (B) Close-t view of contoured orbital mesh (Leibinger; dynamic mesh). (Figure continues.)

used, with straight or angulated hand pieces. It comes with appropriate long attachments suitable for deep central skull base surgery. Cutting as well as diamond bur are used with suction irrigation. For adequate microsurgical visualization, the Zei microscope on a Contraves stand is very useful. Bipolar cautery is essential. Bor plating systems are available from several manufacturers. I have used sets fro: Leibinger, Synthes, and Howmedica.

# Postoperative Management

Most patients are extubated at the completion of skull base surgery. Elective temporary tracheostomy is performed in patients with palatal transections. All suctic drains maintain vacuum through a closed bulb system or a wall unit. External dressing is seldom used. Arterial and central venous pressure lines remain in during the immediate postoperative period as does the Foley catheter. Both lower extremities





2 8-9 (Continued). (C) Inserted contoured mesh into left orbit with lateral screw fixation. Inserted mesh with medial screw fixation in left orbit.

covered with intermittent air compression stockings to maintain venous circulan. Once ambulation is resumed, they are discontinued. Nasogastric tube is conted to a low suction until bowel activity resumes. Tube feeding is started and conted until oral intake is resumed. Antibiotic coverage is usually discontinued after to 72 hours. If spinal drain is in place, 50 to 75 cc are removed every shift for 2 to ays. A CT scan is done within the first 24 to 48 hours to ascertain the immediate tsurgical changes (looking for collections of blood, CSF, or air). General systemic well as neurologic examinations are continued throughout the postoperative iod.

# **emplications**

mplications at the skull base may be quite hazardous. The major complications d to fall into three categories: bleeding, infection, and wound healing problems.

The sometimes bothersome venous bleeding at the skull base is usually control intraoperatively with bone wax or Gelfoam. Arterial bleeding may be encountefrom the vertebral as well as the carotid atteries. Repair should be attempted following application of temporary vascular clips.

Infection is often the result of the presence of nonvascularized tissue, postsurg "dead space" or both. The transfer of the temporalis muscle provides vasculari reconstruction of the surgical defect. Postoperative CSF leakage with the threat meningitis is also possible and should be treated aggressively with spinal drains reoperation, or both. Beta-2-transferrin electrophoresis of suspected fluid is currer the most accurate test to document CSF leakage.

Wound healing problems are more frequent in patients who have had previ surgery and/or radiotherapy. They include minor or major tissue necrosis. When develops the extent of local wound care is dependent on the size and location of necrosis. When it overlies an essential structure, surgical debridement and vascui ized tissue transfer are indicated.

Certain surgical steps lessen the potential for complications. First and foremos the assurance of displaced tissue viability. This requires detailed knowledge of a vascular anatomy and judicial use of electrocoagulation. The use of vascularized of electrocoagulation in the use of vascularized overage of surgical site is the second essential element in lessening the risk of postoperat complications. This step also increases the chances for a seal of the CSF-contain space. When pharyngeal or palatal incisions or both are also used for exposure, a leaded closure with mattress sutures should be performed.

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# Una versatil via de abordaje al esqueleto del tercio medio facial

A versatile route for reaching the mid-third of the facial skeleton

Sr. Director:

De la lectura y estudio del artículo, hemos podido deducir que el plan terapéutico que proponen, en el caso clínico que presentan, parece que consiguen, según la iconografía que exponen, un resultado muy satisfactorio, por lo que debemos felicitarles, desde luego en este caso el procedimiento modificado de la técnica de Casson ha logrado sus objetivos terapéuticos.

El método mantiene sus indicaciones para patologías, no sólo traumatológicas, sino para cirugías oncológicas y/o tumorales del espacio medio facial en sus distintas profundidades, así como para el tratamiento de secuelas del fisurado, etc., como bien indican los autores del artículo que comentamos. No obstante, en lo que a la cirugía oncológica se refiere, con el procedimiento de Casson y sus modificaciones, es preciso seleccionar exquisitamente el caso clínico, para no caer en la tentación, de que por evitar incisiones externas, se pueda perder la perspectiva quirúrgica, que en oncología es obligado que debe ser de la más absoluta radicalidad y si los campos quirúrgicos son muy ajustados como puede ocurrir en este tipo de accesos "cerrados", estamos sometiendo al paciente a una verdadera yatrogenia al dar preferencia a aspectos cosméticos, sabiendo que la cirugía abierta convencional, la que se basa en el diseño de incisiones cutáneas siguiendo trayectos clásicos, avalados por años y años de experiencia, va a permitirnos normalmente accesos más seguros, para acercarnos a la zona de interés quirúrgico.

Siempre es fácil apuntarse, a que cuando aparece una técnica reconocida, el que más y el que menos ya la había hecho antes, en todas o algunas de sus partes y como no pensado en ello, y a veces, esto es verdad. Nosotros mismos, al inicio de la segunda mitad de la década de los setenta, en el Infantil del ahora, Hospital Universitario Miguel Servet de Zaragoza, abordábamos las estructuras nasoseptales mediante un abordaje similar al de Casson, y no lo hacíamos por ingenio, lo hacíamos por absoluta necesidad quirúrgica, ya que no nos sentíamos capacitados técnica ni quirúrgicamente para abordar por vía nasal en niños de poca edad, las estructuras nasoseptales, al ser las narinas de pequeño calibre, que en las secuelas nasolabiales de los fisurados por ejemplo, eran a veces muy dificultosas y, por ello, de forma natural buscábamos la vía sublabial, vía que veníamos empleando desde hacía varios años, rutinariamente para la realización de las osteotomías Le Fort I que, al fin y al cabo para nosotros, no deja de ser prácticamente la mitad de la técnica de Casson y diría más, ¿Cuántas veces hemos tenido que soltar el anclaje nasoseptal en cirugías oncológicas del maxilar superior/es cuando el tumor se hacía medial o en cirugías de las secuelas de patologías malformativas y/o traumatológicas?,

From reading and studying this article, it would appear that the proposed therapeutic plan in the case report presented is achieved. According to the iconography revealed, a very satisfactory result is obtained and the authors should be congratulated. In this case, Casson's technique with a modified procedure has achieved the therapeutic objectives.

The method is indicated for not only trauma-type pathologies, but also for oncological and/or tumor midfacial surgery of different depths, as well as for treating cleft palate sequelae etc., as indicated by the authors in the article under discussion. Nevertheless, with regard to oncological surgery, with Casson's procedure and its modification, all clinical cases should be meticulously selected, so as not to fall into the temptation of avoiding external incisions, as the surgical perspective will be lost, which in oncology has to be completely radical. If the surgical fields are very tight, as can occur in these types of "closed" accesses, we will be subjecting the patient to true latrogenia in order to give preference to cosmetic aspects, in the knowledge that conventional open surgery, based on the designs of skin incisions along classical lines, and supported by many years of experience, will normally permit safer accesses to the surgical area of interest.

When an acknowledged technique appears, someone will always claim to have carried it out before, either in part or completely, and sometimes this is true. We too, at the beginning of the second half of the seventies decade, in the children's hospital that is now the Hospital Universitario Miguel Servet in Zaragoza, reached nasoseptal structures using an approach that was similar to Casson's. We did not do this through ingenuity, but rather as a response to absolute surgical necessity, as we did not feel technically or surgically capacitated to use a nasal approach in very young children to access nasoseptal structures as children's nostrils are very small. Nasolabial sequelae, for example, in cleft patients are sometimes very difficult, and because of this we naturally sought a sublabial approach. This is an approach that for various years we had routinely been using for carrying out Le Fort I osteotomies, which for us at the end of the day is half Casson's technique, and moreover: How may times have we had to release the nasoseptal anchor in oncological surgery involving the upper jaw when the tumor became medial, or in surgery for malformation and/or trauma pathologies? For certain the answer is, numerous times, and we are sure that many surgeons working in the midfacial

seguro que numerosas veces y estamos convencidos que lo mismo les habrá ocurrido a numerosos cirujanos que actuaran en la región mediofacial por distintas patologías.

No obstante, no tratamos de desmerecer el procedimiento de Casson y las modificaciones que al mismo se han podido venir produciendo a lo largo de los años, es más creo que está bien que existan autores que sean capaces de sintetizar procedimientos casi habituales, dándoles una sistemática en su diseño y en sus posibles indicaciones, esto se debe agradecer al autor referido. Hoy dia desde que dio a conocer en Plasti Reconstr Surg 1974; 53: 102-3. The midface deglobing procedure de Casson PR, Bonanno PC, Converse JM, siguen saliendo más y más modificaciones no sólo en el aspecto técnico quirúrgico sino también en el de sus aplicaciones terapéuticas, para no extendernos en el Year Book de 1987 otorrinolaringología cirugía de cabeza y cuello aparece referenciada la publicación de 1972 Gerald B. Healy de la Universidad de Harvard, "An Approach to the Nasal Septum in Children" Laryngoscope 1986;96:1239-42, y más recientemente, en Neurosurgery 2002; 50:4, aparece Deglovin Transfacial Approach with Le Fort I and Nasomaxillary Osteotomies: Alternative Transfacial Approach de entre otros Kaguhiko Kyoshima, y colaboradores pertenecientes a los departamentos de Neurocirugía y Pfástica de Shinshu University School of Medicine, Matsumoto, Japón para acceder a la región central de la base del cráneo y ya por último acabamos de ver en "The British Association of Plastic Surgeons" 2004; 57:156-9 de R. Bracaglia, etc., su trabajo "Double Lateral Osteotomy in Aesthetic Rhinoplasty" que consigue por vía endonasal resultados similares al caso que se presenta en el artículo que comentamos con 210 casos tratados, en definitiva pues siempre hemos pensado que técnicas razonables en buenas manos pueden ser excepcio-

nales aunque sin duda las técnicas sobresalientes en manos no excepcionales son las que mejores resultados dan, al facilitar la actividad quirúrgica.

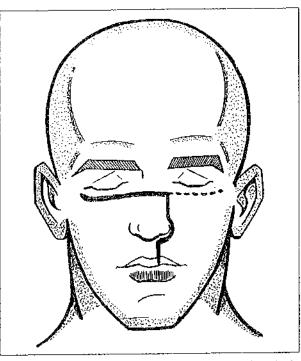


Figura 1. Incisiones cutáneas. La insición subpalpebral izquierda puede extenderse por la línea de puntos.

Figure 1. Cutaneous incisions. The left incision under the eye lid can be extended along the dotted line.

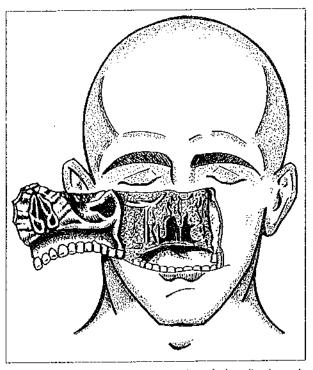


Figura 2. Apecto del campo operatorio después de realizar la movilización del maxilar y de las estructuras nasales.
Figure 2. Appearance of the operating field after the maxilla and nosal structures have been moved.

area, because of different pathologies, have also experience this.

Nevertheless, we are not trying to belittle Casson's procedure and its modifications over the years. Moreover, I believe that it is good to have authors that are able to synthesize procedures that are practically habitual, cataloging their design and their possible indications, and the authors should be thanked for this. Ever since the appearance in Plastic Reconstructive Surgery, 1974 Jan; 53(1): 102-3, of The midfacial degloving procedure by Casson PR, Bonanno PC, Converse JM, more and more modifications are appearing, not only of the surgical technique, but also of its therapeutic applications, without going into the 1987 Year Book of Otorhinolaryngology, surgery of the head and neck which refers to the 1972 issue of Gerald B. Healy from Harvard University and, "An Approach to the Nasal Septum in Children" Laryngoscope 96:1239-1242, November 1986 and more recently in Neurosurgery Vol. 50, No.4, April 2002, the Transfacial Dealovina Approach with Le Fort I and Nasomaxillary Osteotomies: Alternative Transfacial Approach including Kaguhiko Kyoshima, M.D. and the relevant collaborators of the departments of Neurosurgery and Plastic surgery of the Shinshu University School of Medicine, Matsumoto, Japan for reaching the central region of the skull base, and lastly in The British Association of Plastic Surgeons (2004) 57,156-159 R.

Bracaglia's work has just appeared "Double Lateral Osteotomy in Aesthetic Rhinoplasty" that, using an endonasal

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Algo de esto puede ocurrir con las técnicas transfaciales a cielo abierto, en ellas los campos quirúrgicos obtenidos facilitan la actividad quirúrgica sin grandes impedimentos y además con la circunstancia de que el diseño de las incisiones cutáneas que discurren por trayectos anatómicos muy meditados y de larga tradición quirúrgica, como ocurre por ejemplo con la clásica incisión de Weber-Fergusson, las cicatrices postquirúrgicas resultan prácticamente invisibles, eso sí, siempre que los volúmenes a movilizar estén diseñados en verdaderos bloques anatómicos sin particiones que luego muchas veces dan lugar a la formación de secuestros con las consiguientes fístulas cutáneas que van a dejar huellas imperecedederas.

Es probable que la aparición de las técnicas transfaciales abiertas, aprovechando incisiones tipo Weber Fergusson, que son la base de los colgajos mucoosteomusculocutaneos que dan cuerpo a la cirugía transfacial y sus modificaciones, haya servido precisamente para actualizar y sacar más a la luz las técnicas cerradas, porque y no es malo, que los cirujanos acudan a aquellos procedimientos que consideren menos agresivos, pero, eso sí, sin perder las perspectivas terapéuticas, en beneficio de las cosméticas, como antes señalábamos. Nosotros mismos ya describimos cómo el acceso tipo Le Fort I se podía emplear cómo vía de abordaje transfacial a las regiones fundamentalmente retromaxilares y para otras indicaciones: "Osteotomy of Le Fort I to reach the rhinopharynx (complementary note a-Desarticulación temporal pediculada a mejilia del maxilar superior (es) como vía de abordaje transfacial a las regiones fundamentalmente retromaxilares y para otras indicaciones (Vía maxilopterigoidea). Rev Iberoamer Ciruq Oral Maxilof 1983:5:81.

Quizás, nos atreveríamos a sugerir a los autores del artículo que estamos comentando, que valorasen para casos seleccionados la posibilidad de emplear la intubación submental, o quizá el despegamiento y la movilización de las

partes blandas mediofaciales. Notarían que sería más fácil y se evitaría que el tubo orotraqueal actuara como anclaje de las mis-

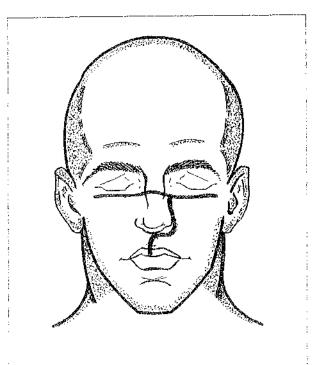


Figura 3. Incisiones cutáneas. Figure 3. Cutaneous incisions.

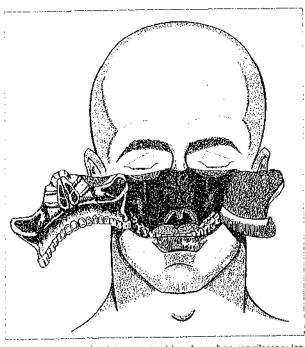


Figura 4. Apecto final. Los contenidos de ambos maxilares y las estructuras nasales y etmoidales están incluidos en los colgajos laterales, concretamente en la figura en el lado derecho. Figure 4. Final appearance. The contents of the jaw together with the nasal and ethmoid structures are included in the lateral flaps, in the figure on the right to be exact.

approach, achieves similar results to those in the article discussed with 210 treated cases. In short, we have always felt that reasonable techniques in good hands can be exceptional, although excellent techniques in not so exceptional hands undoubtedly give the best results, as surgical activity is facilitated. This can occur to a certain extent with transfacial open sky techniques. Here the surgical fields obtained facilitate surgical activity, and there are no great impediments. Given that the design of the cutaneous incisions running along anatomic lines have been carefully thought out, and that they have a long surgical tradition, such as for example the classical Weber Fergusson incision, postsurgical incisions are practically invisible; that is providing the volume to be moved has been designed as true anatomic blocks, without partitions, as these on many occasions will lead to the formation of sequesters and the resulting skin fistulas will leave permanent traces.

It is probable that the appearance of open transfacial techniques that make the most of Weber Fergussontype incisions, which are the base of mucoosteomuculocutaneous flaps that give body to transfacial surgery and its modifications, has served precisely to bring closed techniques up to date and more into the light, because it is not a bad thing for surgeons to be inclined towards the procedures that they find less aggressive, providing the therapeutic perspectives are not lost for the

benefit of cosmetic perspectives, as mentioned previously. We ourselves described how the Le Fort I type approach could mas, eso sí claro, hay que hacer una incisión submental, por ahora.

Felicitar pues a los autores, por haber afinado el acceso mediofacial por técnicas cerradas. Sin contradecir, para nada, con dichas técnicas, nosotros hemos diseñado nuestras osteotomías transfaciales y sus modificaciones, en su mayoría, a través de incisiones externas y, en nuestras manos, los resultados estéticos y funcionales han sido excelentes. Queremos agradecer que la Dirección de la Revista nos haya animado a publicar junto con el artículo comentado, los esquemas de nuestra metodología transfacial, para llegar a la cirugía craneofacial pediculada en sus distintos diseños y a la que se puede asociar el empleo de nuestro arco de tracción craneofacial, como ayuda en la cirugía de acceso a la base del cráneo, en técnicas de distracción, traumatológicas y en procesos rehabilitadores como pueden ser, en el tratamiento de la anquilosis temporomahdibular, uni o bilateral, etc. Debe entenderse que la cirugía abierta que preconizamos tiene que ser elegida libremente para cada caso clínico a tratar, nadie debe de tratar de imponer si hacer técnicas cerradas o abiertas. Hoy sólo cabe, el criterio clínico serio y sereno. Es un hecho curioso, al menos para nosotros, que si se repasa la literatura médica en el tema referente a los diferentes accesos que comentamos, cómo siendo más antiguas las descripciones cerradas, desde que se dieron a conocer las técnicas transfaciales abiertas, aquellas se han hecho más habituales, es el ejemplo del péndulo, si alguien con cierto éxito desarrolla un procedimiento siempre surgen autores, que parece que llevan la contraria. Pues ni lo uno, ni lo otro, es el criterio desinteresado, el que debe prevalecer sobre el enfermo a tratar. A veces hemos dicho, no obstante, que casi todas las técnicas en buenas manos, suelen ser excelentes, ya pode-

mos describir una técnica más o menos maravillosa, que si, no se realiza con los parámetros adecuados, puede llevar a su fracaso y empiezan a atribuirle resultados muchas veces insospechados, que sorprenden a los autores de las mismas. Algunos de los esquemas que presentamos, sobre todo en la cirugía craneofacial pediculada, no los hemos llevado a efecto todavía, porque no se nos ha presentado el caso, pero por si sucediera, la metodología, ahí está.

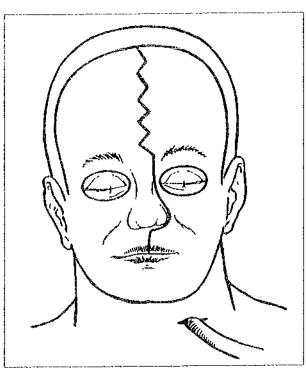


Figura 5. Líneas de incisión cutáneas. Figure 5. Cutaneous incision lines.

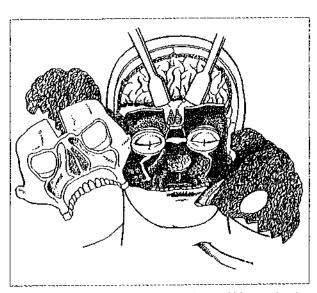


Figura 6. La región craneofacial completa y el bloque alveolomaxilar-dental es desplazado.

Figure 6. The complete craniolacial region and the alveolar-maxillarydental block is moved. be used as a transfacial approach in areas that are basically retromaxillary and other indications: "Osteotomy of Le Fort I to reach the rhinopharynx (complementary note for-Desarticulación temporal pediculada a mejilla del maxilar superior (es) como vía de abordaje transfacial a las regiones fundamentalmente retromaxilares y para otras indicaciones (Vía maxilopterigoidea). Iberoamer, cirug. Oral y Maxilof, 5 (1983) 81.

Perhaps we might suggest to the authors of the article under review that the possibility of using submental intubation should be evaluated in selected cases, or perhaps degloving and mobilization of the midfacial soft tissue. This would avoid the orotracheal tube acting as an anchor and facilitate things, although a submental incision would of course have to be made.

We would like to congratulate the authors for refining the midfacial approach using closed techniques, Without wishing to make any contradiction, we have used these techniques to design own transfacial osteotomies with modifications, mostly using external incisions and, in our hands, the aesthetic and functional results have been excellent. We would like to thank the Directors of the Journal for encouraging us to publish, together with the arti-

cle discussed, diagrams of our transfacial methodology for pedicled transfacial surgery in its different designs and which can be used in conjunction with our craniofacial traction arch. This aids the surgical access to the base of the skull in distraction techniques, trauma and in rehabilitation processes which can be for uni- or bilateral temporomandibular ankylosis treatment, etc.

Es tema de actualidad los trasplantes de cara, quizá no se tarde mucho, en que sean una realidad y al respecto quisiéramos llamar, una vez mas la atención de nuestros diseños transfaciales y los que se obtienen con los de la cirugía cráneo-facial pediculada, preparados para si fuera el caso, trasplantar esas unidades tridimensionales funcionales, en bloque, ya que pensar exclusivamente, en trasiegos de partes blandas aunque solo falten éstas, puede ser un error de concepto y si así se hiciera, difícilmente caben esperar resultados favorables. Un trasplante de cara hoy día debe interpretarse, cuando existe la necesidad de aportar grandes volúmenes, ya que para resolver pérdidas más o menos moderadas las técnicas reconstructivas convencionales, son las indicadas.

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It should be understood that the open surgery that we support should be freely chosen depending on each clinical case to be treated. No one should impose either closed or open techniques. These days there is only room for serious and serene clinical criteria. It is, at least for us, a curious fact that if the medical literature is reviewed with regard to the different accesses discussed, and despite closed descriptions being older, ever since the appearance of open transfacial techniques, the former have become more habitual. This is an example of the pendulum effect; if someone develops a procedure with a certain degree of success, you will always find authors emerging who disagree. It should be neither one thing nor the other. Impartial criteria should prevail with regard to the patient requiring treatment. We have nevertheless sometimes said that nearly all techniques in good hands tend to be excellent. However, a more or less magnificent technique, if not carried out with the right parameters, could lead to failure and unexpected results could be attributed to the technique much to the surprise of its authors. We have not been able to put into practice some of the diagrams presented, particularly in pedicled craniofacial surgery because the case has not arisen, but should this happen the methodology is there.

