THE TRANSZYGOMATIC TRANSMANDIBULAR APPROACH TO INFRATEMPORAL FOSSA.

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INTRODUCTION

The infratemporal fossa is a deep quadrangular space located at the inferior aspect of the middle cranial fossa. Numerous surgical approaches have been described to gain access to benign and malignant pathology of this anatomical area. Honeybul et al [1, 2] described in detail the Transzygomatic approach to infratemporal fossa, and the Transmandibular component was devised by Donovan et al [3] to provide complete exposure of lower parts of the infratemporal space, in addition to the access provided by the transzygomatic route.

The infratemporal space may be afflicted by a variety of tumours, that may be benign or malignant. [4] Such tumours may originate extracranially from the soft tissues or intracranially from the dura or calvarial bone. The extracranial tumours that extend towards intracranial compartment include schwannoma, usually of the trigeminal nerve; parotid tumours, both benign and malignant, especially from the deep lobe; and squamous cell carcinoma arising from nasopharynx, paranasal sinuses and temporal bone. The intracranial neoplasms that extend extracranially, may be enlisted as chordoma, chondroma, chondrosarcoma and meningioma.

The infratemporal fossa is a retromaxillary space corresponding to the inferior aspect of middle cranial fossa. The anatomical limits of this area are represented anteriorly by the maxillary tuberosity and maxillary sinus, above by the greater wing of the sphenoid bone and a part of the plate of temporal bone, medially by the lateral pterygoid plate and lateral wall of pharynx, and below by a horizontal plane passing through the inferior border of angle of mandible.

The Preauricular Transzygomatic Transmandibular Approach to the infratemporal fossa increases visualization of critical anatomical structures, minimizes brain retraction and results in improved resection and outcome. Reconstruction is rapid and there are minimal functional or cosmetic deficits. The following discussion will provide a detailed description of the surgical technique [3, 4] under the following headings:

A) Patient preparation
B) Incision and superficial dissection
C) Exposure of internal carotid artery and internal jugular vein
D) Elevation of Temporalis muscle
E) Osteotomy of zygomatic bone
F) Osteotomy of mandible
G) Exposure of subtemporal trapezoid
H) Extended approach with infratemporal craniotomy
I) Reconstruction and closure

A) Patient Preparation

As in preparation of patients for skull base surgery, a tracheostomy is done followed by placement of lumbar subarachnoid drain. [5] Temporary tarsorrhaphy is done to appose the eyelids. Unless fixation pins are required by the neurosurgeon, a Mayfield headrest is used for ease of surgical access. Central venous pressure and arterial lines are placed. If any cranial nerve monitoring devices are required, they are inserted at this time. The abdomen is prepared if rectus abdominis free flap is to be used. Both the legs are scrubbed for possible harvest of split thickness skin graft, fascia lata, or saphenous vein grafts.

B) Incision and Superficial Dissection

The incision extends in a curvilinear fashion from the vertex of the skull to the preauricular crease in front of the ear, and under the lobule of the ear, then curves
The scalp incision extends oroly to an imaginary plane. A temporalis fascia incision in a plane parallel to the superficial temporal branch of the facial nerve, which merges approximately 1.5 cm. in front of the auricle and arches into the frontalis muscle about 2 to 2.5 cm. above the eyebrow. The nerve is thus protected from injury. The cervicofacial part of the incision proceeds superficially to the platysma and superficial muscular aponeurotic system (SMAS) fascia, in a plane similar to the one utilized in superficial plane face lift. This is carried forward anteriorly to an imaginary plane, extending from the angle of mandible to lateral orbital rim.

C) Exposure of Internal Carotid Artery and Internal Jugular Vein
In lower part of the dissection extending through the neck, the internal carotid artery and internal jugular vein are identified and dissected superiorly as close as possible to the skull base foramina through which they pass. Care must be taken to avoid damage to cranial nerves IX to XII during the dissection.