Face transplants are currently a popular subject, and perhaps in the not too distant future they may be a reality. In this sense we would, once again, like to draw attention to our transfacial designs and those regarding pedicled craniofacial surgery. These are in preparation, should the case arise, for the transplantation of these functional tridimensional units, as a block, because contemplating only the transferal of soft tissue even though only this may be required, may be a conceptual error. And if this were to occur, it would be difficult to expect favorable results. A face transplant these days should be carried out when there is a need for large volumes, because for resolving more or less moderate losses, conventional reconstructive techniques are the most indicated.

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# HEAD AND NECK

C. Suárez · L. A. García · R. Fernández de León J. P. Rodrigo · B. Ruiz

# Infratemporal approaches to nasopharyngeal tumors

Abstract Twenty patients with neoplasms originating in the nasopharynx were operated using the infratemporal fossa approach with facial translocation (15 cases), the subtemporal-preauricular infratemporal approach (2 cases), and the transmandibular approach (3 cases). A craniectomy was also required in 14 cases. Fifteen tumors were malignant, while 5 were juvenile angiofibromas with infratemporal and intracranial extensions. Most of the lesions were large and involved multiple areas of the skuli base. Tumor excision was total in all but 3 patients. Local flaps were utilized in all patients to seal the operative cavity and consisted of temporalis muscle flaps. The most frequent postoperative complications were wound infections and cerebrospinal leaks. Two patients died as a result of postoperative complications. To date, 1 patient has died from disease and 3 are alive with local or distant disease.

Key words Infratemporal fossa · Skull base · Nasopharyngeal tumors · Subtemporal surgical approach

# Introduction

In addition to undifferentiated carcinomas, the nasopharynx is the site of a wide variety of uncommon benign and malignant tumors. Some of these tumors can be treated primarily with radiotherapy, but in other types only surgery is effective. On the other hand, local recurrences after radiotherapy make salvage surgery occasionally necessary. Most of the malignant tumors share a pattern of spread that is similar, with the exception of adenoid cystic carcinomas which demonstrate perineural invasion. Usually, when the diagnosis of tumor is made, it is no longer confined to a primary site within the nasopharynx, but involves more than one site or has spread to adjacent structures. If this is the case, the sites more commonly involved are the infratemporal fossa, posterior part of the

nasal cavity, prevertebral muscles, clivus and intrapetrous internal carotid artery. Intracranial spread occurs when the tumor enters the intracranial compartments through the sphenoid sinus, eroding the greater sphenoid wing in the floor of the middle cranial fossa, or passes through different foramina in the base of the skull, with secondary involvement of the cavernous sinus and trigeminal ganglion. The juvenile angiofibroma is the most frequent benign tumor of the nasopharynx. A number of these tumors spread widely into the infratemporal fossa, with intracranial progression through the superior orbital fissurae.

A number of approaches to neoplasms within the infratemporal fossa and the nasopharynx have been reported. These include the subtemporal-preauricular infratemporal fossa approach [10], the subtemporal approach with facial translocation [6], various infratemporal approaches of type C [1, 2], maxillary swings [4], and the transmandibular approach [7, 9]. The purpose of this paper is to present our experience with different infratemporal fossa approaches and criteria for the selection of patients.

# Patients and methods

Twenty patients with tumors involving the nasopharynx and treated by an infratemporal approach were studied. All patients were managed at the Department of Otolaryngology, Hospital Central de Asturias, between 1 January 1992 and 31 December 1995, Operations performed on nasopharyngeal tumors through an approach other than the infratemporal were not included in this study. Seventeen patients were men and 3 women. The age range was 8–70 years with a mean of 44 years.

Fifteen tumors were malignant: squamous cell carcinomas (4), recurrent undifferentiated carcinomas (4), adenoid cystic carcinomas (3), adenoid cystic carcinomas (3), and malignant pleomorphic adenoma (1). The remaining 5 patients had a juvenile angiofibroma with infratemporal and intracranial involvement.

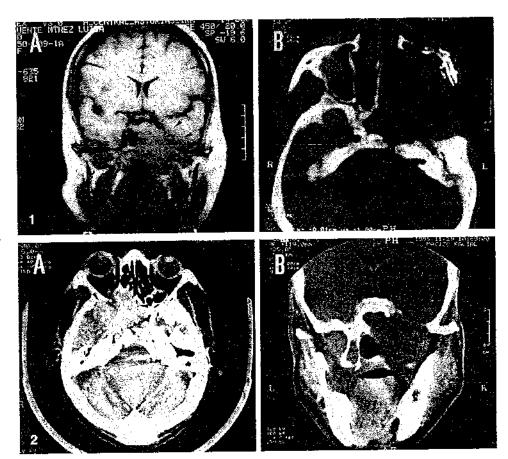
UICC criteria for TNM staging were used. Of the 15 malignant tumors, 2 were T2, 4 T3 and 9 T4. Most of the malignant and benign tumors were large and involved multiple areas of the skull base, including the posterior part of the nasal cavity (16), infratemporal fossa (15), cavernous sinus or parasellar region (7), internal carotid artery (5), dura (5), clivus (3), and petrous apex (2). Examples are shown in Figs. 1-5. Seven patients had been treated previously, either with surgery (1 case) or with radiotherapy (6 cases).

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Fig. 1 A Low-grade adenocarcinoma of a minor salivary gland involving the nasopharynx, infratemporal fossa, middle cranial fossa, cavernous sinus with encasement of the carotid artery, and sphenoid sinus in a 48-year-old female. B Postoperative CT scan 1 year later showing the operative cavity filled with the temporalis muscle flap

Fig. 2 A Low-grade adenocarcinoma of a minor salivary gland of the nasopharynx of a 64-year-old male spreading into the posterior ethmoid and sphenoid sinuses and parasellar region. B Postoperative CT scan 6 months later showing the temporalis muscle flap in the operative cavity



Three forms of surgical treatment were used: the subtemporal-reauricular infratemporal fossa approach as described by Sekhar et al. [10, 11] (2 cases), the subtemporal approach with facial translocation [6] (15 cases) and the transmandibular approach (3 cases). In addition, 14 patients required craniectomy. For well-lateralized tumors, involving only a lateral wall of the nasopharynx and the infratemporal fossa, the subtemporal-preauricular approach was used. In more extensive tumors, with extensive involvement of the nasopharynx or progression to the nasal cavity, sphenoid and clivus, a facial translocation approach was chosen. Patients with extensive nasopharyngeal tumors involving the upper part of the lateral wall of the oropharynx underwent a infratemporal transmandibular approach, sparing the mandible (two cases) or with hemimandibulectomy (one case). In these latter patients a pectoralis major myocutaneous flap was used to seal the extensive surgical defect.

When disease surrounded the internal carotid artery a preoperative evaluation was done to assess the risk for cerebral infarction should carotid sacrifice be required. Testing was performed with carotid compression and electroencephalography, single photon emission computed tomography and transcranial Doppler ultrasonography.

# Results

Tumor excision was total in all but three patients. These latter patients failed preoperative tests for carotid exclusion (two cases) or showed a limited involvement of the brain stem through the trigeminal root (one case). These patients were managed with postoperative radiotherapy using a linear accelerator or gamma-knife to treat small tumors remnants. In addition to these patients, six others were irradiated postoperatively.

Defects in the dura were reconstructed with Lyodura® or pericranial grafts in seven patients. Temporalis muscle flaps were utilized in all patients to seal the operative cavity.

The most frequent postoperative complication, wound infection, occurred in six patients, two of whom developed an osteomyelitis of the orbitozygomatic segment. Other complications included cerebrospinal leaks (4), pneumonia (3), ophthalmoplegia (3), meningitis (1), and breakdown of the carotid artery (1). Two patients died as a result of postoperative complications, resulting from pneumonia (one case) and carotid hemorrhage (one case).

Surgical morbidity included facial and tongue numbness because of the division of the mandibular and maxillary nerves, temporomandibular joint dysfunction when the mandibular condyle was resected, and incomplete recovery of the frontal branch of the facial nerve despite microsurgical reanastomosis. The only cosmetic defect was depression in the temporal region caused by temporalis muscle flap rotation.

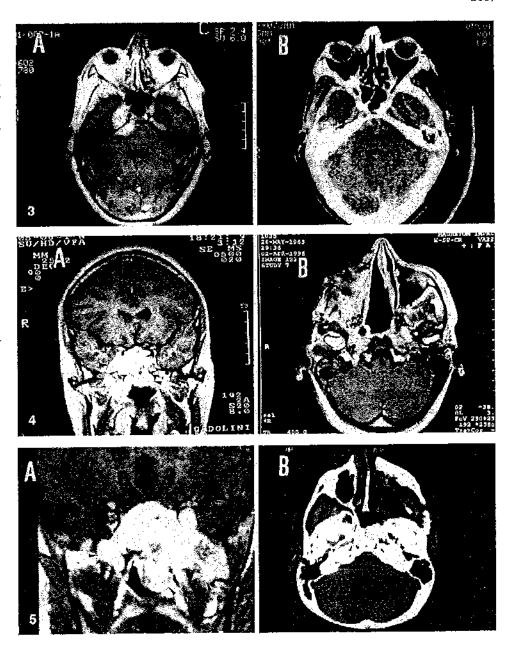
Additional surgery to correct a complication was required in two patients to close a cerebrospinal fluid leak and was done endoscopically. A parascapular free flap was used to repair a fistula between the zygomatic region and oral cavity resulting from osteomyelitis of the malar bone.

To date, one patient with a low-grade adenocarcinoma has died from distant metastases, another from unrelated causes, and three are alive with local disease. One patient with an adenoid cystic carcinoma had tumor recur through

Fig. 3 A Perineural spread of a recurrent undifferentiated carcinoma into the cavernous sinus and prepontine cistern along the trigeminal nerve in a 45-year-old male. B Postoperative CT scan I year later showing no rests of the tumor

Fig. 4 A Adenoid cystic carcinoma involving the nasopharynx and infratemporal fossa of a 30-year-old female. Tumor has progressed into the sphenoid sinus and middle cranial fossa. B Postoperative MRI 3 year later. There are no signs of recurrence; the temporalis muscle is lining the operative cavity.

Fig. 5 A Giant juvenile nasopharyngeal angiofibroma in a 10-year-old male. Tumor involves the infratemporal fossa, sphenoid sinus and parasellar region with displacement of the carotid artery. B Postoperative CT scan 2 years later with no signs of recurrence



perineural spread in the petrous apex and parasellar region 3 years after surgery, with tumor successfully resected by a subtemporal transcavernous approach. None of the juvenile angiofibromas have recurred as yet.

# Discussion

A number of anterior and lateral approaches to neoplasms within the infratemporal fossa have been reported during the past several years. The access obtained by anterior approaches is compromised by the long working distance required and is limited laterally in large tumors. This may prevent tumor removal from the peritubal space and control of the internal carotid artery. Therefore, transmandibular approaches with [9] or without [7] mandibulec-

tomy are required when tumors of the tonsillar region extend into the infratemporal fossa or when nasopharyngeal carcinomas extend into the tonsillar region.

Other techniques have been described that expose the skull base and the nasopharynx from superior and lateral directions [1, 8, 10]. Exposure from the superior direction is produced largely by extradural temporal lobe retraction rather than by removal of bone from the skull base. When there is no intracranial invasion, drilling the roof of the infratemporal fossa from below may suffice to remove tumor. In cases with intracranial progression, especially with tumor encasement of the internal carotid artery, the advantages of a superior exposure are clear. In contrast, an infratemporal approach type C [2] will also require a subtotal petrosectomy.

The facial translocation approach [6] is well suited for management of extensive tumors in the paracentral skull base, especially when there is substantial extracranial tumor and tumor involves the nasal cavity. It allows the surgeon an exposure that is not easily obtainable by other procedures. When necessary, a subtemporal craniectomy permits exposure of the floor of the middle fossa and cavernous sinus. Taking these factors into account, this technique was used in most of our patients with nasopharyngeal tumors. Only when limited invasion of the nasopharynx was found, with no involvement of the nasal cavity and maxillary sinus, was the subtemporal-preauricular infratemporal approach employed. A cosmetic defect produced was a depression in the temporal region caused by temporalis muscle flap rotation, but this was minimized with free-fat grafts. When a facial translocation was added, the possibility of osteomyelitis or late bone resorption existed, as well as epiphora due to nasolacrimal duct obstruction.

The variability of histological types of tumors in the nasopharynx, their uncommon presentations, and the small number of cases and follow-up in the few series published make it difficult to draw conclusions on long-term prognosis.

The most common benign tumor involving the floor of the middle fossa from below is nasopharyngeal angiofibroma. At presentation, 15–20% of the patients have radiographic evidence of widening of the superior orbital fissure and displacement of the intracavernous carotid artery. Frontotemporal craniotomy followed by lateral rhinotomy [5] and the infratemporal approach type C [2] has the disadvantage of high rates of incomplete removal. In contrast, the infratemporal facial translocation approach does not damage the temporal bone and provides greater access to the orbital apex, superior parts of the tumor, nasopharynx and nasal cavity. With this approach complete excisions have been achieved in five patients in our series, with no significant morbidity.

The 10-year survival rate for adenoid cystic carcinoma at any site is reported to be 22% [13]. In the series published by Shotton's group [12], 5 of 13 patients with adenoid cystic carcinoma of the skull base and nasopharynx followed for between 7 and 15 years had no sign of recurrence. The review period for the remaining 8 cases did not exceed 4 years, with one patient dead and another alive with disease. Our experience also suggests some confidence in our ability with the technique of infratemporal dissection to control such tumors permanently at the base of the skull.

The role of surgery in the management of malignant nasopharyngeal and parapharyngeal tumors involving the floor of the middle cranial fossa is not well established. The results of the infratemporal fossa removal of 13 recurrent nasopharyngeal carcinomas after radiotherapy, reported by Fisch et al. [3], are encouraging for T1 and T2 tumors, with six patients alive without disease at least 2 years after surgery, while those patients with more advanced stages died. When total resection is achieved, local recurrence is not very common. However, patients with highly malignant lesions fare poorly, due to the development of metastatic disease [11].

The mortality rate in our series due to postoperative complications was 10%. One patient with an extensive squamous cell carcinoma and encasement of the internal carotid artery who failed preoperative tests for carotid exclusion was operated on to debulk the tumor as much as possible before treatment with radiation therapy. The carotid artery was dissected free from tumor in the lateral aspect of the cavernous sinus, after which tumor was resected subtotally. The patient had a massive hemorrhage from the carotid artery 1 week later after the temporalis muscle flap used for reconstruction necrosed and failed to exclude the artery from the nasopharynx. Another patient succumbed to aspiration pneumonia, local infection and uncontrolled sepsis. The danger of carotid artery rupture contraindicates the use of operative approaches through the upper aerodigestive passage (such as the transmandibular approach), which may leave arteries at risk to the bacterial flora of these areas at the end of the operation. When such approaches expose major vessels, these should be protected with a vascularized flap. Infection was a common complication in our cases but, except for the case reported above, was in general readily treatable with antibiotics and did not represent a major clinical problem.

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gland and the infundibulum guard the region when an endonasal route is undertaken. A superior transposition of the pituitary gland and infundibulum is described as a functional alternative to access this complex region via an endoscopic transnasal route.

Methods: The last 10 consecutive patients in whom a pituitary transposition was performed were reviewed. The series consisted of 7 men and 3 women with a mean age of 44.4 years. Pathology was in 4 craniopharyngiomas, 4 chordomas, and 2

petroclival meningiomas.

Results: Five patients (50%) underwent total resection of the tumor, 3 patients (30%) had near-total (> 95% removal), and 2 patients (20%) had partial resection (meningiomas). All 4 patients with visual deficits recovered their vision completely. There was no neurological function deterioration. Eight patients had normal pituitary function preoperatively, of which 6 had endocrine follow-up proving normal pituitary function at 30 days (75%). There was 1 case of transient diabetes insipidus and one patient who is still taking desmopressin.

Conclusion: Endoscopic endonasal transposition of the pituitary and its stalk can provide a corridor to the retroinfundibular space and interpeduncular cistern with preservation of

pituitary function in the majority of cases.

139. Long-Term Results of Craniofacial Implantation: A Return to Methylmethacrylate Anii Shetty (presenter), Jason Hess, Rebecca Studinger, Gustavo Bello-Rojas, Arunesh Gupta, Halil I. Canter, Ian T. Jackson (Southfield, USA)

Purpose: Although autologous bone is the traditional material used in the reconstruction of bony defects, it has drawbacks such as donor site morbidity, increased operative time, and resorption. Alloplastic materials for autologous bone are an appealing alternative. One of the earliest alloplastic materials used in cranioplasty was polymethylmethacrylate

(PMMA).

Methods: Incisions were deliberately not placed directly over a site of implantation. Methacrylate impregnated with tobramycin was used. Multiple layers of SurgicelTM were used to separate the brain from the exothermic reaction of curing PMMA. In addition, cold sterile water was poured over the implant in order to reduce the conduction of heat. Screws of 2-4 mm length were placed into the bone edges. Approximately one half of each screw was left exposed. The exposed screws were incorporated into implants as they hardened, and the implants themselves were thus fixed to the defect margin.

Results: Thirty patients, treated between 2000 and 2006, were included the study. Fifteen patients had full-thickness cranial defects, while the other half had partial-thickness defects. The etiologies of the defects were trauma, congenital

hypoplasia, and tumor resection.

Conclusion: PMMA is a safe and effective option for craniofacial reconstruction. PMMA may be used to create a reliable reconstruction composed of an easily molded and biologically inert material. Graft immobilization via screw fixation not only increases the stability of the reconstruction but also contributes to a reduced rate of peri-implant infection. It is probable that impregnation of the cement with tobramycin has also contributed to a decline in infectious complications.

140. Orbitocranial Penetrating Trauma by a Tree Branch: Case Report and Literature Review

Clara R. Epstein (presenter), Dongwoo J. Chang (Columbus and Davis, USA)

Orbitocranial penetrating injury should be considered a neurosurgical emergency in order to avoid potential infectious and neurologic sequelae. Incomplete removal of a foreign body may lead to complications that can be avoided. This is a case report of a 15-year-old male who sustained orbitocranial penetrating trauma with a tree branch. Management of orbitocranial penetrating injury with a foreign body is described. We discuss the importance of urgent diagnosis and foreign body removal in order to avoid infectious and neurologic complications and the utility of a skull base style of cranioorbital exposure to facilitate the safe complete removal of the foreign body. Because of potential infectious and neurologic sequelae, appropriate neurodiagnostic studies and exploration with foreign body removal should be performed without undue delay in cases of orbitocranial penetrating injury. Appropriate antibiotic coverage should be initiated immediately. The operative approach should be tailored to the anatomic location of the foreign body penetration. In cases that involve the anterior and middle cranial compartments, it is necessary and beneficial to utilize a skull base style of neurosurgical exposure in order to completely extract the penetrating foreign bodies while avoiding further injury to adjacent neurovascular structures. A literature review is also presented.

141. Facial Swing for Central and Lateral Skull Base Exposure Ian T. Jackson (presenter), Daniel R. Pieper, Barbara J. Beal (Southfield, USA)

Mandibular and maxillary swings, together with facial bipartition, provide the skull base surgeon with a very convenient exposure of the central and lateral skull base. The mandibular swing opens up the lateral skull base and provides excellent exposure for resection of lesions such as neurofibroma and glomus tumors. The maxillary swing provides access to central skull base tumors. These may be benign (for example, vascular) or malignant. The surgical technique, the anatomy of the area, and how to prevent complications will be presented with dissection specimens and case presentations.

142. Surgical Treatment of Anterior Cranial Fossa Meningiomas: Complications and Outcome Vijayakumar Javalkar (presenter), Anil Nanda (Shreveport, USA)

A total of 65 patients with anterior cranial fossa meningiomas underwent surgical resections from 1992 to 2006 at LSUHSC, Shreveport. The majority of the patients were female (64%). One patient died following surgical excision (1.5%). Four patients developed endocrine-related complications (6%). Two patients developed delayed hydrocephalus which required a CSF diversion procedure. One patient developed transient aphasia and 1 developed sixth nerve paresis. One patient had CSF leak which required surgical repair. Recurrent seizures were noted in 1 patient in the postoperative period. Other nonneurological complications were atrial fibrillation in 2 and DVT in 1 patient. Residual tumor was noted in 6 patients (9.2%) in the postoperative scans. Three had had prior resections. In 1 patient who had received prior radiotherapy a small tumor was left between the carotid and optic nerve. In 1 patient subtotal resection was performed due to severe hemorrhage.

# Operative technical review

# Selected midfacial access procedures to the skull base

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Summary The indications and operative technique of various procedures commonly used to provide or increase access to the central skult base, anterior and middle cranial fossae, nasopharynx, infratemporal fossa and retromaxillary space are discussed with illustrative cases.

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Keywords: transfacial access, osteotomy, skult base, infratemporal fossa, anterior cranial fossa, middle cranial fossa, retromaxillary space

# INTRODUCTION

Lesions involving the central and lateral skull base, infratemporal fossa and retromaxillary region are difficult to access. Tumours once considered inoperable by virtue of their site are accessible using various techniques that have been developed over many years to allow access to these sites with minimal morbidity. In cooperation with the neurosurgeon, the oral and maxillofacial surgeon is able to select and provide appropriate access in these cases. The purpose of this article is to review some of the more commonly used approaches and discuss their indications, operative details and limitations.

#### Anatomy of the skull base

A systematic approach to tumours of the base of the skull has previously been described in which the base of skull is divided into right and left lateral and central compartments by the internal carotid arteries. The lateral compartments are further subdivided into anterior, middle and posterior segments. The central compartment contains the anterior cranial fossa (cribriform plate, planum sphenoidale, orbital roofs and greater wing of sphenoid), clivus, body of sphenoid and upper cervical spine.

The anterior segment of the lateral compartment extends from the anterior middle cranial fossa back to the anterior edge of the petrous temporal bone and contains part of the greater wing of the sphenoid and the inferior surface of the petrous temporal bone (the infratemporal and retromaxillary areas) (Fig. 1). The middle and posterior segments of the lateral compartment are not accessible via transfacial approaches and will not be discussed in this article.

Access to the central compartment is achieved via anterior approaches whilst the anterior segment of the lateral compartment is accessed from lateral or combined anterolateral approaches.

# **ANTERIOR APPROACHES**

# Le Fort I approach

Osteolomy of the maxilla at the Le Fort I level is not a new concept and was first described by von Langenbeck over 140 years ago. Cheever subsequently used this procedure to remove a

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nasopharyngeal polyp. Kocher described a midline lip and palatal split to provide improved access to the pituitary fossa.<sup>2</sup> In 1987, Archer et al.<sup>3</sup> used the approach to access distal vertebral and midbasilar aneurysms and in 1991, James and Crockard<sup>4</sup> added a midline sagittal split of both maxilla and soft palate to improve access to the cranio-vertebral junction.

Horizontal osteotomy and down-fracture of the maxilla offers wide exposure to the postnasal space, central skull base, and upper clivus and is the procedure of choice for the removal of benign lesions such as clival chordomas and nasopharyngeal tumours.

When combined with a mid-palatal split, the improved access to the cranio-vertebral junction facilitates access to tumours that extend above and below the foramen magnum, and enables surgical decompression in cases of severe basilar invagination. The development of bone miniplate systems has enabled surgeons to rigidly replace the osteotomised segments, and pre-location of the miniplates before the osteotomy is completed enables rapid fixation with restoration of the occlusion at the completion of the procedure.

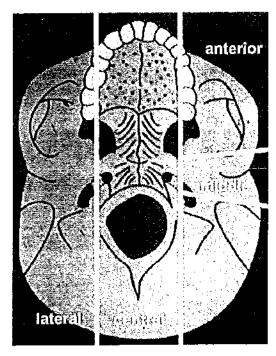


Fig. 1 Compartments of the skull base.

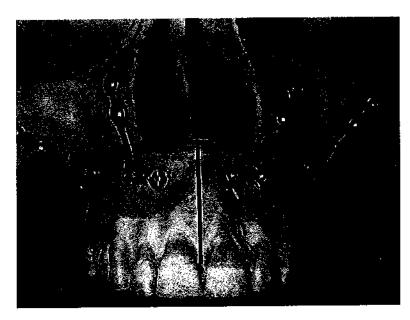


Fig. 2 Anterior view of Le Fort I level osteotomy lines and mini-plate fixation.

# Operative technique

Pollowing either tracheostomy or more commonly, orotracheal intubation, a local anaesthetic containing adrenalin is infiltrated along the maxillary mucogingival reflection. A horizontal incision is performed at this level and a mucoperiosteal flap is raised over the anterior surface of the maxilla. Subperiosteal dissection is developed medially to expose the piriform apertures, laterally around the zygomatic buttress areas and superiorly to the level of the infraorbital nerves. The nasal mucosa is then elevated from the floor and lateral walls of the nose, and nasal septum. Using a reciprocating saw or fissure bur, a horizontal osteotomy is performed above the apices of the teeth. Before any further bone cuts are made, four 2 mm titanium miniplates are adapted to the bony surface to enable the occlusion to be restored at the end of the procedure (Fig. 2), The lateral nasal wall and septum are divided with guarded osteotomes, and the pterygoid plates are separated by means of a curved osteotome. The maxilla can now be downfractured, exposing the nasal floor. An Archer or modified-Dingman gag, which is inserted to retract the maxilla inferiorly, provides approximately 8 cm of horizontal anterior exposure and 5 cm posteriorly<sup>5</sup> (Fig. 3).

For access to the lower clivus, and cranio-vertebral junction, a midline palatal split through the hard and soft palate can be performed (Fig. 4). The divided maxilla can be separated by a self-retaining retractor and maintains its blood supply from the greater palatine and ascending pharyngeal arteries, as well as smaller unnamed pharyngeal vessels traversing the fauceal pillars.

At the end of the procedure, the maxilla is returned to its initial position, stabilised with the previously adapted miniplates and the wound is closed in layers with a continuous absorbable suture.

This approach has the advantage of being a commonly performed, well-understood, predictable and safe procedure that provides wide anatomical exposure with minimal morbidity, and a hidden intraoral incision. Alternative transfacial approaches offer limited exposure; have the potential to divide sensory or motor nerves, or destroy the anterior facial skeleton. Reported complications include CSF fistula and meningitis (intradural lesions), postoperative nasal haemorrhage, and ischaemic necrosis of the maxilla. Oronasal fistulae can occur in those cases where the palate is split, but offsetting the mucosal incision with respect to the palatal

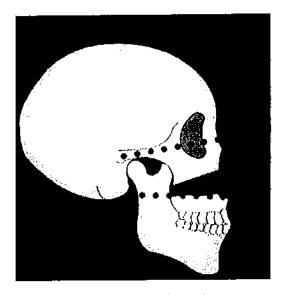


Fig. 3 Diagram demonstrating arc of maxillary rotation.

osteotomy reduces this risk. Occasional velo-pharyngeal incompetence can occur, especially when extensive vertebral bone removal leaves a depression in the posterior pharyngeal wall. This risk can be diminished if a dermal fat graft is placed before closure.

# Maxillo-nasal-cheek flap approach

This technique was popularised by Curioni et al.<sup>8</sup> and is useful in providing access to tumours extending to involve the central skull base from the soft palate, retromaxillary and postnasal spaces.<sup>8,9</sup> The maxillo-nasal-cheek flap has been used to remove a wide variety of tumours including adenocarcinomas, malignant schwannomas, and adenoid cystic carcinomas, and provides excellent access for oncologic surgery in this region.<sup>10</sup>

Variations of this procedure follow the same basic concept of mobilising facial structures on a viable pedicle, and when increased exposure is required, the nose can be included in the flap (maxillo-nasal cheek flap), or the face can be opened like a book (maxillo-nasal cheek flap and contralateral maxillo-cheek flap).

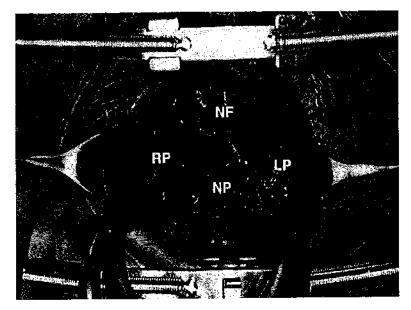


Fig. 4 Intra-operative photo following mid-palatal osteolomy (NF, nasal floor; RP, right palate; LP, left palate; NP, nasopharynx).

# Operative technique

Following tracheostomy or orotracheal intubation, a standard Weber-Ferguson skin incision is made, for a maxillo-cheek flap. For a maxillo-nasal-cheek flap, the paranasal incision is made on the contra-lateral side, extended across the nasal bridge and then into the ipsilateral lower eyelid. As the blood supply to the skeletal segments is derived from the cheek flap, minimal periosteal elevation is performed. A horizontal osteotomy is made along the anterior surface of the maxilla inferior to the orbital rim, and extended laterally through the body of the zygoma to the pterygomaxillary fissure. The medial extent of this osteotomy depends on the type of flap. With a maxillo-cheek flap the medial extent of the osteotomy runs vertically and lateral to the piriform aperture, then inferiorly between the ipsilateral central and lateral incisors. With a maxillo-nasal-cheek flap the horizontal osteotomy is extended across the nasal bridge anterior to the lacrimal fossa to join a vertical osteotomy on the contra-lateral side (Fig. 5). To allow for mobilisation, a palatal Osteotomy is performed backwards between the central and lateral incisors, and the pterygoid plates are separated with a curved osteotome through a small vestibular incision. The infraorbital nerve is divided, and after miniplate pre-localisation, the osteotomised segment is mobilised (Fig. 6). At the conclusion of the procedure the segment is replaced and fixed with the pre-contoured plates, and the wounds closed.

This versatile procedure is mainly used to access malignant lesions in the postnasal and retromaxillary spaces as it provides wider access than the Le Fort I approach and can be modified to include sub-total maxillary resection. This approach allows access to the buccal fat pad, which can be used for palatal reconstruction in selected cases. This procedure has increased morbidity compared with a Le Fort I maxillotomy, with facial scarring and infra-orbital anaesthesia.

# Extended transbasal approach

Over the past two decades many craniofacial techniques have been described which improve exposure to the anterior cranial fossa and central skull base. Based on the outlines described by Tessier et al. 11 of the fronto-orbital bandeau as used in craniofacial

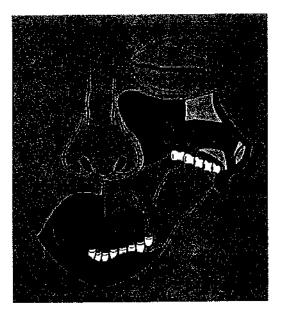


Fig. 5 Diagram of left maxillo-cheek flap.

surgery for congenital anomalies, and the 'low fronto-orbital technique for sphenoethmoid tumours' or transbasal approach described by Derome etal. 12, various skull base teams introduced more direct approaches. 13,14 Raveh 15 described the extended subcranial or transbasal approach for use in craniofacial trauma and later adapted it to tumour resection. 16 Spetzler further modified the approach to involve an osteotomy of the cribriform plate with a view to olfactory preservation in appropriate cases, and to facilitate reconstruction of the anterior fossa. 17

The extended transbasal approach involves the en-bloc mobilisation of the supra-orbital rim, orbital roofs and nasoethmoidal complex. This approach provides access to the sphenoethmoidal region, clivus and foramen magnum.

# Operative technique

A bicoronal flap is raised and developed further anteriorly so that the subperiosteal dissection exposes the nasal bones, nasal process



Fig. 6 Intra-operative photo of reflected right maxillo-nasal-cheek flap.

of the maxilla and continues into the orbits to the level of the anterior ethmoidal artery. The medial canthal ligaments and upper lateral nasal cartilages are detached, and the nasolacrimal duct is exposed and preserved. After bifrontal craniotomy and dural exploration and/or dissection have been performed, the fronto-nasal complex is outlined and osteomised (Fig. 7). The anterior osteotomies run upwards from the piriform aperture, across the nasal process of the maxilla to the medial orbital floor. Crossing the medial orbital floor onto the medial orbital wall, they end at the level of the anterior ethmoidal artery. The medial orbital walls and roof are osteotomised, and if this technique is used to approach a tumour that does not involve the cribriform plate, the design of the orbital roof osteotomy is modified to include a circumferential cribriform plate osteotomy to preserve the plate and olfactory nerves. 18 Following removal of the frontonasal unit, an osteotomy is performed posterior to the cribriform plate through the planum sphenoidale. The cribriform plate, released from all bony connections, can then be elevated attached to the frontal lobe dura (Fig. 8). At the conclusion of the procedure fixation of the osteotomised bones is accomplished with a combination of plates and/ or wires, and the upper lateral nasal cartilages and medial canthal

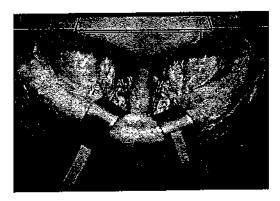


Fig. 7 Anatomical dissection showing estectomy lines of extended transbasal approach.



Fig. 8 Anatomical dissection showing access on removal of fronto-nasal unit.

ligaments are reattached. The cribriform region is usually repaired with a pericranial flap.

Advantages of this procedure include a wide vertical exposure of the anterior cranial fossa and central skull base with minimal brain retraction, avoidance of facial incisions and preservation of olfaction in some cases. Complications of this procedure include CSF leakage, transient pituitary dysfunction, cranial nerve deficits, and nasolacrimal duct injury.<sup>18</sup>

# LATERAL APPROACH

# Transzygomatic approach

Described by Obwegeser<sup>19</sup> as an approach to the temporomandibular joint, orbit and retromaxillary-infracranial region, this approach has many applications. It can be used to access tumours arising within the infratemporal fossa such as schwannomas, and can provide access to the posterior extension of orbital, maxillary and palatal tumours, as well as those tumours with perineural spread along the trigeminal nerve. This approach can also access tumours of the anterolateral skull base, and intracranial tumours with inferior extension such as meningiomas as when combined

with a pteryonal approach it provides excellent access to the middle cranial fossa, allowing tumours above and below the skull base to be simultaneously accessed. This versatile approach can also be combined with an anterior approach if required.<sup>20</sup>

# Operative technique

The planned surgical incision is marked and local anaesthetic infiltrated. A full bicoronal scalp flap is raised from the most caudal point of the tragus to the contralateral temporo-parietal suture, approximately 2 cm posterior and parallel to the hairline. No hair is shaven, and the incorporation of a wavy coronal incision helps to better camouflage the scar, especially when the hair is wet.<sup>21</sup>

The incision is deepened to the subgaleal plane, superficial to the pericranium over the top of the scalp and temporalis fascia laterally. The flap is developed forwards in this plane to 3-4 cm superior to the orbital rims where the pericranium is incised across the forehead from one superior temporal line to the other. The scalp flap is turned back from the root of the zygomatic arch to the ipsilateral supraorbital rim. Near the ear, the flap is dissected inferiorly to the root of the zygomatic arch. Starting at the root of the zygomatic arch, an incision running 45° upwards and forwards is made through the superficial layer of temporalis fascia, joining the cross-forehead incision previously made through the pericranium. The periosteum of the zygoma is incised, and the layers turned forwards as one flap. The upper branches of the facial nerve lie superficial to the dissection on the undersurface of the temporo-parietal fascia and are thus preserved.<sup>72</sup>

Depending on the requirements of the case, the body of the zygoma or the arch alone is osteotimised and outfractured after miniplate prelocalisation. Now the separated body or arch can be swung downward, pedicled to the masseter muscle. The upper half of the mandibular ramus, with the insertion of the temporalis muscle, is now presented in the operative field (Fig. 9).

The temporalis muscle is carefully detached from its origin to avoid damaging its blood supply from the anterior and posterior deep temporal arteries which enter the muscle below the zygomatic arch and deep to the coronoid process. The temporalis is



Fig. 9 Diagram of zygoma reflected inferiorly and pedicled on origin of masseter muscle.

swung inferiorly, or alternatively the coronoid process is cut off from the ramus of the mandible and the temporatis and attached coronoid swung superiorly. The site of the pathology dictates the direction of displacement of the muscle. If the lesion is primarily intracranial with extension into the infratemporal fossa, the temporalis muscle is usually displaced inferiorly. Sub-cranial lesions extending to the skull base require superior temporalis muscle reflection. Access to the middle cranial fossa is achieved with a fronto-temporal craniotomy.

If access to the retromaxillary and infratemporal regions is required, the pterygoid muscles are divided and the maxillary artery ligated and divided. The lateral aspect of the lateral pterygoid plate should now be visible and if followed superiorly to its junction with the base of the skull, will guide the surgeon to foramen ovale. At the completion of the procedure, the zygomatic body or arch is replaced and secured with pre-contoured miniplates.

If the temporalis muscle has been devitalised it will need to be excised. If it is viable it can be replaced, the coronoid process is removed to minimise post-operative limitation of mouth opening.

This approach provides direct lateral access, preserving the facial nerve and temporo-mandibular joint, whilst avoiding a visible facial scar. The disadvantages of this approach are an increasingly restricted medial exposure as the depth of the dissection increases, and the inability to follow the internal carotid artery through the skull base. Should exposure of the internal carotid artery be necessary, the post-auricular approach described by Fisch and Pillsbury<sup>23</sup> may be used.

#### DISCUSSION

The most important step in access surgery is the selection of the most appropriate technique or combinations thereof. This depends on the anatomical location as well as the nature of the pathology in question, with each approach designed to provide short, straight-line access, maximal exposure, and minimal morbidity. The Le Fort I downfracture is generally reserved for access to benign pathology in the nasopharynx and central skull base and is the most cosmetic and least morbid of all the approaches described. It however lacks the versatility of the maxillo-nasal-cheek flap and gives poor access when dealing with malignant lesions. In these cases, the maxillo-nasal-cheek flap, which can include maxillary resection, is the approach of choice.

Access to lesions within the anterior cranial fossa, as well as those extending into the superior, medial and posterior aspects of the orbit is achieved via the extended transbasal approach. For lesions in the middle cranial fossa, infratemporal fossa, retromaxillary space, and lateral orbit the lateral transzygomatic approach is the procedure of choice and can be combined with other mid-facial approaches for extensive oncological resections.

# **ACKNOWLEDGEMENTS**

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# Nasopharyngectomy for recurrent nasopharyngeal carcinoma: an innovative transnasal approach through a mid-face deglove incision with stereotactic navigation guidance

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SUMMARY. Traditional approaches to nasopharyngectomy for the treatment of recurrent nasopharyngeal carcinoma carry considerable complications. This paper presents an innovative transnasal approach with stereotactic navigation guidance through a mid-face deglove incision which has been done for 15 patients with minimal morbidity. All patients had resumed their oral diet within a week, and were discharged within 10 days. The intraoral wound had healed within a week. The only complications were a mild degree of saddling of the nasal dorsum in one patient and temporary facial numbness that resolved within six weeks in three. Tumour had been resected with clear margins in 12/15, in the other three being stuck to the carotid artery. © 2001 The British Association of Oral and Maxillofacial Surgeons

# INTRODUCTION

Nasopharyngealcarcinoma is prevalent among Southern Chinese and Hong Kong has the highest documented incidence in the world. It is more common in man with an incidence of 27.5/100 000 per year.2 In other parts of the world such as United States, Canada and South America, the age-adjusted incidence for both sexes is generally less than 1/100 000 people/year. Depending on the initial stage of presentation, 19-56% of patients have recurrent disease within 5 years of treatment after modern radiotherapy.3-6 The initial tumour stage (T-stage) is the main factor that governs local control. An early T-stage gives satisfactory local control in excess of 85%, but T3/T4 tumours have over 30% local failure after radical radiotherapy.<sup>7-9</sup> There are various ways to salvage the local failures, which include further high dose external beam radiation (<60 Gy); interstitial brachytherapy with Au<sub>198</sub> or I<sub>125</sub> seeds; intra-nasopharyngeal brachytherapy with a mould applicator; or nasopharyngectomy. Each method has its own advantages and drawbacks. In general, nasopharyngectomy is preferred rather than further irradiation when the recurrent tumour is bulky but still resectable 10,11 as tumours that failed soon after primary radiotherapy are often more radioresistant and less amenable to more irradiation. 10,12,13

Various surgical techniques have been established for resection of tumours in the nasopharynx, <sup>14</sup> of which transcropalatal, <sup>15</sup> mandibular swing, <sup>16</sup> and maxillary

swing 17,18 are commonly used nowadays. There has been no consensus about which technique is superior for resection of the tumour with the least morbidity. However, in general, an ideal surgical approach to the nasopharynx should allow good surgical access to facilitate oncological resection of tumours, it should be feasible to extend the resection margins and identify important neurovascular structures and give minimal facial scarring and maximal preservation of functions. The latter are particularly important in patients with recurrent disease as they have already been given high doses of irradiation before salvage surgery, which significantly jeopardizes the organs' functions and the ability of the wound to heal. The success of nasopharyngectomy for a locally relapsing tumour should be judged from the operative mortality, the acute and late morbidity, and the tumour control as well as long-term survival. Because recurrent nasopharyngeal carcinoma has a tendency to extend posterolaterally to invade the paranasopharyngeal and carotid spaces, the main complications or risks of the operation are dissecting too laterally and causing inadvertent injury to the internal carotid artery, or leaving too little supporting tissue adjacent to the arteries, which predisposes them to delayed rupture when coupled with intracavity brachytherapy (as in combined treatment).

The other major morbidity and drawbacks associated with the transoropalatal approach, the LeFort I osteostomy, <sup>19,20</sup> the mandibular swing approach, and the

maxillary swing approach are:21 facial scar, trismus, dental malocclusion, transsection of nerves (infra-orbital nerve in the maxillary swing, lingual nerve in the mandibular swing), palatal dehiscence, nasal regurgitation of food, dysphagia, incorporation of foreign bodies (metal plates for osteosynthesis), infection of the osteostomy site, and prolonged operation time. In an endeavour to improve the results of nasopharyngectomy further and to minimize surgical morbidity, we have used a mid-face deglove transnasal approach for the resection of recurrent tumours. In this paper we describe the preliminary results of the surgical technique combined with the use of stereotactic navigation guidance for precise localization of the internal carotid artery bilaterally and for tumour dissection in 15 of our patients who had recurrent nasopharyngeal carcinoma.

# PATIENTS AND METHODS

At the Prince of Wales Hospital, we have treated 60 patients with nasopharyngeal tumours by nasopharyngectomy during the period 1986-2000 of which 29 were operated on by the first author. Fifty-eight patients had recurrent tumours and the remaining two had a clival tumour and a teratocarcinoma respectively. In the 58 patients treated by nasopharyngectomy, 11 were done by the transoropalatal approach, 15 by the mandibular swing approach, 17 by the maxillary swing approach, and 15 by the mid-face deglove transnasal technique.

Before salvage surgery, all patients were fully investigated to confirm the resectability of the recurrent tumour in the nasopharynx, the status of the cervical lymph nodes, and the possibility of distant metastases. These investigations included nasopharyngoscopy with biopsy, fine needle aspiration of cervical lymph nodes, magnetic resonance imaging (MRI) of the skull base and neck, chest radiograph, ultrasonographic examination of the neck and abdomen, and bone scan. All patients who had a nasopharyngectomy had already had either postoperative intracavitary or stereotactic radiotherapy, depending on the surgical resection margins in the nasopharynx and the previous dose of irradiation.

# Surgical technique

The patient is positioned supine and anaesthetized with oral-endotracheal intubation. A tracheostomy is followed by setting up of the navigation system, which takes about 20 minutes. A throat pack is then inserted and both nasal cavities packed with ribbon gauge soaked with 5% cocaine solution 2 ml to reduce intraoperative nasal haemorrhage. The patient is then re-draped, and corneal shields inserted to protect the eyes.

Lignocaine 2% 3 ml with 1/80 000 adrenaline is then injected intra-orally at the upper labial sulcus for haemostasis. An incision is made along the upper labial sulcus down to bone from the first molar tooth on one side to the first molar tooth on the opposite side, A buccal mucoperiosteal flap is raised up to the inferior orbital rims on both sides and both the infra-orbital nerves are identified and preserved. A transfixing intercartilaginous intranasal incision is then made, and the nasal skin is undermined with a sharp scissors and freed from the underlying nasal bone to complete a mid-face deglove incision; the mid-face skin flap is retracted to expose the entire nasal cavity and anterior maxillae. A strut of the nasal dorsal septal cartilage is preserved while raising the mid-face skin flap to prevent saddling of the nasal dorsum postoperatively. The rest of the cartilaginous and bony nasal septum are resected to expose the central nasopharynx and anterior wall of the sphenoid sinus.

Bilateral medial maxillectomy with a 1cm lateral extension to the anterior wall of the maxillary sinuses is done with an oscillating saw (Fig. 1). The lateral nasal walls or medial maxillary antral walls are therefore removed together with the inferior and middle nasal turbinates, and the septal cartilage (Fig. 2). This provides direct access to the entire nasapharynx, sphenoid sinus, vomer, retromaxillary region, and maxillary antra on both sides and further improves inspection, palpation, and instrumentation in both the nasopharynx and paranasopharyngeal territory (Fig. 3).



Fig. 1 Bilateral medial maxillectomy with 1 cm lateral extension to the anterior wall of the maxillary sinuses.

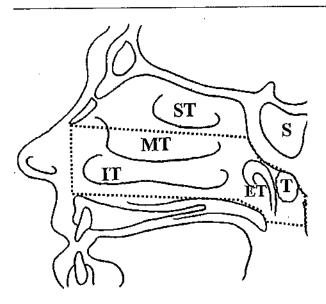


Fig. 2 A diagram showing the resection of lateral nasal wall of the nose to include the inferior tubinate (IT) and middle turbinate (MT) and the outline of the nasopharyngeal resection (dotted line). (S = sphenoid, ST = superior turbinate, T = tumour in nasopharynx,



Fig. 3 Direct access to the nasopharynx for resection of the turnour.