D) Elevation of Temporalis Muscle
The temporalis muscle is exposed throughout its insertion over the temporal fossa. In more than half of the cases, temporalis muscle serves as the major reconstructive flap that separates the middle cranial fossa from the upper aerodigestive tract. Thus, it is essential to maintain the viability of the muscle. This requires an understanding of its blood supply. The superior blood supply from the superficial temporal artery and branches of postauricular artery is unavoidably eliminated during the elevation of muscle. Hence the integrity of inferior blood supply through the deep temporal branches must be maintained. The deep temporal branches arise from the internal maxillary artery. The posterior artery emerges from the internal maxillary artery just anterior of the latter’s emergence from under the neck of the mandible. The anterior deep temporal branch exits the internal maxillary artery just before the latter disappears into the pterygomaxillary fissure. In order to achieve haemostasis of the bleeding that occurs from the pterygoid plexus of veins, indiscriminate cautery employed to control bleeding in this area, may compromise the anterior deep temporal artery. Henceforth, the use of bipolar cautery is advised. The temporalis muscle is elevated entirely with a 2 cm. cuff of pericranium, along the calvarium from superior to inferior, as the muscle curves from a vertical to an oblique plane.

The inferior reflection of the temporalis muscle, rather than sectioning it below at coronoid process, preserves the blood supply of this muscle.[5] Also, the muscle is preserved for postoperative reconstruction using the temporalis flap.[4]

E) Osteotomy of The Zygomatic Bone
To achieve exposure of the depths of infratemporal fossa, the zygomatic arch, including a part of the body and the orbital process, is removed in one piece (Fig. 2). An incision is made in the periosteum, followed by subperiosteal elevation, from just in front of the articular process to the posterior part of the malar eminence, superiorly around the lateral orbital rim and immediately adjacent lateral orbital wall. Care is taken to preserve periorbita without perforation. It is protected with a malleable retractor during subsequent drilling. Drill holes are placed in the zygomatic arch and the lateral orbital rim in anticipation of placing miniplates for later reconstruction. A fine blade power saw or high speed drill is used to cut across the posterior arch, just anterior to the articular eminence. A sagittal saw or high speed drill then cuts across the lateral orbital rim above the zygomaticofrontal suture. This is carried about 2-4 mm. deep, until the thin lateral orbital wall is encountered. This cut is extended down the lateral orbital wall, just inside the rim, until the inferior orbital fissure is reached, the final cut passes through the posterior portion of the zygomatic body, carried from the beginning of malar eminence, to the inferior orbital fissure. The bone is now reflected inferiorly, over the pedicle of masseter muscle attached to the zygomatic arch.1,2

F) Osteotomy of The Mandible3,4,6
An incision is made at the angle of mandible, up to the bone, so as to divide the pterygomasseteric sling. The masseter muscle and medial pterygoid muscle are elevated from the posterior half of the mandible. The facial nerve lies well protected in the soft tissue flap superficial to masseter muscle. Before making the bone cuts, miniplates are bent into appropriate shape and preregistered with drill holes. The osteotomy of the mandible is designed to preserve the integrity of the temporomandibular joint, while providing adequate access. Two bone cuts are made in the ramus of mandible (Fig. 2). The first bone cut is made starting from the posterior part of sigmoid notch, just anteroinferior to the attachment of lateral pterygoid muscle, extending downwards and backwards towards the posterior border of the ramus. A retractor must be placed medial to the neck of condyle to protect the internal maxillary artery. The second bone cut is made corresponding to a vertical ramus osteotomy.3,6 It extends from the sigmoid notch to inferior border of mandibular ramus, just posterior to the mandibular foramen. The mandibular foramen lies on the medial surface of the ramus of mandible, about 10 mm. anterior to posterior border of ramus.7 It provides passage to the inferior alveolar neurovascular bundle. Hence, the cut should be placed about 6-8 mm. from the posterior border of the ramus, or as per the clinical position of foramen found at surgery.7 Thenceforth, the stylomandibular ligament is detached from the medial surface of mandible.
In cases that require a radical neck dissection for tumours arising from deep lobe of parotid, both superficial and deep lobes of parotid gland are removed. The facial nerve is carefully dissected and the continuity of the nerve is preserved. If the nerve is found to be invaded by cancer, the involved portion of the nerve is resected. At the end of the surgery, it will be replaced by a nerve graft or hypoglossal-facial anastomosis.