The outline of the resection margins in the nasopharynx is marked by direct vision after consideration of the radiological extension of the tumours. A Doppler probe is then used to locate the internal carotid artery, and is followed by the stereotactic navigation probe for precise localisation of the internal carotid arteries bilaterally (Fig. 5A-C). The surgical resection margins and the eustachian tube openings are then incised with a No. 15

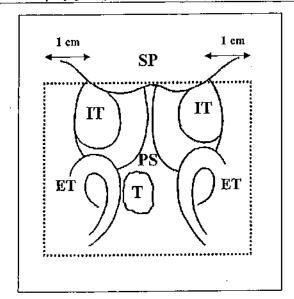


Fig. 4 A diagram illustrating the resection of the nasopharyngeal turnor in the nasopharynx. (IT = inferior turbinate, SP = sphenoid sinus, PS = posterior nasal septum, ET = eustachian tube, T = tumour).

scalpel, taking care not to injure the internal carotid artery (Fig. 4). The nasopharyngeal mucoperiosteal and musculoligamentous component are resected en-bloc with the tumour. Endoscopic instruments include illumination retractors, scissors and diathermy, which are used to facilitate dissection at the naso-oropharyngeal junction and central nasopharynx where it is mostly ligamentous and fibrotic after previous irradiation. Angulated sharp Pott's scissors (Codman®, USA) are also used to facilitate dissection in the relatively hidden area near the lateral borders of the nasopharynx. Afterwards, a periosteal elevator is used to dissect the tumour from the underlying bony nasopharynx with particular focus on the sphenoid sinus region in which bony invasion of the anteroinferior wall is likely. Removal of part of the corresponding bony wall of the sphenoid is necessary once invasion has been noted.

Multiple samples of tissue are obtained from the inferior, lateral, superior, and central deep surgical margins of the nasopharynx for frozen section histology after resection. The entire soft and hard palate and the infraorbital nerves are not violated. Haemostasis is achieved by diathermy. A nasogastric tube is inserted for enteral feeding postoperatively. The nasopharynx and the maxillary antra are loosely packed with sulpha-tulle gauze. The intraoral incisional wound is then closed with 3/0 interrupted polyglactin 910 (vicryl) sutures. The nasal pack is removed on the fifth postoperative day and the tracheostomy tube is removed on the sixth postoperative day. Oral feeding is resumed by day 7 after the operation. All patients are routinely offered postoperative

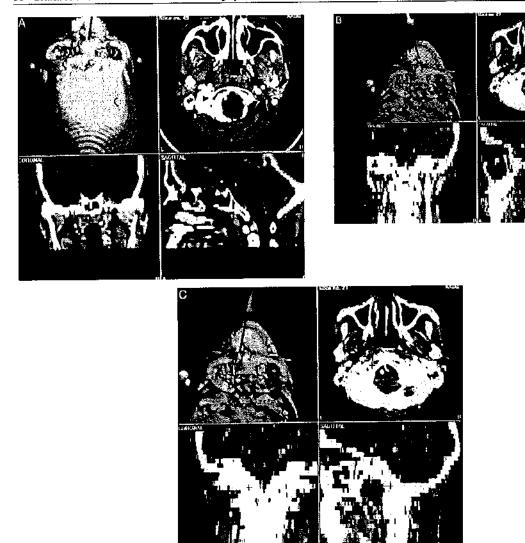


Fig. 5 (A,B & C) Sterotactic navigation guidance was used to locate for the internal carotid artery bilaterally.

intracavitary brachytherapy or stereotactic radiotherapy depending the status of the surgical margins in terms of tumour clearance and the previous dose of irradiation. All patients have a postoperative MRI scan of the nasopharynx at 4 weeks (Figs 6, 7) to act as a baseline image for detection of any future recurrence and relapse. They are discharged and followed up in the combined head and neck - oncology specialty clinic at the Prince of Wales Hospital.

# STEREOTACTIC NAVIGATION GUIDANCE SYSTEM

Stereotactic Navigation Guidance is a well established technique used in neurosurgery. Its use in anterior skull base operations such as nasopharyngectomy for recurrent nasopharyngeal carcinoma has not to our knowledge been reported previously.

Stereotaxy was obtained using a computed tomogram (CT) with five temporary markers placed over the forehead and face of the patient, whose head was not extended flexed, or turned. The scanning region extended from the cranial fossae down to the mandibular symphysis and included the entire nasopharynx, all the markers, and the carotid arteries. The data were then transferred to a floppy disc in the computer workstation of the stereotactic navigation system in the operating theatre.

The patient's head, with the markers, is attached rigidly to the operation table by a skull clamp. A wireless navigation probe with reflective markers is then used to calibrate the sites of the markers. The position and information given by the markers was picked up by an infra-red camera, which is part of the component of the workstation.

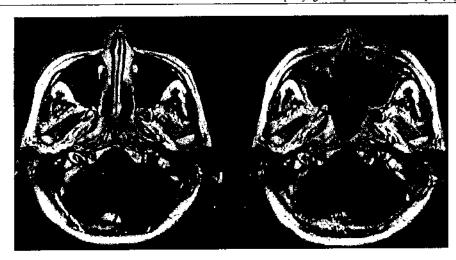


Fig. 6 MRI showing the axial view of the nasopharynx before and after the operation.



Fig. 7 MRI showing the coronal view of the nasopharynx before and after the operation.

Once it has been calibrated, the workstation computer screen will constantly show the position of the tip of the navigation probe in relation to the computerized anatomical structures, particularly the internal carotid arteries, during the operation (Fig. 5A-C).

# RESULTS

Of 15 patients treated by nasopharyngectomy by the mid-face deglove technique, seven patients had rT1, five patients had rT2, and three patients had rT4 recurrent nasopharyngeal carcinomas. The mean age of the patients was 40 (range: 33-52 years). Seven patients were women. They were all given 6628cGy (range 6340-7000 cGy) of external irradiation to the nasopharynx and another 6260 cGy (range 5400-6600 cGy) external irradiation to the neck as primary radiotherapy. One patient had extra intracavitary brachytherapy of 1200 cGy delivered to the nasopharynx for extensive skull base disease. The mean time interval between primary radiotherapy and recurrence of tumour was 17.6 months range 12–22).

Two of our patients had cervical lymph node metastases at the time of the detection of nasopharyngeal recurrence and so were treated by radical neck dissection



Fig. 8 Postoperative view of the patient after nasopharyngectomy by mid-face deglove incision showing no change in facial contour. Reproduced with the patient's permission.

as well as nasopharyngectomy. The mean operation time for the mid-face deglove technique was 3 hours (range: 2 hours 40 minutes-3 hours 15 minutes). Eleven patients were given 3000 cGy of intracavitary brachytherapy delivered to the nasopharynx postoperatively. Three patients were given stereotactic radiotherapy because of gross residual disease that could not be removed. One patient was not suitable for postoperative adjuvant radiotherapy because of the high irradiation dose given to treat the primary nasopharyngeal tumour. The mean postoperative follow up was 6 months (range: 2-10).

No adverse complications were noted immediately after operation. All patients could resume their oral diet on the seventh postoperative day and all patients were discharged from hospital within 10 postoperative days. The intraoral incisional wound was well healed one week postoperatively. No change in the facial contour was noted in our patients after operation (Fig. 8) except for one patient who had a mild degree of saddling in the nasal dorsum. Three patients had temporary facial numbness during follow-up, all of which resolved within six weeks. Moreover, no trismus was noticed in our patients and no nasal regurgitation was complained during swallowing. Tumour clearance (as indicated by frozen sections and final histological examination) was achieved in 12 of the 15 patients. In the other three specimens the tumour was stuck to the internal carotid artery.

# DISCUSSION

Local failure (persistence and recurrence) is the second most common failure after radical radiotherapy for nasopharyngeal carcinoma, occurring in 15-48% of natients. 12,22-28 Further irradiation is an established form of treatment, with further local control rates of 22-80% and further 5 year survival of 14-82%. 17,22,33 Further

high-dose re-irradiation (<60 Gy) has been shown to be more effective than low-dose re-irradiation (<60 Gy), with good further local control and survival. 12,13 However, many of the historical reports on the efficacy of further irradiation can only be regarded nowadays as suboptimal primary radiotherapy. The poor quality of primary radiotherapy was evidenced by the frequent use of a low dose of total radiation (40-50 Gy), the lack of uniformity of radiation techniques including wide ranges of dose, and the inaccurate delineation of the extent of the primary tumour and radiotherapy planned mainly as a consequence of the lack of CT evaluation, 12,22,25,30,32 It is possible that a substantial number of the local failures were actually radiosensitive turnours which should have been cured by the primary radiotherapy were it not for its underdosage or inability to encompass the tumour fully causing the radiation to miss. With the advent of CT for localizing the primary tumour, the giving of a tumouricidal dose (<60 Gy) and the improved quality control of the primary radiotherapy, the local failure rate should decrease, but tumours that still fail locally despite all these treatments should also be more radioresistant and less salvageable by further irradiation. By reviewing 123 local relapses treated by further irradiation (n = 103)or by nasopharyngectomy (n=20), we concluded that after modern primary radiotherapy, local relapse could seldom be salvaged by further high dose irradiation (<60 Gy) using mainly external beams, and that morbidity is considerable and outweighs benefit,28

Even though good local control by interstitial brachytherapy was reported by Choy et al.8 and Vikram and Hilaris30 for small tumours that spared the eustachian cushion and the nasal septum, local failures suitable for Au<sub>198</sub> or I<sub>125</sub> implants were rare in our experience. Moreover, headache could be problematic in many patients after the implant.8 Most local failures are therefore not suitable for interstitial implants, or reirradiation with external beams, 28 and the only viable option is nasopharyngectomy. However, tumours involving the clivus, cranial nerves, internal carotid artery, or those that extend intracranially are not suitable for surgery. Nevertheless, for resectable lesions, nasopharyngectomy has been successful in permanently controlling the local tumour in around 40% of cases. 10,28 In our institute, King et al. reported a 5-year actuarial overall survival, actuarial disease-free survival, and tumour control in 47%, 42%, and 43%, respectively.21 Its long term morbidity was also less than that for further high dose irradiation with external beams.28

The surgical access to the anterior skull base always remains a clinical challenge to surgeons, and different approaches have evolved based on the complex nature of the skull base, the site, and the extent of the lesions. Consequently, quite divergent approaches have been developed to facilitate the access to different parts of this area. Controversy still persists about which surgical approach is superior to the others in terms of surgical access and preservation of functions. However, the transoropalatal, LeFort I, mandibular swing, and maxillary swing approaches are the techniques being commonly used for the resection of recurrent cancers of the nasopharynx.

The mid-face deglove approach was first described by Casson et al. in 1974,34 and was first used in the remodelling of bone in patients with fibrous dysplasia; it was subsequently used in mid-face fractures, craniofacial dysostoses, and maxillary sinus neoplasm.35 It is relatively easy to acquire and provide excellent access to the nasopharyngeal tumour with considerably less morbidity than with the various conventional surgical approaches. The mid-face deglove technique involves intraoral and intranasal incisions, and only part of the nasal septum, bilateral middle, and inferior nasal turbinates, as well as the medial maxillary sinus walls are removed. This provides excellent access to the nasopharynx and paranasopharyngeal region for tumour resections and identification of important structures around nasopharynx with special emphasis on the internal carotid artery during dissection, as guided by the navigation system. The closure of the surgical wound is easy as a minimal osteotomy is required and the intranasal as well as the intraoral incisional wounds are small.

The greatest achievement of this method is the avoidance of interruption of the integrity of the infratemporal fossa, temporo-mandibular joints, the upper and lower jaw, and the soft and hard palate. No trismus, palatal fenestration, or dental malocclusion were noticed in our patients, and none of our patients had any impairment in either the oral or the pharyngeal phase of swallowing. This is in considerable contrast to our patients in whom the operation was done by the transoropalatal, mandibular swing, or maxillary swing approach in which many of them had postoperative difficulties in swallowing.21 We have therefore now adopted the transnasal mid-face deglove approach for all our patients unless the tumour has extended inferiorly beyond the level of soft palate, which will then require a maxillary or mandibular swing to gain access; the superior and lateral extent of the tumour might involve the dura, brain, and internal carotid artery, respectively, and that will decide whether it is a salvagable operation with clear tumour margins but will not decide the surgical approach.

Although the Weber-Fergusson incision in the maxillary swing approach and the lower jaw median lip split can give a well-healed relatively invisible scar postoperatively, postoperative wound infection, ectropion of the lower eyelid,21 and keloid formation are potentially problems in patients with pigmented skin. Adopting a mid-facial deglove approach with an intraoral and intranasal incisions can therefore essentially avoid these complications.

Both the maxillary swing and the mandibular swing approach involve a considerable osteotomy in the maxilla and mandible, respectively, and wound infection with resulting malunion of bone and osteomyelitis aggravated by previous irradiation have been reported. 17,21 This is exaggerated by the use of miniplates for osteosynthesis of the bone, which further increases the chance of infection in the surgical wound because of the presence of foreign bodies. However, the mid-face deglove technique can essentially avoid this complication as no osteosynthesis is required after surgical resection, and osteotomy is minimal.

Postoperative facial numbness is common in those patients treated by nasopharyngectomy by the maxillary swing approach because of the division of the infraorbital nerve during operation.<sup>21</sup> Similar complications with glossal numbness also present in patients operated on by mandibular approach as the lingual nerve is sacrificed during operation. However, no permanent postoperative sensory complications were noted in our patients operated on by the mid-face deglove technique, as both infraorbital nerves are identified and protected during operation and no other important sensory or motor nerves are in the way of the surgical field during access. The mid-face deglove technique can therefore preserve maximal organ functions postoperatively compared with the mandibular swing and maxillary swing approaches, but it does not compromise the surgical access to the nasopharyngeal tumour. The mean operative hours is also significantly shortened by using the mid-face deglove technique (mean 3 hours), whereas the maxillary swing and mandibular approach took 41/2 hours and 8 hours, respectively, in our series.

All 15 patients treated by nasopharyngectomy by a mid-face deglove incision had recovered uneventfully without the morbidity that would have been associated with the maxillary or mandibular swing. Although one patient had a mild saddle-nose deformity, it can be entirely avoided once the critical strut of the anterior nasal septum is preserved. Postoperative nasal crusting as a result of the absence of most of the nasal septum and turbinates was not particularly troublesome if daily nasal douches using normal saline were used, which is similar to the conventional operations because all four approaches involve the removal of the nasal septum, and inferior and middle turbinates.

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# Modified Wunderer's Osteotomy to Approach Palatal Tumors

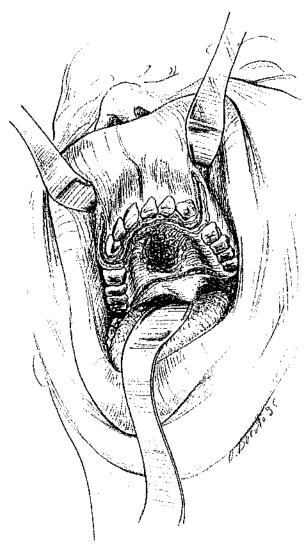
Enrico Sesenna, MD, DMD,\* Mtrco Raffaini, MD, DMD,†
and Riccardo Monteverdi, MD‡

In the removal of deep malignant tumors of the craniomaxillofacial region, access osteotomies that spare the overlying structures that are not affected by the tumor, but that present an anatomic obstacle to the exposure of the lesion, have became the accepted method for en block resection. Thus, over the years, a large number of osteotomies designed to gain access to the craniomaxillofacial structures have been published by various authors. <sup>17</sup> Some of these mobilize bony segments of the upper maxilla, providing access for removal of neoplasms deeply embedded in the facial skeleton, the nasal and paranasal cavities, the rhinopharynx, and the infratemporal fossa.

In the treatment of malignant tumors of the palate, especially when they involve quite large areas and require the removal of bony structures, the classic surgical technique consists of an extended maxillectomy performed from an intraoral or an extraoral route. This approach almost always leads to damage of structures not necessarily affected by the neoplasm, such damage being necessary to ensure oncologically sound removal of the tumor. In this report, we describe a technique that, using principles of orthognathic surgery (Wunderer's osteotomy), allows unaffected structures to be preserved.

# Surgical Technique

First, the posterior resection margin is defined as the border between the hard and soft palate. Anteriorly, bilateral vertical incisions are then made through the mucoperiosteum deep into the vestibule and carried through to the interdental space, where the osteotomy will be made (Fig 1). If a reconstructive temporalis muscle flap will be used, the incision on one side is reflected posteriorly to expose the posterolateral wall of the maxilla, where an ostectomy will be performed to allow passage of the flap. After the piriform aperture and the anterior wall of the maxilla are exposed by tunneling subperiosteally, the mucosa is detached from the floor and lateral walls of the nose as far posterior as possible. A classic cortical vestibular osteotomy is then performed, extending from the piriform aperture to the interdental area between the canine and the first premolar.



**FIGURE 1.** Diagram showing anterior palatal and vestibular incisions and posterior resection margin.

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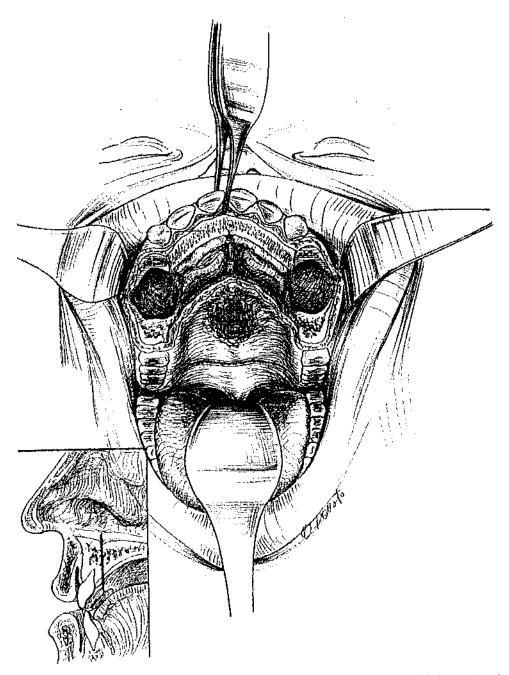
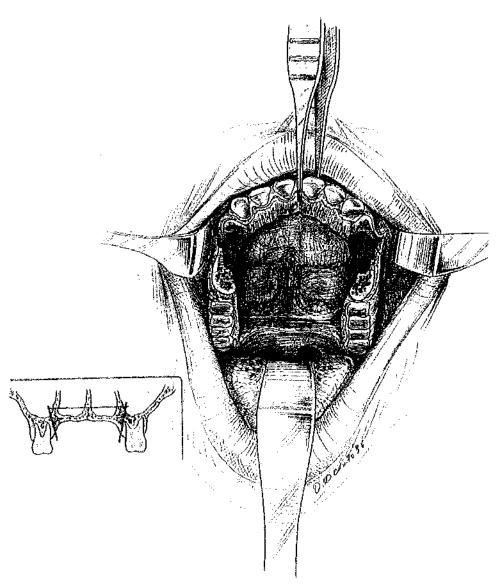


FIGURE 2. Diagram showing the cranial elevation of the osteodental segment (canine to carrine) vestibularly pedicled. Inset: the palatal osteolomy is made parallel to the dental roots.

Removal of a section of mucosa about 0.5 cm wide adjacent to the palatal side of the teeth from canine to canine exposes the bony cortex. With an oscillating saw suitably positioned at the level of the palatal cortex, an osteotomy is made parallel to the dental roots, extending cranially for about 2 cm. It is then possible, by means of a thin osteotome, to connect the palatal and vestibular osteotomies and elevate an osteodental segment extending from canine to canine and left pedicled on the vestibular mucosa (Fig 2). This method differs from Wunderer's<sup>13</sup> in that the body palate is left almost entirely in place.

Once the osteodental segment is raised, it is possible to complete the elevation of the nasal mucosa as far as the border between hard and soft palate, which defines the posterior margin of the resection. Subsequently, an ostectomy of the anterior wall of the maxilla is performed, opening the sinuses, if this has not already been effected with elevation of the anterior bone segment. Horizontal sectioning of the lateral walls of the nasal cavity, the septum, and the vomer from their connection with the maxilla can now be performed. Lastly, using a reciprocating saw, bilateral transantral sagittal osteotomies extending to the poste-



**FIGURE 3.** Diagram of region after the surgical resection. Inset: Osteotomies are made horizontally through the nasal septum and the lateral nasal walls and vertically through the sinus floors to the border between the palate and alveolar process.

rior margin of the resection are performed. These can be made either at the border between the palate and alveolar process or, after extraction of the appropriate teeth, in the crest of the alveolus itself, sparing the alveolar vestibular cortex. In those cases in which the osteotomy is made at the border between the palate and alveolar process, it is possible, were it oncologically acceptable, to conserve part of the palatal mucosa attached to the alveolar process. If not, a short strip of the mucosa is detached to allow the transantral osteotomies to be effected.

Finally, the posterior wall of the sinus is cut transantrally. By completing the bone sectioning with a thin osteotome, and cutting the remaining bridges of soft tissue (palatal or nasal mucosa, major palatal artery, etc), it is possible to mobilize the resected specimen

consisting of the hard palate in toto with or without the palatal cortex of the maxillary alveolar process (Fig 3). The resection leaves an opening between the maxillary sinuses and the oral cavity, whereas at the coanal level the communication is usually only posterior, because anteriorly the nasal mucosa has been left intact.

The anterior access ostectomy is repositioned and fixed, preferably with rigid fixation. The resected area can subsequently be fitted with an obturator, or the defect can be filled with a temporalis muscle flap. The latter option involves performing a posterolateral maxillary ostectomy (below the zygoma) and passing the flap transantrally. The ostectomy must be done as far posteriorly as possible to leave a healthy maxillary bone segment between it and the anterior access osteotomy.

# Discussion

The proposed surgical procedure involves an initial Wunderer's osteotomy, making the palatal bone cut parallel to the dental roots of the canine-incisor teeth rather than trasversally across the palate, thus leaving practically all of the bony palate in the resected specimen. The superior elevation of the osteodental segment, which is osteotomized and left pedicled on the vestibular mucosa, allows elevation of an intact nasal mucosa as far as the border between soft and hard palate (the posterior margin of the resection). The subsequent opening of the maxillary sinuses, if not already done with elevation of the anterior bony segment, allows the lateral osteotomies to be made under direct vision, and thus in a completely correct manner from the oncologic viewpoint. These osteotomies can be done either at the level of the alveolus or more medially (sparing the dentition), according to the extension of the tumor. In any case, with this technique, if the alveolar arch and the dentition are sacrificed, it will only be for oncologic reasons. We have experienced two drawbacks with this operation, both attributable to technical problems. First, unless rigid fixation is used, there is instability of the anterior osteodental segment. Second, the teeth can be damaged during the surgical procedure if the cuts are brought too close to the tooth roots in an attempt to remove only the alveolar palatal cortex while sparing the teeth. Notwithstanding these technical errors, we believe that this method makes it possible to deal with malignant tumors of the palate in an oncologically safe

manner and without necessarly sacrificing structures not affected by the tumor.

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# Osteoblastoma: a case report and description of the access used to the retromaxillary area

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SUMMARY. A case of benign osteoblastoma in the retromaxillary region which presented as chronic left sided facial pain of 3 years' duration is reported. The surgical approach to a tumour in this site is difficult and potentially severely mutilating. A transfacial access is described.

# INTRODUCTION

Osteoblastoma is a benign neoplasm of bone which constitutes about 1% of all primary bone tumours (Lichtenstein & Sawyer, 1964; Obwegeser, 1985) but less than 1% of all tumours of the maxillofacial region. It was first described by Jaffe and Mayer (1932) and was later designated giant osteoid osteoma by Dahlin and Johnson (1954) and osteogenic fibroma by Lichtenstein (1957). The term osteoblastoma was first proposed by both Jaffe (1956) and Lichtenstein (1956) independently. Over 30 cases of osteoblastoma in the jaws have now been reported, with the mandible affected more frequently than the maxilla (El-Mofty & Refai, 1989) with over 90% of cases arising in patients who are less than 30 years of age (Smith et al., 1982). The most common mode of clinical presentation is pain and swelling which is dependent upon the site and size of the lesion at presentation (Lichtenstein, 1956; Kent et al., 1969; Farman et al., 1976; Huvos, 1979). The swelling may be tender to palpation and the teeth may become tender or mobile if the supporting bone is involved. The duration of symptoms from jaw lesions is said to be less than in other sites, with a maximum of 2 years in previously reported cases (Smith et al., 1982) but one case of an asymptomatic lesion detected by routine radiographic examination has been reported (Kopp, 1969).

The radiographic appearance is extremely varied and is largely dependent upon the degree of calcification within the lesion; it may appear radiolucent, mottled or even sclerotic with a radiolucent halo (Kopp, 1969; Smith, 1972).

Tomography is a useful adjunct to diagnosis and may be of value in determining the extent of the tumour as well as the degree of calcification (Marsh et al., 1975). Radionucleotide bone scanning has also been reported to be of some value in determining the extent of these tumours (Martin et al., 1976). Histologically the osteoblastoma is seen as a highly vascularised stroma with trabeculae of osteoid and immature bone formation with numerous plump

osteoblasts, many of which may line the trabeculae in single rows.

# Case report

A 26-year-old male presented with a 3-year history of left sided facial pain which had been diagnosed as temporomandibular joint dysfunction syndrome prior to his referral to Oxford. The pain was a constant dull ache which was exacerbated by opening the mouth. In the 6 months preceeding this referral, the pain had become more severe, woke him from sleep and was associated with increasing limitation of mouth opening. He also complained of sensitivity of the left side of his palate of recent onset.

Examination revealed marked limitation of mouth opening with a maximum interincisal distance of only 10 mm, but with unhindered movement up to this, then an abrupt inability to open further. There was no tenderness, clicking or crepitus of the temporomandibular joint however.

An orthopantogram showed abnormal calcification in the left pterygoid plate region, and another orthopantogram taken at a higher level demonstrated this more clearly (Fig. 1). A computerised tomography scan was performed and revealed a 16 mm diameter globular mass in the left lateral pterygoid plate with a speckled pattern of calcification within the lesion and sclerosis of the adjacent bone. The appearance was thought to be strongly suggestive of an osteoblastoma. The surrounding tissue had an appearance suggestive of oedema (Fig. 2).

A transfacial approach was used to gain access to the retromaxillary region, by use of a Ferguson-type incision.



Fig. 1-Orthopantomogram taken at a high level to show the abnormal calcification in the left pterygoid plate region.

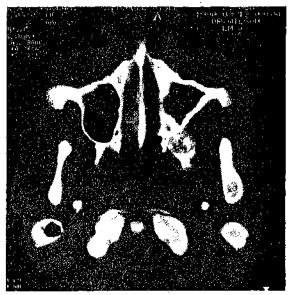


Fig. 2–C.T. scan which shows a 16 mm diameter globular mass in the left pterygoid plate.

An osteotomy of the maxilla was performed as described by Altemir (1986). This allowed the mobilised maxilla to be hinged out laterally on a facial pedicle. The infraorbital nerve was sectioned electively and reconstituted at the end of the procedure.

Prior to disarticulation of the pedieled maxilla, Champy plates were positioned and fixed temporarily to ensure accurate relocation of the maxilla at the end of the procedure. These were then removed and the maxilla disarticulated. Good access to the retromaxillary region was obtained and the tumour could be seen clearly as a



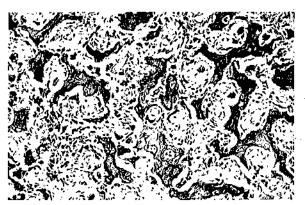
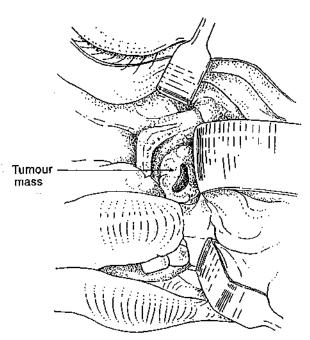


Fig. 5—Photomicrograph of the tumour showing hyperchromatic osteoblasts surrounding osteoid and thin irregular bone trabeculae. (H & E. Original magnification × 400).

friable, granular, gritty, purplish red lesion (Figs 3 & 4). This was removed en bloc with a margin of normal tissue and frozen section examination of the adjacent soft tissue was carried out immediately to confirm that the tumour had been excised completely. The diagnosis of osteo-blastoma was confirmed histologically on paraffin sections (Fig. 5) and the margins of the resected specimen did not show any evidence of tumour involvement.

# DISCUSSION

Osteoblastoma is a rare bone tumour of the maxillofacial region and may pose problems with diagnosis and management. The differential diagnosis has been reviewed recently (Haug et al., 1990) and the difficulties of distinguishing it from the so called fibro-osseous lesions of the jaws was addressed. This particular tumour had been causing symptoms for more than 3 years and is of note because it has been stated that lesions in the maxillofacial region present earlier than other sites, with a maximum duration of



Figs. 3 and 4-Photograph and line drawing of the lesion in the retromaxillary region. This was seen clearly by use of the transfacial



Fig. 6-Photograph of the retromaxillary region after complete removal of the tumour.

2 years in previously reported cases (Smith et al., 1982). It is interesting that the osteoblastoma in this case presented as chronic facial pain associated with limitation of mouth opening. This has not been reported previously. Mouth opening was without restriction initially and progressed as the lesion enlarged. This is rather difficult to explain as the lesion itself did not impinge on the mandibular ramus directly when seen at operation. However the surrounding tissue appeared oedematous in accordance with the radiologist's preoperative report and it may have been this tissue oedema which restricted mandibular movements.

Surgical access to the retromaxillary region is difficult and potentially mutilating. The temporal approach to the region described by Obwegeser (1985) does not give good access to the more medially located tumours of the pterygoid region and was not considered to be appropriate in this case. The transfacial approach described by Altemir-(1986) gives excellent access to this region, with good vision, and complete removal of the tumour could be assured (Fig. 6). The use of plate osteosynthesis for this maxillary osteotomy allows accurate relocation of the maxilla to be achieved and also avoids the use of intermaxillary fixation postoperatively. The treatment of osteoblastoma of the facial bones is essentially the same as that for osteoblastoma of the long bones. Local excision and curettage should be sufficient, when the diagnosis has been confirmed by histological examination, although two cases have been reported with recurrence of tumour after apparently complete excision

(Smith, 1972; Remagen & Prein, 1976) and therefore long term follow up is necessary.

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# Access Surgery for Oral Cancer

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The oral cavity is the surgical home for the oral and maxillofacial surgeon. Familiarity with this area gives the surgeon the ability to carry out demanding resections without the need to make facial skin incisions. This ability continues to be one of the major strengths of our specialty, in fact, separating us from most of our counterparts. Although most of our resections can be carried via the transoral route, at times, the position of the tumor and the disease process require a more exacting resection. The management of malignant processes requires that the resection be performed with negative margins. To this end, the surgeon is sometimes required to increase the access to the oral cavity to resect with clear margins.

This article highlights some of the most common surgical accesses to the oral cavity. There are a multitude of surgical accesses for the facial skeleton based on the concept of modular osteotomies. These are primarily used for tumors in the nasopharynx or the skull base. The goal of this article is to review the surgical access used to aid in the resection of tumors of the oral cavity. To this end, the article is divided into two parts: midface access for maxillary pathologic findings and transmandibular access for tumors in the oral cavity and the base of tongue. To provide the ideal approach to the tumor, in selected cases, the ablative surgeon needs to incorporate the midface approach as well as one of the transmandibular accesses in a combined fashion. The method used is predicated on a thorough understanding of the head and neck anatomy and careful presurgical planning. This offers the surgeon an understanding of the location of the tumor and how it encroaches on its surroundings. An appreciation of the tumor location as well as the anatomic constraints of the region should reveal to the experienced surgeon the area of greatest difficulty for resection. The use of the correct surgical access is predicated on this understanding.

# Maxillary approach

Weber-Fergusson maxillectomy incision

The term transfacial is used to describe any procedure that mobilizes the midfacial skeleton through a facial (skin) incision, irrespective of the extent of midface disassembly used [1]. One of the most commonly used transfacial approaches to the midface for the resection of maxillary tumors is the Weber-Fergusson (WF) maxillectomy incision. This approach was first described by Weber [2] in the German literature and was later modified by Fergusson [3] in the English literature.

The benefit of this incision is that it allows for improved access to the maxilla and for unimpeded resection of tumors affecting the anterior and superior aspects of the maxilla. It may also be used to aid in swinging the maxilla laterally while pedicled to the cheek flap. The lateral maxillary swing is used routinely in accessing the nasopharynx for the resection of nasopharyngeal carcinomas [4]. An important caveat to using the WF incision is that when the tumor involves the posterior aspect of the maxilla and/or the pterygoid plates, the approach does not improve the access.

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Since the first description of the WF approach, it has undergone multiple minor modifications; yet, the essence of the incision is the same. One of the most common modifications of this incision is Altemir's incision [5], whereby the straight line incision in the lip is moved from the midline and placed on the philtrum.

The authors' approach is to mark the patient by carefully placing the incision in an area in which the healed incision leaves the least noticeable scar. This is accomplished by placing the incision along the philtrum, carrying the lip extension with a slight step away and with an option of placing a chevron in the vermillion portion of the incision. The superior extent of the lip incision should be performed into the nasal sill and then extend out along the base of the ala and in a cephalad direction. The lateral nasal incision should be raised and placed in the nasal side wall at the junction of the nasal subunit (Fig. 1). Once the medial canthal region is approached, the incision may be extended laterally inferior to the lower eyelid in one of the creases (as in the Dieffenbach modification) or extended superiorly into a Lynch incision, A full-thickness flap is then elevated while maintaining sound oncologic margins. The bony osteotomies are made as the tumor dictates. At the conclusion of the resection and reconstruction, the flap is reapproximated, taking care to have correct anatomic closure so as to minimize the postoperative scar.

# Midfacial degloving approach

An alternative approach to maxillary tumors is by use of the midface degloving technique. This



Fig. 1. WF incision marking with a chevron placed on the vermilion of the lip and extension of the incision into the nasal sill and onto the lateral nasal wall subunit.

approach requires familiarity with closed rhinoplasty techniques by the ablative surgeon [6]. The technique incorporates the use of vestibular and intranasal incisions to lift or "deglove" the facial skin from the facial skeleton, improving the access to the maxillary tumor.

# Posterior maxillary approach

When the surgeon is confronted with a large tumor that extends anteriorly, superiorly, and posteriorly with extension toward the pterygoid plates or the infratemporal fossa, it may be advantageous to use two approaches. The WF approach may be combined with a lip-splitting mandibulotomy approach so that the posterior aspect of the tumor can be resected in a more direct fashion. The combination of the two techniques was first reported by Dingman and Conley [7] using a lateral mandibular osteotomy, and it was later modified by Lawson and colleagues [8] by moving the osteotomy to a midline mandibulotomy. The approach to the posterior maxilla and the retromaxillary and/or infratemporal space would not be complete without mentioning Obwegeser's work on the subject [9]. The detailed surgical technique may be found in his article on the temporal approach to the temporomandibular joint (TMJ), the orbit, and the retromaxillaryinfracranial region. The major impetus behind this approach is the lack of facial skin incisions.

# Transmandibular approach

Lip-split mandibulotomy approach

The mandibulotomy approach is typically used in combination with a lip split. The placement of the incision for the lip split varies significantly among surgeons. The first description of a lip-split technique was by Roux [10] in the middle of the nineteenth century. Since then, there have been a multitude of variations to the lip-splitting incision. The three classic incisions most often used are (1) the Roux incision [2], whereby a straightline incision is made from the midline of the lower lip, extending through the chin and connecting to the neck incision (Fig. 2); (2) the McGregor incision [11], which extends in a vertical fashion from the midline of the lip toward the chin, circumventing the chin along the chin and/or labiomental groove; and (3) the Robson incision [12], which is placed on a relaxed skin tension line medial to the commissure and descends down toward the neck to meet with the neck incision. Hayter

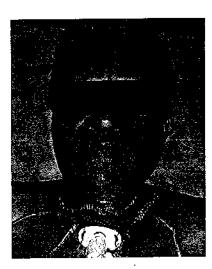


Fig. 2. Roux incision for the lip-splitting mandibulotomy used in this patient, who needed a bilateral neck dissection at the time of resection of the primary tumor.

and colleagues [13] recently published a modification of the McGregor incision that incorporates a chevron into the vermillion margin and the midline lip incisions to improve closure, thereby improving the final esthetics. The authors routinely use the McGregor incision in association with a mandibular osteotomy for oral access. The incision is marked in the midline of the lower lip, with or without a chevron, and extended to the labiomental crease. Once the crease is reached, the incision is extended to the ipsilateral side of the neck along the mental crease toward the midline of the submental region; from there, the incision is connected to the neck incision (Fig. 3). The



Fig. 3. Skin markings for a lip-splitting mandibulotomy in conjunction with a neck dissection.

placement of the circum-mental incision on the ipsilateral side rather than the contralateral side of the neck dissection is to decrease the possibility of ischemic necrosis of the chin [14]. Before making the incision, the senior author prefers to place a large hemostatic suture on each side of the lip. A 1-cm section of angiocatheter is threaded over a 0-silk suture to protect the lip vermillion. Before tying the stitch, the skin incision is completed with a number 11 blade to prevent distortion from the hemostatic stitch (Fig. 4). The mucosal cuts are placed, leaving a cuff for closure at the end of the procedure. Once the flap is elevated, the osteotomy is then marked anterior to the mental foramen. Two 2-0 plates are then contoured and placed at the marked osteotomy site, with one superior and one at the inferior border. The inferior plate used is a locking 2-0 plate with bicortical screws. This is our preferred method based on the work performed at our institution by Engroff and coworkers [15]. The plates are then removed and placed on the back table to be used at the time of mandibular fixation. The osteotomy is completed first, taking care to elevate the lingual mucosa and protect it. The osteotomy is completed, and the mucosa incision is performed on the floor of the mouth along the lingual mucosa. A cuff is left for later closure if possible, or a gingivosulcular incision is placed to reflect a lingual mucoperiosteal flap. The mucosal incisions through the buccal and lingual gingival mucosa should be stepped away from the bone cuts so that the soft tissue closure does not lie directly over the osteotomy site.



Fig. 4. Hemostatic sutures in the lip also used for flap retraction. Note the angiocatheter protecting the vermillion (inset).

With the osteotomy and mucosal incision completed, the mandible is then able to be reflected laterally, providing a clear view of the tumor and allowing for uncompromised resection (Fig. 5). This lateral "swinging" of the mandible is why this technique is at times referred to as the mandibular swing approach [16]. Once the resection and reconstruction are completed, the fixation is reapplied and the incisions are closed (Fig. 6). When the incisions are closed with attention to the careful alignment of tissues, the postoperative scar is imperceptible (Fig. 7).

# Non-lip-splitting mandibulotomy approach

The use of a non-lip-splitting mandibulotomy is most commonly employed to improve access to the parapharyngeal space and the infratemporal fossa. In some circumstances, however, it may be used to improve access to the oral cavity. This approach incorporates two osteotomies: one at the parasymphyseal area and another at the ramus region. The approach of Attia and coworkers [17] uses a parasymphyseal and horizontal ramus osteotomy above the lingula and

swings the segment in a superior direction. As described by Attia and coworkers [17], this procedure involves a lip-splitting incision. We have used a similar double osteotomy with a modification of the proximal osteotomy to a vertical subsigmoid osteotomy. This modification allows for the use of the double osteotomy without the need for a lip-split incision [18]. Whenever this technique is used for the oral cavity, one needs to pay meticulous attention to the overlying attached mucosa so as to maintain perfusion to the mandible.

# "Pull-through" technique

The concept of in-continuity resection has been around for many years. The rationale for this approach lies in the possibility of a tumor focus in the lymphatics between the primary and the cervical nodes. To that end, proponents of this theory advocate that the resection should remove the primary, the intervening lymphatics, and the cervical nodes in one block specimen. The technique was first described by Scheunemann [19] in 1975 and was later modified by Stanley [20]. The







Fig. 5. (A) Lip-splitting mandibular swing approach demonstrates increased access to the oral cavity for tumor extirpation. (B) Lip-splitting mandibular swing approach demonstrates increased access to the oral cavity and resected posterior floor of the mouth and tongue tumor. (C) Lip-splitting mandibular swing approach demonstrates increased access to the posterior oral cavity and resected posterior floor of the mouth and tongue tumor.

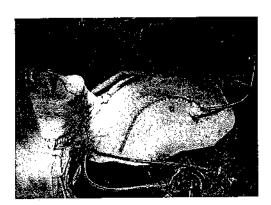


Fig. 6. Closure of flap with careful reapproximation of the lip-vermillion and chin flap.

pull-through operation is performed by making a releasing incision on the lingual aspect of the gingival and the elevation of a mucoperiosteal flap. The dissection is performed until the mylohyoid muscle is encountered, taking care to leave a small cuff of muscle attached to the mandible to aid in closure. Similarly, the genioglossus and geniohyoid muscles are detached, and the contents of the oral cavity are then pulled into the neck, allowing for a more direct resection through unimpeded visual and tactile feel of the tumor (Fig. 8). Devine and colleagues [21] compared their experience between the lip-split mandibulotomy and the mandibular lingual releasing access and found that patients with lingual release reported more problems with speech, swallowing, and chewing.

# Visor flap

An alternative to the pull-through technique is the visor flap. This flap is mostly used in the resection of tumors involving the anterior oral cavity; however, at times, it may also be used in the resection of lateral tongue and floor of the mouth tumors. The incision for the flap is performed from the mastoid process on one side and is extended toward the contralateral mastoid or to the mandibular symphysis on the unaffected side. The flap is elevated as usual, taking care to identify and preserve the marginal mandibular branch of the facial nerve. Once the inferior border of the mandible is encountered, a periosteal incision is made along the exposed mandible. An intraoral incision is made along the gingivobuccal sulcus, and a mucoperiosteal flap is elevated and reflected toward the inferior border of the mandible. The two dissections are then connected. The flap is tethered to the mandible only at the mental foramen region (Fig. 9). The mental nerve is incised, and the flap is then mobilized in a cephalad direction with the aid of two rubber drains. With the drains secured, the surgeon has an unimpeded view of the oral cavity to proceed with the tumor extirpation.

One of the obvious drawbacks of this technique is the sacrifice of the mental nerve, leading to anesthesia of the tip and chin. The benefit is that the surgeon is able to remove the tumor without the need for a lip-splitting incision, however.

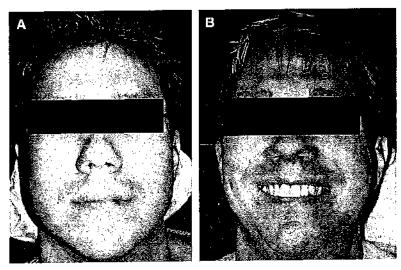


Fig. 7. (A) Preoperative view of patient compared with postoperative view. (B) McGregor lip-splitting incision mandibulotomy. Note the excellent healing of the incision.

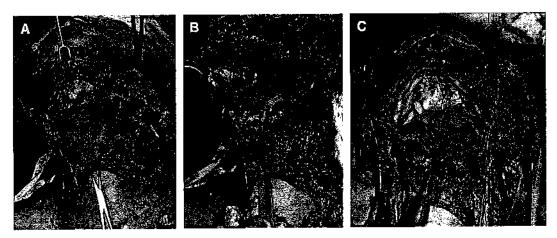


Fig. 8. (A-C) Pull-through approach for resection of intraoral tumors. Note that the mylohyoid, genioglossus, and geniohyoid muscles have been disinserted to all the contents of the oral cavity to drop or be pulled into the neck.

# Summary

The most important task in managing oral cancer is the resection of tumors without positive margins. To accomplish this goal, the surgeon is often faced with placing facial skin incisions to improve access to the oral cavity. This article has reviewed some of the most commonly used approaches and highlighted techniques used by the authors to resect tumors with minimal postoperative scaring. Although esthetics are



Fig. 9. Development of a visor flap. Note the elevation of the periosteum from the mandible with only the mental nerve tethering the flap to the mandible before incising the oral mucosa.

important to the patient, they remain a distant third consideration to the resection of the tumor and functional reconstruction. The surgeon and the patient should not lose sight of this fact.

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# Midfacial translocation, a variation of the approach to the rhinopharynx, clivus and upper odontoid process

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SUMMARY. Objective: A surgical variation of the technique of facial translocation procedure is proposed, which has been called midfacial translocation for approach to the entire medial and lateral region of the middle third of the face, including the rhinopharynx, sphenoid sinus, pterygomaxillary fossa, odontoid process, and clivus. Patients and methods: The medical records of five treated patients accordingly were reviewed for an analysis of the surgical technique, the disease, the topography of the lesion, and the complications. Results: The approach permitted ventral decompression of the bulbomedullary junction with resection of the C1 arch and the odontoid process in four patients and resection of a chordoma of the clivus located along the midline and extending intradurally in the fifth patient. Only one patient presented with dehiscence of the posterior half of the soft palate, this being the only complication observed following surgery in these patients. Three months postoperatively, no patient presented any aesthetic alteration of the face. Functionally, there was only infraorbital hypoaesthesia on the side of flap rotation. Conclusion: The technique of midfacial translocation provides both good surgical approach and access to the rhinopharynx, pterygomaxillary fossa, high odontoid process and clivus, with few adverse sequelae for the patient. © 2006 European Association for Cranio-Maxillofacial Surgery

Keywords: base of the skull; surgical treatment; surgical approach

# INTRODUCTION

The nasopharynx, pterygopalatine fossa and sphenoid sinus, as well as the skull base, are difficult to access surgically (Janecka et al., 1990). Transfacial approaches with removal of structures of the middle third of the face offer ample access to the median structures of the skull base but may produce severe adverse sequelae (Nuss et al., 1991). Approach to the rhinopharynx, odontoid process and clivus through the natural pathways of the face produces a greatly restricted surgical field which cannot always be used in patients with structural anomalies of the face or neck, especially malformations of the craniocervical junction. Endoscopic access to the rhinopharynx is less invasive but some neoplastic diseases cannot be treated safely via a restricted endoscopic field. Thus, different approaches such as lateral rhinotomy combined with transantral or transmaxillary, transpalatine, infratemporal, subfrontal, degloving, and Le Fort I access with a number of variations have been proposed for the treatment of diseases in these regions.