G) Exposure of Subtemporal Trapezoid
The surgical anatomy of infratemporal fossa is described in Figure 3. The inferior reflection of temporalis muscle leads to identification of deep temporal branches of internal maxillary artery, entering the medial surface of the muscle. The internal maxillary artery lies medial to the neck of mandibular condyle. As the dissection continues inferomedially, an exposure of undersurface of sphenoid and temporal bones is achieved. The sphenoid spine can be identified at the anteromedial aspect of glenoid fossa. Deep and medial to the spine, is the middle meningeal artery. A few millimeters anterior to it is the foramen ovale and emergence of mandibular nerve. Subperiosteal dissection from the lateral orbital wall inferiorly, leads to the origin of pterygoid plates, the superior surfaces of the pterygoid muscles, and the pterygoid venous plexus. Next, it is pertinent to describe the anatomic boundaries of the subtemporal trapezoid\(^4\) (Fig. 4). If a line connects the articular eminence to the hamulus of medial pterygoid plate, from this point to the occipital condyle and from thence to the mastoid process and back to the eminence, a trapezoid is inscribed. All the important neurovascular structures relevant to the middle fossa skull base are contained within the confines of this trapezoid. The two target structures for the inferomedial extent of craniotomy, namely the foramen spinosum and foramen ovale, are seen as a direct line is made anteriorly from the anteromedial extremity of glenoid fossa.

H) Extended Approach with Infratemporal Craniotomy
The extended approach with infratemporal craniotomy requires the detachment of mandibular condyle from glenoid fossa. As such, only the vertical ramus osteotomy is done, without separating the condyle from the mandibular ramus. Care is taken to preserve the attachment of lateral pterygoid muscle to the condylar neck, in order to maintain the vascular supply and improve the functional outcome. The temporomandibular joint (TMJ) disc is resected, retaining a small rim of the disc anteriorly and medially, so as to facilitate reconstruction with a free galeal graft, which is placed as a hood over the condyle to obtain optimal soft tissue coverage of the condyle in both rotational and translational movements. The TMJ disc is removed because the osteotomy of the glenoid fossa and its posterior surface requires reflection of posterior soft tissue attachments of the disc. Burr holes are placed, followed by a frontotemporal craniotomy (Fig. 5) with the help of high speed craniotome, which provides lateral access to the intracranial extension of the lesion. Anteriorly, the osteotomy extends posterior to orbit, medially to the plane of foramen ovale and foramen spinosum, and posteriorly to the posterior aspect of glenoid fossa.

I) Reconstruction and Closure
Following complete resection of tumour, dural closure is done. All the bone flaps that have been removed by osteotomy are fixed back by using plates and screws for osteosynthesis. Prior to repositioning the infratemporal bone flap containing the glenoid fossa, the autologous galeal graft is sutured to the remnants of the resected disc and bilaminar tissue of the TMJ as a disc replacement. The infratemporal bone flap and zygomatic arch are then stabilized using standard osteosynthesis techniques. The mandibular segment is reapproximated and seated in the glenoid fossa on the inferior surface of the galeal graft. The mandible is stabilized by the application of bone plates. The temporalis fascia is reattached to the zygomatic arch to restore the facial contour. The galea, scalp and skin are closed in the standard fashion.

Legends for figures

Fig. 1: Skin incision and superficial dissection.

Fig. 2: Osteotomies of the zygomatic bone and mandible.
CONCLUSION

The transzygomatic transmandibular approach provides excellent wide exposure of the infratemporal fossa. The transzygomatic route provides surgical access to superior part of infratemporal fossa, while the transmandibular osteotomy provides access to the lower half of infratemporal space. The temporomandibular joint is preserved in cases where craniotomy is not required. The vertical ramus osteotomy provides wide exposure to the inferior half of infratemporal fossa, so that this approach is suited to resection of all kinds of tumours involving the infratemporal space. The extended approach involving the craniotomy provides access to tumours involving both the extracranial and intracranial compartments.

CONFLICT OF INTERESTS

The author declares that there is no conflict of interests that could influence this work.

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