Research carried out at CIEDEF - Centro Integrado de Estudos de Deformidades da Face (Integrated Center of Study of Facial Deformities), University Hospital, Ribeirão Preto, USP.

Among the various techniques of access to the skull base, the transfacial approach introduced by Janecka et al. (1990) has proved to be one of the most effective for direct access to some of the lateral and anterior parts of the skull base. Mobilization of soft and hard tissues permits a wide surgical field and direct access and therefore has been extensively used (Hao et al., 2003). Facial translocation can be performed in different ways according to the site to be accessed, and many modifications of the technique initially described have been proposed, resulting in considerable variations of access to the skull base (Janecka, 1995). However, despite its numerous advantages, the facial translocation approach may also produce several adverse functional and aesthetic sequelae (Nuss et al., 1991, Hao et al., 2003).

In a search for central transfacial access to the skull base with the minimum sequelae, a technical variation of the facial translocation procedure as described by Janecka et al. (1990) is proposed which was named midfacial translocation (MFT). It can be used for access to the entire medial and lateral regions of the middle third of the face including the rhinopharynx, sphenoid sinus, pterygomaxillary fossa, odontoid process, and clivus. Its advantage is to offer adequate visualization with facilitation of surgery to the skull base and related structures, with a low rate of adverse postoperative sequelae.

# **PATIENTS**

Five patients were admitted for facial translocation to the University Hospital, Faculty of Medicine of Ribeirão Preto, USP, from March 1995 to December 2004. The medical records of these were analysed regarding the disease treated, the ocations of the lesions, aspects of the surgical technique, and complication.

# SURGICAL TECHNIQUE

### Facial incision

A large flap with a lateral pedicle was prepared from the upper lip, including the labial philtrum. The incision continued, contouring the ala nasi, sectioning the middle portion of the lateral wall of the nose up to the level of the ipsilateral medial canthus and proceeded towards the contralateral medial canthus, subciliary along the lower eyelid towards the lateral canthus, going beyond the lateral wall of the orbit (Fig. 1). The incision deepened to all the planes down to the facial bones (Fig. 2). Another paramedian incision followed in the mucosa of the hard and soft palate from the level of the canine fossa to lateral to the uvula ipsilaterally and up to the incision in the lateral wall of the nose.



Fig. 1 - Marking the skin incision for midfacial translocation.



Fig. 2 - Incision of soft tissues of the face and oral cavity.

# Preparing the internal rigid fixation

Titanium miniplates (1.5 mm) were moulded and screwed to the bones of the nasomaxillary, nasofrontal and zygomatico-orbital regions (Fig. 3). This guaranteed that the mobilized bones would return to their original position exactly (at the end of the surgical procedure). The plates were then removed, followed by the osteotomies of the nasomaxillary, nasofrontal, zygomatic-orbital, and pterygomaxillary bones and of the palate using an electric saw. The compound flap with all the tissues of the zygomatic complex, parts of the maxilla including the nasal septum that was cut at the same level as the nasal bones (with preservation of the lachrimal duct by sectioning anteriorly to it), the palate, the entire nose and lip flap was rotated laterally as a single block in a fashion similar to opening a book, offering ample access to the rhinopharynx, pterygomaxillary fossa, and upper cervical spine (Fig. 4).

# Exposure of the clivus and odontoid process

A median longitudinal incision was made in the mucosa of the posterior wall of the nasopharynx, prevertebral fascia and muscles, with exposure of the bone surface in

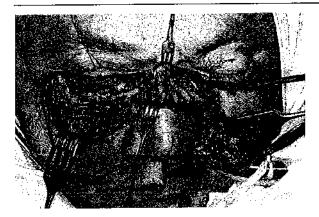


Fig. 3 - 6 Titanium 1.5 plates in situ prior to osteotomy.

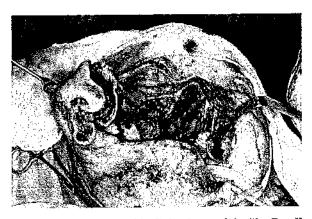
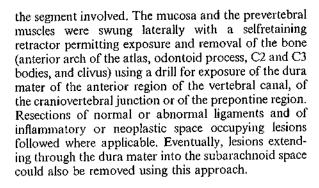


Fig. 4 - Compound flap with all the tissues of the "Le Fort II complex" (zygoma, maxilla, palate, nose) and lip rotated laterally as a single block.



# Reconstruction

After bone or tumour removal, the dura mater was closed hermetically (if it was opened) to prevent a cerebrospinal fluid leak. This closure could be performed using fascia lata adherent to a fat fragment which served to occupy part of the retropharyngeal dead space resulting from bone resection. Due to the ample exposure obtained, the fascia lata could be apposed and sutured to the dura mater with sutures in the four corners of the surgical wound and then sealed with fibrin glue. The musculature of the

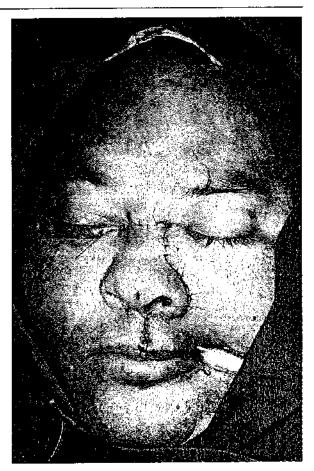


Fig. 5 - Postoperative repair.

nasopharynx was sutured with resorbable material in layers and the mucosa was sutured separately also using Vicryl 2-0. The compound flap was repositioned into its original site. The plates were fixed at the sites previously prepared to guarantee stability of the segment. Repair of the facial soft tissues was performed in layers (Fig. 5).

# RESULTS

Five patients were evaluated having undergone midfacial translocation. Four patients had presented with basilar invagination in which the odontoid process was very high and could not be reached through a conventional transoral approach, and the fifth patient presented with a chordoma of the clivus centred in the midline, with intradural extension and protrusion into the brain stem (Table 1).

The access permitted resection of the C1 arch and of the odontoid process with ventral decompression of the bulbomeduliary junction in four patients and resection of a midline clivus chordoma and its intradural extension in the fifth patient. In addition, it was possible to repair the dura mater with a fascia lata graft, and the patient did not develop a

Table 1 - Patient data, diagnosis, surgical technique (midfacial translocation, MFT) and complications other than hypoaesthesia of the

Patient no.	Age (years)	Diagnosis	Surgery	Complications
1	61	Vertebral basilar invagination Vertebral basilar invagination Vertebral basilar invagination Vertebral basilar invagination Chordoma of the clivus	MFT	Dehiscence of part of the soft palate
2	65		MFT	None
3	54		MFT	None
4	62		MFT	None
5	46		MFT	None

cerebrospinal fluid fistula. Only one patient presented with dehiscence of the posterior soft palate. No other complication occurred in any of the patients following this approach (Table 1). Three months postoperatively, no patient showed any aesthetic alteration of the face. Functionally, there was hypoaesthesia of the infraorbital territory only on the side of flap rotation.

#### DISCUSSION

Advances in imaging techniques have permitted better evaluation of the pathological processes around the clivus and the odontoid process, and better understanding of tumours (Hao et al., 2003). However, surgical access to the skull base continues to be a challenge for surgeons. For this reason, countless transfacial types of access have been described to reach the various compartments of the face itself and the skull base. Access procedures such as Le Fort I osteotomy (Williams et al., 1998), subtotal maxillotomy (Catalano and Biller, 1993), infratemporal fossa (Fisch, 1978) and the natural cavities have been used, but important limitations exist with all the techniques described in terms of complete tumour resection and technical difficulties of access to the skull base.

In an attempt to treat radically cancer of the maxillary sinus Barbosa (1961) described a new technique of maxillary sinus removal that also results in exposure of the rhinopharynx and pterygomaxillary fossa. Altemir (1986) using the same principle, accessed the retromaxillary area through the face and called this process 'transfacial access'. Finally, in 1990, Janecka et al. expanded and created a method for this procedure to access the skull base.

The basic principle of facial translocation is the temporary removal of a facial unit to permit a direct approach to the skull (Janecka et al., 1990). In the 'facial translocation' technique described by Janecka et al. (1990) the facial unit translocated always includes part of the orbit and may or may not include the nose, ethmoid, maxilla, and zygomatic bone. In the midfacial translocation (MFT) technique proposed here the orbit remains intact, and the maxilla, nose and parts of the ethmoid, palate and the zygomatic bone are always mobilized. Preservation of the orbit prevents some possible complications such as defects of the orbital walls, the medial canthal ligament, and of the nasolacrimal duct.

During embryological development of the face there is fusion of tissues along the midline. Thus, the vascular and nervous structures are distributed in a lateral to median direction providing lines of separation into units for surgical dissection. The incision of soft and hard tissues in MFT preserves the entire vascular and neural network in a manner which renders this access less traumatic. The facial nerve, the carotid branches and the sensory innervation provided by the branches of the trigeminal nerve are preserved, except for the infraorbital branch.

Another important difference among the transfacial approaches concerns vascularization and innervation of the mobilized tissues. In standard facial translocation (Williams et al., 1998) the zygomaticmaxillary facial unit is usually skeletalized by undermining the soft tissues of the face. This may cause vascular and neural lesions with consequent morbidity including possible bone necrosis (Hao et al., 2003). In the MFT technique, the soft tissues of the middle portion of the face remain fixed to the bony structures, forming a compound flap with all the soft and hard tissues, which is then mobilized in a single block with an ample lateral pedicle. The advantages of the MFT technique for access to the midline are shared by all other techniques of facial translocation, but without permanent damage to anatomical structures, with better exposure and better cosmetic results. Thus, it is possible to fully re-establish the facial anatomy after repositioning the midfacial unit, with a high degree of functional and aesthetic rehabilitation and without the need for maxillomandibular fixation. In the specific case of access to lesions in the midline of the skull base, MFT provides a wide surgical exposure and considerable reduction of the depth of the operative field, permitting execution of procedures with instruments of ordinary

The proposed access can be indicated for ventral bone compressions of the bulbomedullary junction (basilar invagination) in which the odontoid process is very high and cannot be reached by a conventional transoral approach, for the removal of tumours of the rhinopharynx and pterygomaxillary fossa and for resecting bone and dural tumours in the midline.

#### CONCLUSIONS

Midfacial translocation provides good surgical access to rhinopharynx, pterygomaxillary fossa, high odontoid process and clivus, permitting bone or tumour resection with a wider and less deep surgical field than other transfacial approaches, with adequate visualization of the important anatomical details of this region. There are few adverse postoperative sequelae.

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# & MAXILLOFACIAL SURGERY

## REVIEW ARTICLE

# The maxillofacial surgeon and cranial base surgery

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SUMMARY. The paper reviews the role of the maxillofacial surgeon, surgical approaches and osteotomies available to allow comprehensive access to cranial base tumours. Maxillo facial reconstruction using free vascularised flaps to rehabilitate the patients is highlighted. Such reconstruction may also require vascularised bone grafts. The range of microvascular free tissue transfer in cranial base surgery is discussed. The need not to merely reconstruct but to rehabilitate the patient is stressed. The benefits of the latest imaging and navigation systems are outlined.

#### INTRODUCTION

Cranial base surgery usually refers to tumour surgery involving the skull base, in particular the anterior and middle cranial fossa. The lesions treated are usually tumours arising from the paranasal sinuses or orbits or from the infratemporal fossa extending upwards to involve the skull base as well as tumours arising intracranially which extend downward to involve the base. The techniques may however be employed for other reasons, such as complex trauma, basal encephlocoeles and exposing basal vascular malformations. Surgery in this region represents one of the last surgical frontiers for both maxillo facial and neuro-surgeons. This article considers advances in surgical techniques as well as technological advances, particularly in relation to surgery of the anterior skull base.

Early attempts to surgically treat lesions at the skull base were associated with a high incidence of complications, in particular cerebrospinal fluid fistulas together with meningitis and brain injury either directly or indirectly due to compromise of cerebral vessels. Whilst the posterior fossa may be involved with a variety of tumours, most do not present to the maxillo facial surgeon. The middle cranial fossa is more commonly involved by direct extension of external tumours often arising from the infratemporal fossa but it is lesions involving the anterior cranial fossa which tend to dominate the interest of the maxillo facial surgeon. It must be stressed that surgery of this nature involves true team work between the maxillo facial and neuro-surgeon, with immediate postoperative management often requiring neurosurgical intensive care facilities.

A major development in rendering approaches to the skull base acceptably safe involved combining intracranial and extracranial surgical techniques. It was realised that the normal frontal sinus contained few bacteria and thus was not a source of gross contamination. In addition, the ability of the surgeon to obliterate dead space added to safety and the use of either local or distant flaps frequently transferred by micro-vascular anastomosis enabled the cranial cavity to be sealed off from the paranasal sinuses, oral and nasal cavities. The use of cranial autografts has improved the survival and the functional results of calvarial reconstruction. These techniques have been reinforced by technical developments. Air driven power tools cut cranial bone with ease, micro fixation plates add to the security of immobilisation and human fibrin glue reinforces the soft tissue reconstructions. Accompanying these surgical developments, major advances have occurred in diagnostic radiology. Fine resolution CT and MRI scanning, have allowed the development of interactive 3D imaging and offer exciting possibilities in more accurate tumour resection, protection of vital structures and preservation of normal tissue. Angiography and interventional radiology with balloon occlusion and selective embolisation are useful adjuncts to cranial base surgery.

#### SURGICAL DEVELOPMENTS

## Access osteotomies

The anterior skull base and middle cranial fossa may be approached in a variety of ways, transfacially using either the Altemir (lateral rotation), Panje (fronto-nasal)<sup>2</sup> osteotomies or from above by means of frontal craniotomy, with removal of the supraorbital bar<sup>3</sup>. The latter approach may be purely central or extended into an anterolateral approach. Finally, the skull base and upper cervical spine may be approached from below using a transoral/transpharyngeal approach or via a Le Fort I maxillotomy with downfracture.

## Access to the clivus and upper cervical spine

Transoral transpharyngeal approach (median mandibulotomy/median glossotomy). The third, fourth and fifth cervical vertebrae (Fig. 1) may be approached by a transoral/transpharyngeal route. The patient is held rigid in a head frame with appropriate weights. The operation is preceded by an elective tracheostomy and via a horizontal cervical incision the mandible is exposed by dissection upwards. It is necessary to transect the mental nerves bilaterally (which are marked to allow repair at the end of the procedure). The mandible is prelocated with miniplates and then divided in the midline with an oscillating saw. The oral soft tissues are divided in the midline, starting between the submandibular plicae and then performing a median glossotomy. It is essential to remain in the midline to avoid excess haemorrhage. Once the back of the mouth is reached, the epiglottis comes into view, which is then displaced in a downward direction. The posterior pharyngeal wall is approached and a superiorly based flap is raised to expose the relevant vertebrae which are then resected. On completion of the resection, the pharyngeal flap is replaced and sutured in layers. The oral soft tissues are repaired in layers with drainage and the mandible plated. Finally, the mental nerves are re-apposed and the skin flap sutured in layers. Stabilisation of the neck is required post operatively (Fig. 2).

The upper two cervical vertebrae and clivus are approached via a pure transoral approach with displacement of the soft palate into the nasopharynx (Fig. 3). It is unnecessary in the majority of cases to precede the procedure with a protective tracheostomy.

A Dingman gag is used to prop the mouth open and a Jacques catheter is passed via the nose into the oropharynx. A transfixation suture is passed through the soft palate and then through the Jacques catheter,

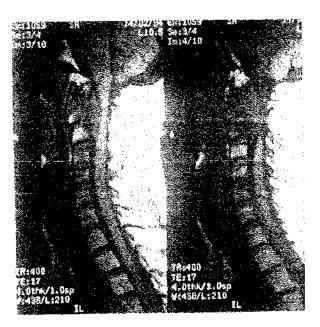


Fig. 1 - MRI scans, showing extensive upper cervical lesion.



Fig. 2 – Postoperative position, note the elective tracheostomy and neck stabilisation.



Fig. 3 - Displacement of the soft palate into the nasopharynx.

enabling the soft palate to be inverted into the nasopharynx. With the blade of the gag displacing the tongue in a downward direction and the soft palate displaced in a upward direction sufficient space is obtained to expose the upper end of the posterior wall of the pharynx. A superiorly based flap is raised with cutting diathermy and the anterior aspect of the upper two cervical vertebrae are exposed. In these cases (usually for rheumatoid disease), the arch of the atlas is resected to expose the odontoid process which is then resected (Fig. 4). On completion of this manoeuvre, the flap is replaced and sutured into



Fig. 4 - Intraoperative view of the resection of the odontoid.

position. Where it is necessary to approach the middle and upper parts of the clivus, the soft palate is split in the midline with lateral extensions to the cuts, which provides sufficient access. On completion of the resection, the soft palate is repaired in three layers in a similar manner to repairing a cleft palate.

#### Le Fort I osteotomy.

Osteotomy of the upper jaw in an axial plane above the roots of the maxillary teeth is a routine procedure for the maxillo facial surgeon. This surgical approach has been applied in order to produce access to the skull base. The jaw is downfractured and pedicled on the greater palatine vessels and soft palate. By opening the nasal mucosa access may be obtained to the skull base in the midline in the region of the clivus, however the ability to explore laterally is extremely limited. The approach is particularly advantageous in an en bloc removal of malignant neoplasms of the nasal septum (Figs 5-10).

#### Trans Facial Osteotomies

Altemir transfacial osteotomy. This approach is well documented in the maxillo facial literature,1 and is particularly useful for accessing tumours involving the paranasal sinuses and the retromaxillary area. The technique involves a standard Weber Ferguson skin incision, with a lateral infra-orbital extension (Fig. 11A). The maxilla is exposed sparingly and mini-midi plates are applied (prelocation) before the osteotomy cuts are made.<sup>5</sup> The osteotomy begins with a vertical cut in the premaxilla, between the incisor teeth (if present) continuing upwards, separating the maxilla from the nasal bones and passing over the infra-orbital margin and along the orbital floor. The bone cut then continues outward across the frontal process of the maxilla. The zygomatic arch is also osteotomised at its mid-point. The mucosa of the hard plate is then incised and the bone osteotomised, the soft tissue incision continues laterally at the junction of the hard and soft palate, towards the tuberosity, where the pterygoid plates are separated





Fig. 5 - (A, B) A fungating tumour of nasal septum, showing skin incision and le Fort I osteotomy to allow en-bloc removal.





Fig. 6 - (A) Exposure of the tumour, (B) its resection.



Fig. 7 - The resected specimen.

from the maxilla with either a saw or osteotome. It is now possible to laterally rotate the maxilla pedicled on the soft tissues of the cheek (Fig. 11B). During this manoeuvre, the infra-orbital nerve is sectioned and marked to allow subsequent microneural anastomosis.

With this approach, the whole of the nasal fossa, nasopharynx and infratemporal fossa is exposed on the operated side. If both sides of the nasopharynx and infratemporal fossa require exposure, then the mid face osteotomy is repeated on the other side. In addition, the ethmoids and mid portion of the anterior skull base are brought into view. This

approach gives unparalleled access to the deepest recesses of the face and anterior skull base, including the sphenoid sinus and clivus, overcoming many of the disadvantages of the more limited Le Fort I osteotomy. By combining the Altemir approach with a standard anterior or anterolateral cranio-frontal approach, optimal access is obtained, permitting removal of extensive paranasal sinus tumours extending upward or alternatively extensive cranial tumours extending downward. On completion of the resection, the osteotomy is replaced and fixed with bone plates (Figs 12 & 13).

Panje fronto nasal approach. Panje and his co-workers2 described a transfacial approach to access anterior skull base lesions (Fig. 14), in which an extended lateral rhinotomy incision is made to expose the nasal skeleton, frontal bone and medial wall of the orbit on one side. An osteoplastic flap is raised, hinging the external nose to the opposite side as one piece on the nasolabial soft tissues having detached the nasal septum from the nose (Fig 15A). It is then possible to remove the posterior wall of the frontal sinus and a resection of the anterior cranial fossa and ethmoids, to include the tumour is performed. On completion of the resection, any tears in the dura are repaired. If a portion of the dura has been resected, then it is necessary to carry out a dural



Fig. 8-(A) The reconstruction using local flaps, (B) pedicled calvarial bone graft.



Fig. 9 - A local forehead flap for skin cover.

Fig. 10 - Final appearance at 1 year.

repair with temporalis fascia or fascia lata. The external nose and osteoplastic flap are replaced and plated into position (Fig. 16). In practice however, the exposure obtained by this approach is somewhat limited and the perceived advantage of performing the procedure through one incision is more imagined than real.

## Anterior and anterolateral cranial approach

These approaches are designed to access tumours involving the anterior and middle cranial fossae and were popularised by Johns  $et\ al^3$  in the early 1980s. The central approach is mainly for ethmoid tumours, whereas the anterolateral approach is primarily

designed to encompass orbital tumours or more extensive paranasal sinus tumours (Fig. 17). As pointed out above, when combined with a transfacial approach, this composite approach offers extremely wide access to paranasal and skull base lesions.

The osteotomy is performed through a bicoronal flap which is placed well back to allow an adequate amount of pericranium and/or galea to be harvested. In addition, by siting the scalp incision further posteriorly, much greater access to the temporalis muscles is afforded should they be required for reconstruction. The dissection of the scalp flap continues onto the face and it is possible via this approach to deglove the entire nasal apparatus and face (Fig. 18), down to the attachment of the oral mucosa. The roofs and medial walls of the orbits are cleared of periosteum, cauterising the anterior and posterior ethmoidal arteries. A frontal osteotomy is performed to allow access to the cranial cavity. The dura from

the cribriform plate backwards is reflected. The extent of the dural reflection depends on the location of the tumour. It may be necessary to identify both optic nerves. The supraorbital bar osteotomy is outlined using the postage stamp technique and the bone is cut using an oscillating saw. The extent of the osteotomy is dependant on the degree of access to the anterior skull base that is required. The periosteum is stripped from the roof of the orbits on the ocular side and the outline of the area of skull base to be resected is again made by the 'postage stamp' technique and then the bone is cut with an oscillating saw. Care is taken to ensure that no damage occurs to the cerebral tissue. It is helpful if the osteotomies are prelocated with midi plates (Luhr Panfixation system) prior to performing the osteotomy. The anterior cranial fossa is resected in a similar manner and if combined with a transfacial approach, an en bloc resection may be performed (Fig. 19). On com-



Fig. 11 - (A) A modified Weber Ferguson incision as used in Altemirs midface osteotomy. (B) The access gained by this approach,

pletion of the resection, a defect of variable size is created with a communication between the nasal cavity and the cranial cavity. The repair of such a defect will be discussed later.

By combining the cranial approach with a transfacial approach, an en bloc resection of the involved cranial base and nasal apparatus may be performed.

Pericranial and galeal flaps. The bicoronal scalp flap allows access for harvesting a pericranial flap as originally described by Johns et al. The flap is raised in a rectangular fashion with its base in the supraorbital area, with the blood supply derived from the supraorbital and supratrochlear blood vessels. The pericranial flap is passed intracranially through the roof of the orbits and sutured to the dura (Fig. 20). This flap resurfaces the anterior cranial fossa and with expansion of the frontal lobes, the dead space between the dura and the flap is eliminated. In

situations where it is impossible to harvest a pericranial flap, an anteriorly based galeal flap is dissected from the bicoronal flap by sharp dissection. This procedure unfortunately tends to produce an 'orange peel' deformity of the frontal scalp skin, which is unavoidable.

Calvarial bone grafts. In recent years, it has become common to harvest bone from the calvarium. The advantages of using bone from this site are as follows:

- i. The contour of the bone is especially suitable to graft defects in the cranial cavity or middle third of the face.
- 2. The bone is extremely hard and is therefore less likely to resorb.
- The bone is readily accessible when performing cranio-facial surgery.

Harvesting bone from the calvarium requires meticulous attention to detail and is time consuming.

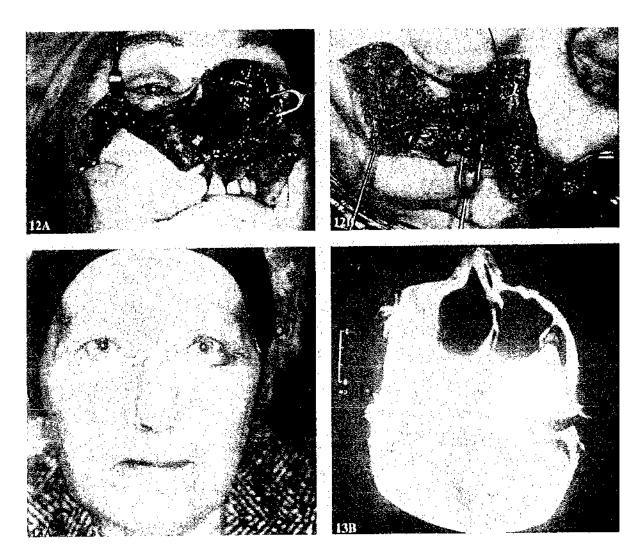


Fig. 12 – (A) The exposure of the Altemir approach, (B) its subsequent fixation. Fig. 13 – (A, B) The postoperative appearance at 1 week.

Using a reciprocating air driven saw, cuts are made through the outer cortex to expose the intramedullary space between the inner and outer table. Eventually the inner and outer tables are separated using fine osteotomes. The graft is used to replace bone either at the skull vault or cranial base. In addition, it may be used to replace defects in the facial bones (Fig. 21).

Microvascular free tissue transfer. The use of the microscope to anastomose vessels of a small diameter (~0.7 mm) enables the surgeon to move tissue from any site on the body, without the constraints imposed by pedicled flaps. Such techniques have become commonplace in most centres engaged in craniofacial surgery and play an increasingly important role in sealing off the cranial cavity from the facial area. Furthermore, microvascular surgery allows neovascularisation of brain tissue, by-passing potential areas of pathology involving the carotid system intracranially, by anastomosing vascular grafts with their

origins in the neck to cerebral vessels 'downstream' of the problem.

Radial forearm fascial flap. The radial forearm fasciocutaneous free flap is a well known flap in head and neck reconstruction. The fascial variant is less well known, but is extremely useful in repairing anterior skull base defects in situations where either pericranial or galeal flaps are not available.

Harvesting the flap is straightforward, under tourniquet control, an L-shaped incision is made in the distal aspect of the flexor surface of the non dominant forearm. A fascial flap of the required dimensions is elevated down to the flexor muscles and tendons, commencing from the ulnar side and extending across to the radial side, incorporating the lateral intermuscular septum which contains the radial artery with its septo-cutaneous radicals and venae commitantes (Fig. 22). A major advantage of this flap is the length of pedicle which may be obtained allowing the vascular anastomoses to be performed in the neck. The

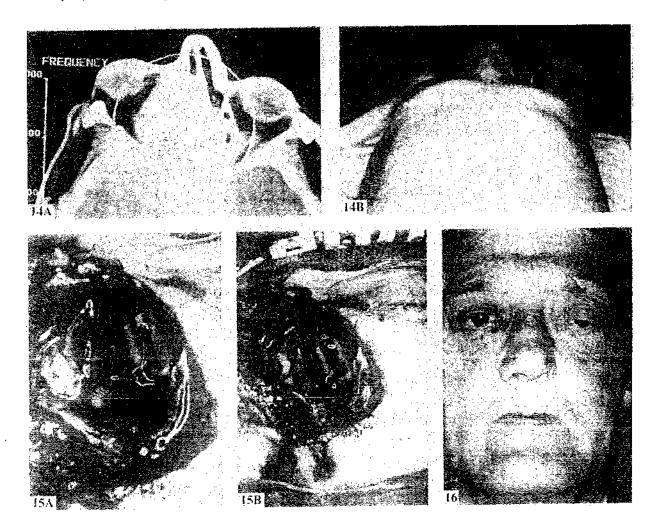


Fig. 14 - (A, B) A large adeno carcinoma of the naso ethmoid region.

Fig. 15 - (A, B) The access gained by a lateral nasal osteotomy.

Fig. 16 - The postoperative appearance at 9 months.

fascial flap readily reconstitutes defects in the anterior cranial fossa and is far superior to allografts in its resistance to infection (Fig. 23).

Vascularised hip graft and internal oblique muscle. Bone harvested from the iliac crest with a blood supply derived from the deep circumflex vessels is a ready source of large amount of vascularised bone. When raised as a composite graft incorporating the internal oblique muscle, this flap is extremely useful for mid-face and anterior skull base reconstruction particularly after major ablative surgery with considerable loss of local tissue (Figs 24, 25).

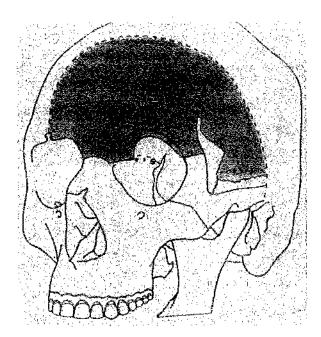


Fig. 17 – Schematic drawing of the antero-lateral approach to the base of the skull.

Flaps based on the subscapular system. When gross cranio facial ablation is indicated (Figs 26-28), it is essential that the cranial cavity is excluded from the oral, nasal and paranasal cavities in order to reduce the chance of intra-cranial infection. In such cases, it is necessary to utilise multiple flaps and the most convenient flap system is based on the subscapular vessels which are major branches of the axillary vessels. A wide variety of flaps may be harvested including bone from the scapula (Figs. 29, 30)



Fig. 20 - The peri cranial flap provides a good seal and separation of the nose from the cranium.





Fig. 19 - The appearance of the en bloc cranio facial resection.



Fig. 21 - Stabilisation of the calvarial bone grafts, providing excellent contour and stability.

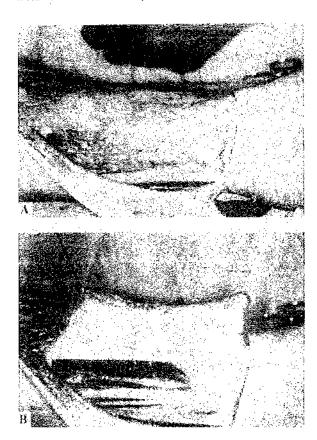


Fig. 22 - Raising the radial forearm flap, note the proximity of suitable nerve grafts.

allowing the immediate reconstruction of complex defects. 8-11 Unfortunately, the cosmetic results of such surgery are less than optimal, although considerable improvement may be obtained with the subsequent insertion of facial prostheses.

Fig. 25 - Insertion of the composite free flap ( DCIA and muscle).



Fig. 23 – A fascial flap is inserted, to the anterior skull base as previous infection precluded the use of pericranium.

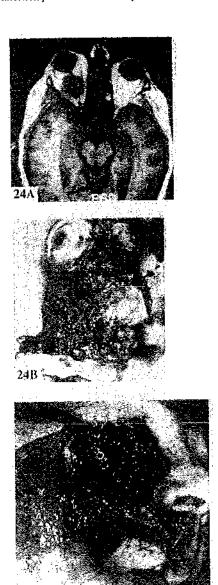


Fig. 24 - Extensive cranial facial resection which will require complex reconstruction.

Neovascularisation of cerebral tissue by microvascular by-pass. Extra-cranial vascular bypass to the anterior or distal middle cerebral artery (MCA) was originally used in an attempt to reduce the incidence of stroke from atherosclerosis. This venture was unsuccessful, however, there is evidence that high flow by-pass from the external carotid system to maintain or improve (MCA) blood supply may be of value in situations where either temporary or permanent occlusion of the internal carotid artery (ICA) is necessary to safely perform the intracranial component of craniofacial surgery. Most authorities utilise either a scalp artery, 12 or alternatively, a saphenous venous graft.13 In view of the known problems associated with either a scalp artery or saphenous vein,14 a radial artery graft harvested from the non dominant forearm is used in our unit. A length of graft in excess of 20 cm is easily harvested and the distal anastomosis is performed either on a branch of the external carotid artery or the main trunk of the external carotid artery. The arterial graft is threaded superficially in the preauricular region and introduced



Fig. 26 - Excision of a recurrent extensive BCC.

Fig. 27 - The residual defect.

Fig. 28 - The resected specimen.

Fig. 29 - The scapular flaps have the benefit of separate tissue paddles allowing flexibility in reconstruction, based on the subscapular artery

Fig. 30 - The immediate postoperative appearance.

intracranially into the split sylvian fissure to a main limb of the middle cerebral artery (Fig. 31). It is easy to follow the progress of the graft by doppler monitoring.



Fig. M - Intra cranial anastamosis of the radial artery graft.



Fig. 32 - Miniplate stabilisation of free bone fragments.

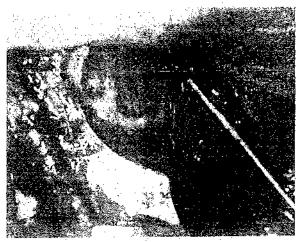


Fig. 33 - Application of Blade glue.

#### Technological developments

Osteosynthesis with mini plates. Bone plates have been used to fix bone fragments in the maxillo facial region for many years. In maxillo facial surgery,15 a variety of bone plates have been designed in a variety of metals and alloys. Relatively recently, mini plates, midi plates and microplates have been utilised to fix bone grafts (Fig. 32), osteoplastic flaps and bone fragments. The major advantages of such plates lies in the ease of handling complex pieces of bone and the ability to hold them in the correct anatomical position. The use of titanium avoids problems with magnetic imaging and the modern plates are of low profile and thus are impalpable beneath the soft tissues. Efforts are currently directed toward developing resorbable plates with similar mechanical properties to metallic plates.

Fibrin glue. Matras originally proposed the use of plasma clots to join nerve ends together and following this development, efforts were directed toward developing a biological tissue adhesive which would be of value in cranio maxillo facial surgery. 16

Biological adhesives are increasingly used in neurosurgery<sup>17</sup> as well as maxillo facial surgery and consist of lyophilised human fibrinogen and bovine thrombin. The fibrinogen component which also contains factor XIII, polymerises soluble fibrin monomers into an insoluble clot. A solution of aprotinin, an inhibitor of fibrinolysis is used to dissolve the fibrinogen and serves to prolong the life of the clot, allowing the clot to persist for up to 15 days. The adhesive is invaluable in areas of the skull base where it is extremely difficult to suture and obtain a watertight seal,<sup>18</sup> thus minimising the possibility of CSF leakage (Fig. 33). The risk of viral cross infection is negligible with good quality control.

Osseointegrated implants. The accidental discovery over 25 years ago that the oxides of certain alloys had an induction effect on bone formation has led to the development of a new subpeciality of surgery. Titanium oxide implants acting as bone anchors, are able to provide support for various supra structures, extra-orally and intra-orally. Where it is impossible to obtain a satisfactory biological reconstruction as in loss of orbital contents or where for a variety of reasons, biological reconstructions are contraindicated, then the use of a prosthesis supported by osseo-integrated implants allows a satisfactory albeit limited reconstruction (Figs 34, 35).

Interactive 3D imaging. The practice of neurosurgery was revolutionised in the 1970's with the introduction of the CT scanner. This greatly enhanced the preoperative assessments of disease particularly in the cranio facial region. Since then image resolution and scanning speeds have increased and a further modality, MRI has been added to the armamentarium. The practice of stereotactic localisation was developed separately, as early as the 1920s by Sir





Fig. 34 - Osseo-integrated facial prosthesis is less than ideal, but is sometimes necessary as in orbital exenteration.

Fig. 35 - The 'at rest' appearance is satisfactory, and the implant gives the patients much more comfort and confidence.

Victor Horsley and involved bringing a surgical instrument to a target with a high degree of accuracy (1-2 mm). Ventriculography was used to provide 'image' localisation.

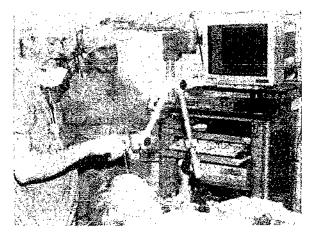
Although stereotactic frames were adapted to use modern imaging techniques they were little used because of their clumsiness. A frame has to be applied to the patient's head prior to scanning and kept there during surgery. However recent advances in computer technology have made possible 'image interactive surgery' or as it was first known 'frameless stereo-



Fig. 36 - Skin mapping with the wand navigation system.

taxy'. By this means data obtained from MRI or CT scanning may be used for accurate surgical targeting.

To achieve this, several processes are carried out. A computerised work station is used to perform image analysis creating multiplanar 2-D slices (reformats) in addition to 3-D reconstructions (segmentation or rendering of the data). In particular a 3-D reconstruction of the skin surface is created. En passant the tumour or other lesion may be reconstructed as an aid to the surgical procedure. In theatre the patient's head (under anaesthesia) is securely fixed from moving using a 3-pin fixator. A 'spatial localizer' is then used to indicate to a computer the precise position of the patient's head, carefully mapping out the position of the patient's skin (corresponding to those features reconstructed in the image prior to surgery) (Fig. 36). There are several systems which perform 'spatial digitisation' but the one which has been used the most to date comprises a pointer at the end of a multijointed arm. Each joint contains a



Flg. 37 - Registration of the navigation system.

sensor so that the computer can 'know' the position in space of the tip of the pointer to within 1 mm. Other systems employ infrared sensors or ultrasound but the principle is the same.

Finally the 'image created' skin surface and the 'probe created' skin surface are matched up (registered Fig. 37). Once this has been done the computer can indicate to the surgeon the corresponding position of the probe within the surgical field to that on the images, displayed on a computer screen in theatre. The movements of the hand held probe then correspond to the movements of the probe on the screen. Many different views (sagittal, coronal, axial and 3-D can be displayed simultaneously, each with the position of the probe marked.

This position is continuously updated as the probe moves through the operating field so the system is 'interactive'. It uses preoperative scan data, so cannot take account of intraoperative changes in anatomy, although registration will remain valid for any rigid structures. It is of course important that the patient does not move; hence the need for the 3 pin head fixator. This has, to date, limited its practical use to the head i.e. neurosurgery. However, the facial skeleton and base of skull are of course parts of this rigid structure so that the system is ideally suited to base of skull surgical techniques. Advantages of the system are as follows:

- To indicate limits of resection as directed by the preoperative imaging,
- To indicate normal anatomy e.g. after debulking a large olfactory groove meningioma the position of the optic nerves can be made certain before they are seen,
- Minimally invasive techniques are made possible. By precisely determining the extent of a tumour the skin incisions and approaches can be made adequate but no larger than absolutely necessary; important for a subject in which procedures are often long and complex.

## Acknowledgements

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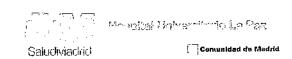
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# Intra-Arterial Infusion Catheters with Implantable Injection Chambers in Maxillo-Facial Oncology

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#### Introduction

Regional intra-arterial chemotherapy in the treatment of maxillo-facial tumours is used with curative intent in combined chemotherapy and radiotherapy (Kreidler and Petzel, 1983: Szepezi et al., 1984; Goepfert et al., 1973), in palliative treatment schedules (Sullivan et al., 1961; Freckman, 1972: Donegan and Harris, 1973), or in induction chemotherapy protocols to reduce the size, extent and viability of advanced tumours (Gollin and Johnson, 1971; Bilder and Hornova, 1970; Snow and Sindram, 1973: Richard et al., 1974; Nervi et al., 1978; Curioni and Quadu, 1978; Szabo and Kovacs, 1979; Molinari, 1985).

Problems with catheter infections are frequently seen during long term local intra-arterial chemotherapy regimes (Szabo and Kovacs, 1979), and are mostly due to contamination of the infusion system used. We therefore advocate intra-arterial infusion with an implantable intra-arterial infusion catheter (Implantofix®, Braun, Melsungen). An innovation in the use of these catheters in the maxillo-facial region is presented.

#### Technique

The implantation technique is usually performed under general anaesthesia

general anaesthesia.

The kind of intubation depends on the site and/or extent of the tumour. When possible, we prefer nasotracheal intubation with a pericranial fixation of the tube (Hernández Altemir, 1986), leaving the mouth, face, neck and temporo-mastoid regions exposed on both sides (Fig. 1) (in the event of bilateral catheterization).

In the majority of cases we used a retrograde cannulation technique through the parietal branch of the superficial temporal artery. If the external carotid artery could not be catheterized via the superficial temporal artery a retrograde cannulation technique via the facial temporal artery was used. Three incisions are used, are in the pre-auricular, the second in the retroauricular and the third in the submastoid region (Figs. 2 and 3).

Depending on the site and size of the tumour, the tip of the catheter is placed in the external carotid artery just caudal to the branches perfusing the tumour area.

The insertion of the catheter tip into the external carotid

#### Summary

An intra-arterial chemotherapy procedure in patients with malignant tumours in the oral and maxillo-facial region which, from the vascular point of view, can be dependent on the external carotid artery and/or its branches is presented. Particularly for the prevention of catheter infection, obstruction, etc., a subcutaneous pouch, connected to the infusion catheter, is implanted subcutaneously in the submastoid region.

#### Key-Words

Maxillo-facial tumour - Intra-arterial chemotherapy - Implantation of catheter

artery, the path of the catheter over the temporal surface around the ear down to the mastoid region, and the insertion of the implantable drug injection chamber at the end of the catheter are carried out before the actual catheterization procedure. The dissection of the superficial temporal artery is made through a preauricular incision (Kreidler and Petzel, 1983; Bilder and Hornova, 1970) (Fig. 1). This

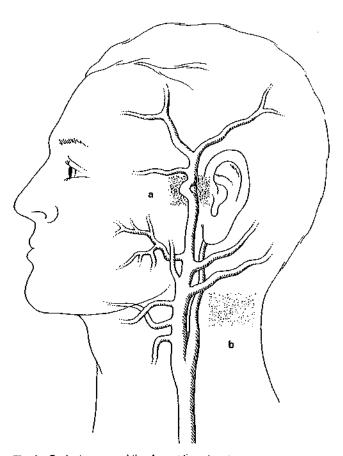
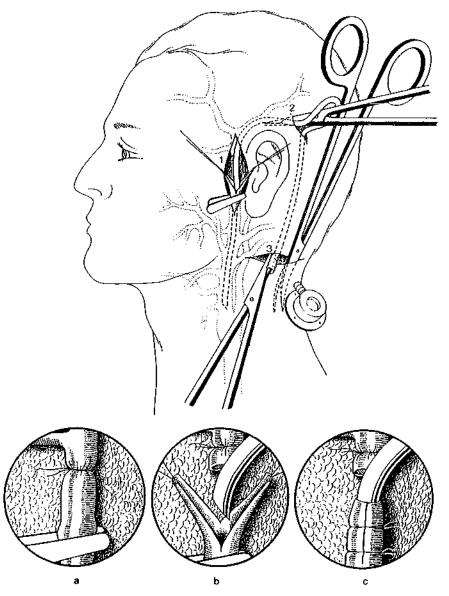


Fig. 1 Perfusion area of the A. carotis externa.

a) The greatest curvature of the vessel is found in the sub-zygomatic region.

 b) Region of the subcutaneous pouch for the implantable injection chamber.



ig. 2

- 1 Pre-auricular incision.
- Retro-auricular incision.
- Submastoid incision.
- a Ligation/clamping of the superficial temporal artery and the longitudinal incision in between.
- **b** Stretching of the artery between ligatures.
- c Ligatures round the catheter and artery after checking for correct positioning.

artery usually lies in front of or under the accompanying vein and auriculotemporal nerve, which can be preserved in the majority of cases.

The artery must be freed as far caudally as possible because the greatest curvature of the vessel is found in the subzygomatic region. After ligating collateral vessels, elevation of the superficial temporal artery is simple and the chance of perforation by the catheter in the sub-zygomatic area is minimized.

The superficial temporal artery is ligated cranial to the preauricular incision (Fig. 2.a) and clamped caudally as atraumatically as possible.

Through a 1 cm. longitudinal incision (Fig. 2 a), sutures are passed through and knotted. After cutting the vessel above the knots, the caudal part of the artery can be stretched between ligatures (Fig. 2 a, b), and the bevelled catheter tip can easily be introduced into the vessel, although advancement of the catheter is not always easy because of anatomical variations (Snow, 1966). The catheter and the implantable drug injection chamber are flushed with a heparinized saline solution before the catheterization procedure.

The correct position of the tip is checked by disulphine blue injection into the injection chamber (Kreidler and Petzel, 1983). After control of the correct catheter tip position by disulphine blue staining of the target area, two ligatures are placed below the entry side of the catheter into the cannulated vessel. The catheter is fixed to the temporal fascia by a ligature.

Via a retro-auricular incision, a supra-auricular tunnel is dissected over the temporal fascia to the pre-auricular region (Fig. 2). A retro-auricular tunnel to the mastoid region is created through the same incision.

The drug injection chamber is temporarily removed from the distal part of the catheter, and the catheter can then be pulled through the upper and lower tunnels with a curved haemostat. Using blunt dissection, a subcutaneous pouch is prepared in a cervico-lateral direction (Fig. 2). The implantable drug injection chamber is fixed over the sternocleido-mastoid muscle.

During suturing, attention must be paid to the position of the catheter in order to avoid kinks or perforation with the suture needle.

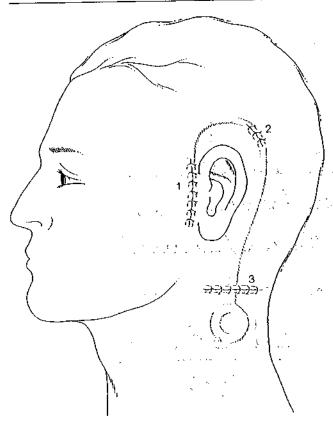


Fig.3 Preauricular subcutaneous course of the catheter, and the lunnels behind the ear to the subcutaneous pouch for the drug infusion chamber.

The procedure can be done bilaterally in the same session if the tumour crosses the midline.

In our department we start with the chemotherapy schedule 5 days after the cannulation, although some authors (Kreidler and Petzel, 1983) start the day after the cannulation procedure.

It must be stressed that the implantable intra-arterial infusion catheters are suitable not only for intra-arterial "pulse" administration of cytostatic agents, but also for "intermittent continuous" intra-arterial infusion. In our department we use a perfusor for the administration of the drugs.

#### Conclusions

Catheterization of the external carotid artery has been used by many authors since Sullivan et al. (1953) introduced the technique, and is now a common procedure. In head and neck oncology, the use of inera-arterial infusion catheters with implantable injection chambers is an improvement, reducing the infection rate associated with the catheter, which always necessitates its removal and leads to delay of the therapy schedules. The technique improves patient comfort and facilitates intra-arterial chemotherapy.

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To Dr. A. Garcia Yanes who, on 23 May 1986, in a Conference given at "Miguel Server" Hospital in Zaragoza, informed us of his results with the technique of intra-arterial regional chemotherapy via

the temporo-carotid route and which formed the basis of our own catheter and reservoir installation technique. To Palex, who provided us with the material necessary and the technical support, to carry out our first cases and lastly to the medical staff, TSA and Auxiliaries of the Maxillofacial and Oral Surgery Service, as well as to the "Miguel Servet" Hospital management, who were appreciative of the development of the technique.

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REMI 2001, Vol 1 REMI 2002, Vol 2 REMI 2003; Vol 3 REMI 2004; Vol 4 REMI 2005; Vol 5 REMI 2006; Vol 6 REMI 2007; Vol 7 REMI 2008; Vol 8 Buscar La asistencia sanitaria al anciano: ¿deben existir límites?

[Versión para imprimir] **Comentarios:** [Francisco Hernández Altemir] [Ricardo Abizanda Campos]

Daniel Callahan en su libro "Poner límites: los fines de la medicina en una sociedad que envejece" [1], consideró la edad como uno de los criterios que deben influir en la distribución de los recursos sanitarios. Sin embargo, sabemos que la edad es un factor más, y por tanto, con un valor limitado en la toma de decisiones clínicas. El presente artículo es una revisión de las ideas expresadas por D. Callahan en su libro.

Auspiciada por la

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1.- Las sociedades envejecidas y el incremento del gasto sanitario

En los años 80 se inició en algunos países desarrollados un periodo de limitación en el uso en determinadas tecnologías en la población anciana. Las poblaciones envejecidas estaban aumentando, y era necesario poner límites al crecimiento del gasto sanitario [2-4]. Sin embargo, otros estudios demostraron que estos datos no eran concluyentes y que podría existir una mala planificación de recursos en relación a las necesidades de la población [5, 6], así como la inadecuación de los procedimientos realizados a los ancianos en relación a sus patologías [7].

Sabemos actualmente que las poblaciones envejecidas poseen determinadas características: las enfermedades crónicas son más prevalentes, la proporción de ancianos enfermos, dependientes e incapacitados es muy elevada, las elecciones morales en los ancianos terminales son muy difíciles y los costes de los ancianos terminales son muy elevados [2]. Sin embargo, no podemos centrarnos exclusivamente en esta población para justificar el gasto sanitario, sobre todo cuando desconocemos qué necesidades asistenciales precisan.

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# 2.- Necesidades asistenciales en la población anciana

Desconocemos las necesidades asistenciales en la población anciana. Ni tan siquiera hemos definido cual es la edad para hablar de ancianidad. Para Daniel Callahan la muerte prematura es la muerte que ocurre antes de haber vivido una duración natural de la vida, periodo que se alcanzaba al comienzo de los 70 años, pero que en la actualidad se ha prolongado hasta finales de esa década de la vida y principios de los 80 años. Lo ideal en esta etapa sería que el anciano sea independiente y sano. Si tenemos en cuenta estos elementos, es lógico pensar que las necesidades deben ir encaminadas a evitar aquellos elementos que pueden acompañar a la ancianidad (las enfermedades crónicas, el dolor, la dependencia y el sufrimiento principalmente).

# 3.- ¿Debemos poner límites a la asistencia sanitaria de los ancianos?

No se puede llegar a conclusiones ya que inicialmente deberíamos conocer las necesidades de salud de los distintos grupos de edad y establecer sus prioridades para planificar programas sanitarios. Daniel Callahan argumenta que las necesidades de los ancianos estarían encaminadas a alcanzar en primer lugar una duración natural de la vida y después de alcanzar esta edad, a aliviar el sufrimiento. Este estándar haría posible una distribución de recursos para las personas ancianas basados en la edad y en las necesidades individuales [1].

Norman Daniels en su teoría de "abanico normal de oportunidades para la distribución de recursos a distintos individuos y grupos de edad" [5], nos dice que satisfacer las necesidades de asistencia sanitaria favorece la igualdad de oportunidades y garantiza a los individuos una opción justa de disfrutar el abanico normal de posibilidades de la sociedad en que viven. Daniel Callahan amplía esta teoría al concepto de "abanico de oportunidades a lo largo de la vida", que significa preguntarse cuales son las oportunidades que resulta razonable esperar a lo largo de la vida, aunque primero tenemos que tener claro qué es lo que debiera entenderse como "normal" dentro de los límites de ese mismo abanico.

#### La edad como criterio para poner límites

Debemos distinguir entre la edad como criterio médico para establecer un pronóstico y la edad como criterio centrado en la persona. El criterio médico considera la edad cronológica equivalente a otras características físicas del paciente (peso, edad, talla, etc.). Si nos centramos en la persona, tenemos que valorar su historia y su biografía, es decir, como persona y no como una mera colección de órganos. Debemos rechazar la edad como estándar médico, pero podemos utilizar la edad como estándar biográfico. La percepción del paciente como una persona total o como un conjunto de órganos que tienen que recibir tratamiento, es lo que determina que el médico utilice los tratamientos intensivos y agresivos en pacientes ancianos o terminales de forma similar a los tratamientos utilizados en la gente joven [1].

¿Es moral utilizar la edad para limitar la asistencia sanitaria?

Daniel Callahan nos dice que los profesionales experimentados y serios

tienen en cuenta siempre la edad en la toma de sus decisiones relativas a la retirada de tratamientos, y siempre lo han hecho. ¿Por qué debemos asumir que este factor no es, y no debe ser, parte de un juicio moral responsable?

## La edad como estándar biológico para poner límites

Podemos emitir dos tipos de juicios: el juicio médico y el juicio moral. Si hacemos referencia a la eficacia clínica estamos emitiendo un juicio médico. Cuando tenemos en cuenta el valor de la vida y decimos que el tratamiento es inútil porque no merecía la pena salvar al paciente por su edad, estamos emitiendo un juicio moral. Los juicios morales acerca del valor social de la vida de un paciente son inaceptables como motivos para retirar el tratamiento médico.

La edad es un componente valioso que nos señala en qué punto se encuentra el paciente en relación a su propia historia vital. A los ancianos enfermos crónicamente y con pocas posibilidades de curación podemos tratar los órganos disfuncionantes, pero no podemos devolverles la salud. Si la edad no es un buen factor pronóstico sobre la eficacia del tratamiento, sí constituye un estándar perfectamente razonable para juzgar la sensatez de la utilización de un tratamiento [1].

# La edad como criterio para retirar el tratamiento médico

Daniel Callahan justifica el uso de la edad como criterio para la retirada de tratamientos médicos en dos situaciones:

- 1. Cuando una persona haya disfrutado de la duración natural de la vida.
- 2. Una vez alcanzada la duración natural de la vida, los cuidados médicos deben de ir dirigidos a aliviar el sufrimiento.

Sin embargo, es difícil saber donde está la línea de separación entre el alivio del sufrimiento y la prolongación de la vida, y bajo ninguna circunstancia sería aceptable no evitar el sufrimiento si esto lleva implícito la posibilidad de alargar la vida. Además, la medicina no puede dar sentido y significado a la vida de los ancianos, solo pueden hacerlo por sí mismos con la ayuda de la sociedad en la que viven.

Daniel Callahan pone énfasis en las distintas connotaciones que suponen las distintas edades en el sentimiento del dolor y el sufrimiento.

- La persona joven no ha vivido toda la duración natural de su vida, y puede tener aún objetivos muy importantes que cumplir. Sin embargo, esto no ocurre en los ancianos, ya que sus objetivos previstos ya están casi todos cumplidos, y la vejez para ellos es otra etapa distinta de la vida que tienen que afrontar.
- En el paciente joven existe la tendencia a realizar tratamientos agresivos. Pensamos casi siempre que el beneficio es mayor que el riesgo. En la población anciana no estamos seguros de poder mantener una buena calidad de vida o similar a la previa del evento agudo, cuestionándonos limitar el tratamiento médico.

## 4.- Eutanasia y suicidio asistido

Aunque los ancianos no tienen derecho a demandar de forma ilimitada los recursos sanitarios, esto no quiere decir que no deban utilizar los recursos sanitarios disponibles y renunciar a la vida. La eutanasia legalizada (eutanasia positiva) y el suicidio asistido dan derecho a los ancianos a controlar su vida y su muerte. Para algunos ancianos sería gratificante, les evitaría una muerte dolorosa y la sensación de ser una carga para los demás.

Sin embargo, Daniel Callahan dice que no aporta solución en la práctica ya que lleva la connotación de la infravaloración de la edad avanzada. La vejez sería vista como algo inútil a lo que tenemos que renunciar. Los jóvenes podrían pensar que no hay que soportar el dolor y que no se puede conseguir una comunidad de ancianos. La salud y la vitalidad serían los valores para ver la vida digna de ser vivida.

La tasa de suicidios en ancianos es más alta que en jóvenes. Sin embargo, los factores de más peso que contribuyen a ello son los problemas sociales y las patologías psiquiátricas. La edad no es un factor de riesgo para el suicidio. El anciano reacciona ante el dolor, la enfermedad crónica y la muerte inminente con un abanico de respuestas tan amplio como cualquier otro grupo de edad.

# 5.- Criterios para elegir el tratamiento adecuado

Elegir el tratamiento adecuado en la población anciana es muy difícil, ya que no hemos sabido encontrar el valor que ocupan el envejecimiento y la muerte en nuestra sociedad actual. Podemos considerar tres factores importantes y utilizar los medios de diagnóstico y tratamiento adecuados a la patología sin alargar la existencia sin sentido y sin llegar a tratamientos excesivos.

# 5.1.- El estado físico y mental

- Pacientes en estado vegetativo persistente, pacientes con demencia grave, pacientes con deterioro leve-moderado de la competencia (o con competencia fluctuante)
- Pacientes gravemente enfermos con estado mental conscientes.
   Pacientes físicamente enfermos con estado mental consciente y que no están gravemente enfermos y pacientes físicamente fuertes en estado mental consciente.

### 5.2.- Niveles de asistencia

- Procedimientos de urgencia para salvar la vida (resucitación cardiopulmonar)
- Cuidados intensivos y soporte vital avanzado
- Cuidados médicos generales (antibióticos, cirugía, quimioterapia, antineoplásicos, hidratación y nutrición artificial)
- Cuidados paliativos de enfermería para proporcionar confort

### 5.3.- Calidad de vida

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- Capacidad para pensar, sentir e interaccionar con otros
- Impedimentos a la calidad de vida (dolor y el sufrimiento)
- Impedimentos que distorsionen la capacidad de pensar, sentir e interaccionar con el medio

# 6.- El estándar mínimo adecuado para la población anciana

Daniel Callahan dice que debemos tender a un estándar mínimo adecuado que permita a la población anciana conseguir sus objetivos planteándonos los siguientes principios:

# 6.1.- Delimitación de prioridades

Es necesaria una política de distribución de recursos y un sistema de prioridades basado en la edad con el objetivo de establecer límites en la asistencia sanitaria para los ancianos, evitar la muerte prematura y el alivio del sufrimiento. Las directrices deben de ir encaminadas a concretar sus prioridades y a favorecer la investigación de las patologías crónicas, así como de la asistencia preventiva y paliativa. La tecnología médica innovadora nos debe hacer recapacitar sobre su utilización, haciéndonos pensar si solo contribuye a alargar las enfermedades crónicas del anciano y su existencia sin aportar una mejoría significativa en la calidad de vida. La evaluación de las tecnologías es importante en estos casos, ayudaría a saber a quién deberíamos aplicarlas y a definir la población que más se beneficiaría de ellas.

# 6.2.- Elementos de una política sanitaria de contención de costes

El Estado no puede soportar sin restricciones los crecientes costes económicos y sociales de la asistencia sanitaria. Hay que poner límites, ya que los avances tecnológicos son cada vez más importantes, pero también más costosos. Además, el Estado tiene responsabilidad con otros grupos sociales. La edad podría ser un factor importante en la toma de decisiones para poner límites en la aplicación de determinados tratamientos para alargar la existencia. La mayor parte de los avances tecnológicos de las últimas décadas han producido más beneficios para los ancianos que para los jóvenes (diálisis), y esto ha llevado a un aumento de la esperanza de vida y a un aumento de las patologías crónicas asociadas a la vejez.

Callahan dice que el Estado está obligado a desarrollar, emplear y financiar tan solo la tecnología adecuada para alargar la existencia con objeto de lograr una duración natural de la vida, y más allá de esta línea solo los medios necesarios para aliviar el sufrimiento y no la tecnología para alargar la vida. Estos principios obligan a establecer un límite superior de edad para optar a los cuidados que alarguen la vida, a la vez que reconocen la gran diversidad que caracteriza las necesidades de los individuos para llegar a este límite, o más allá de él para aliviar el sufrimiento [1].

# 7.- El principio de reciprocidad de los jóvenes para los aucianos

Daniel Callahan argumenta que los ancianos no deben anteponer su propio bienestar al de los jóvenes y a las futuras generaciones. Aunque hemos asistido a cambios sociales importantes como es el menor sentimiento de obligación moral [6], los hijos y la familia siguen siendo la principal fuente de apoyo emocional del anciano. Una comunidad que no cuidase de sus ancianos no sería una comunidad moral [1].

El principio de reciprocidad según el cual los jóvenes tienen una deuda con los ancianos, al igual que un día sus hijos la tendrán con ellos, es una constante en la mayoría de las sociedades. Se ha dicho que los deberes de los hijos para con los padres emanan del principio de justicia natural y de retribución [8], mientras que otros no niegan un vínculo moral de amor y de afecto que no puede ser la justificación de sus obligaciones para con sus progenitores [7]. Daniel Callahan nos dice que los requerimientos morales recíprocos parecen evidentes por sí mismos. Es posible imaginar que existe cierta obligación cuando los padres han hecho por sus hijos más de lo que moralmente podría pedírseles. En el núcleo de cualquier obligación moral importante se encuentra el estado de vulnerabilidad y de necesidad última del otro, que en el contexto de la vida familiar y de la enfermedad solo se puede satisfacer plenamente a través de un miembro familiar [1].

#### Resumen

 Debemos aceptar el envejecimiento como parte de la vida y no como una situación de la vida que debe ser modernizada con el progreso médico y la tecnología.

 Los ancianos no deben ser discriminados por razones de edad para acceder a una sanidad pública cara. Deben tener el mismo derecho de acceso a la asistencia sanitaria que cualquier otro

grupo de distinta edad.

• El Gobierno debe garantizar a todos los grupos de edad evitar una muerte prematura. Se debe considerar "la duración natural de la vida" como punto de corte donde ya no hablamos de muerte prematura (finales de los 70 e inicio de los 80 años), pero no debe prolongarse innecesariamente la existencia, sino que los cuidados deben de ir dirigidos a aliviar el sufrimiento. Si fuera necesario poner límites, el ideal sería un sistema individualizado, justo y eficaz, todo a un tiempo.

 La eutanasia y el suicidio asistido quitan el valor de la ancianidad como una nueva etapa de la vida que merece la pena ser vivida.

 El Gobierno tiene compromiso de ayuda con todas las edades, por ello los ancianos no tienen derecho a vivir una existencia larga con la financiación pública indefinidamente, ya que eso podría poner en peligro a otras generaciones jóvenes, evitándoles llegar a ancianos y haciendo más ancianos a los que ya lo son.

 La reciprocidad pone el énfasis en establecer vínculos continuos de obligación y deber entre las generaciones a lo largo del tiempo. Los lazos familiares son la piedra fundamental para los ancianos dependientes y enfermos. En el núcleo de cualquier obligación moral importante se encuentra el estado de vulnerabilidad y de necesidad última. Es posible imaginar que existe cierta obligación cuando los padres han hecho por los hijos más de lo que moralmente podría pedírseles.

 La edad es una variable que carece de sentido por sí misma para poner límites de asistencia sanitaria en la población de ancianos. Encarnación Molina Domínguez, Servicio de Medicina Intensiva, Hospital General de Ciudad Real Miguel Ángel Sánchez González, Profesor de Historia de la Ciencia, Facultad de Medicina, Universidad Complutense, Madrid ©REMI, http://remi.uninet.edu. Enero 2008.

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# Búsqueda en PubMed:

- Enunciado: Futilidad terapéutica en el anciano
- Sintaxis: Medical Futility AND aged
- [Resultados]

Palabras clave: Vejez, Asistencia sanitaria, Limitación del esfuerzo terapéutico, Ética.

# Comentario de Francisco Hernández Altemir

Para mi, que no soy Callahan, que se plantee prestar la asistencia sanitaria mirando el D.N.I. del paciente me parece impresentable para un profesional de la medicina, y en su caso para las autoridades sanitarias y/o gubernamentales y para la sociedad en general. Yo creo que el médico está obligado a poner a disposición del paciente y de su entorno todos los medios necesarios, no para intentar prolongar la vida del paciente, sino para curarlo, entendiendo curar en el sentido de darle en todo momento las mejores ayudas materiales y humanas de las que se pueda disponer para el caso que le ocupe, y así mantenerlo en el mejor estado de bienestar posible, junto a su familia y seres queridos. Y si no los tuviera, el médico y el personal sanitario deberán aceptar ser además de eso sus familiares y amigos, y esto puede no coincidir necesariamente con el control exhaustivo de las constantes.

Cuando se presentaban enfermos en el Comité de Tumores de cabeza y cuello del hospital donde yo trabajaba y se hablaba de la edad como factor con intenciones excluyentes de terapeúticas, yo no lo aceptaba. La edad no es un parámetro que deba prevalecer, bajo ningún concepto, sobre la suma del conjunto del enfermo.

Dr. F. Hernández Altemir

Profesor Colaborador Extraordinario de la Universidad de Zaragoza ©REMI, http://remi.uninet.edu. Enero 2008.

# Comentario de Ricardo Abizanda Campos

Sr. Director:

He leído con atención, y sorpresa, el artículo firmado por E. Molina y M.A. Sánchez (REMI artículo especial 80) sobre la conveniencia o no de establecer límites de edad en la asistencia sanitaria al anciano.

El interés nace de que este es un tema que me preocupa. Algo he trabajado sobre ello y siempre espero que alguien me sorprenda con alguna consideración que para mí sea nueva.

La sorpresa es porque esta vez me han sorprendido por donde no esperaba. Los indios se esconden detrás del árbol en el que no te fijas. Pero, ¿de verdad los autores son conscientes de lo que dicen? ¿es posible que en alguna UCI se establezcan criterios de indicación de ingreso, de limitación de esfuerzo asistencial o de restricciones de prestaciones, basadas sólo en la edad? Si la respuesta es afirmativa que me digan en cuál. No existe evidencia documental de semejante hecho, al menos que yo conozca. Repito, limitación sólo basada y justificada por criterios ageistas. Esa sería una actitud rayante en el nazismo. ¿Tienes mas de ... 60, 70, 80, 90 años? Pues lo siento, NO TE TOCA (como en el chiste: Ah ¡Haber pedido muerte!).

Los autores en su exposición se centran exclusivamente en criterios de teoría ética (de eso creo que también sé un poco), y no en la práctica asistencial adecuada. ETHICUS y el estudio multicéntrico español que lideró Andrés Esteban dejaron muy claro que la edad no era un elemento decisorio a la hora de plantear la limitación del esfuerzo asistencial (LET). Sí lo eran, en cambio, el mayor bien para el paciente (BENEFICENCIA) al evitar un encarnizamiento inútil, la falta de respuesta al tratamiento (NO MALEFICENCIA Y JUSTICIA), y el respeto a las directrices previas, cuando existían (AUTONOMÍA), que por desgracia son las menos ocasiones.

Pues si la evidencia documental dice una cosa, y no dice la otra, ¿para qué levantar fantasmas?

Tampoco los autores hacen consideración de la estimación de la calidad

de vida por parte de los equipos asistenciales por proyección de los propios valores frente a los del paciente. Y ese me parece un asunto mucho más frecuente y mucho menos tratado.

Tampoco se considera el empobrecimiento de la reserva fisiológica (comorbilidades cada vez más frecuentes y crecientes en relación al incremento de edad) de los pacientes de edad avanzada, lo que los hace más susceptibles al fracaso de las medidas terapéuticas.

A mi me parece un grave error de estrategia plantear la cuestión de la LET como una actitud ageista. No hay que olvidar que REMI se dirige, primordialmente, a un colectivo profesional, que intenta encontrar en sus artículos (originales o comentados) una guía para la propia actuación, y de pronto se les dice que no deben ni debieran hacer aquéllo que no hacen. Pues sí que estamos al cabo de la calle.

Si lo que pretenden los autores es, exclusivamente, impartir docencia, quizás debieran manifestarlo desde el principio, y no provocar confusión en los que puedan buscar una recomendación o una orientación. La LET es un tema vivo, y lo que precisa es clarificación y no confusión, innecesariamente justificada por otro lado. Me recuerda, salvando las distancias, la actitud de determinadas confesiones religiosas: "esto es pecado"; vale, pero ¿qué es lo que no es pecado? Catecismos y similares ya nos inculcaron muchos en nuestra infancia, nada más falta que ahora aparezcan otros maximalismos, aunque se disfracen de actitudes éticas.

Ricardo Abizanda Campos Hospital General de Castelló ©REMI, http://remi.uninet.edu. Enero 2008.

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