A surgical technique to avoid postoperative enophthalmos in the cranioorbital approach

Technical note

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The authors describe a surgical technique to avoid postoperative enophthalmos when using the cranioorbital approach. To perform osteotomies with a less demanding technique, two separate bone flaps were created: 1) a free frontotemporal bone flap and 2) en bloc removal of the superior and lateral orbital rims. Because the latter bone flap includes both the orbital roof and the posterolateral wall of the orbit with the greater wing of the sphenoid bone, unnecessary bone defects in the lateral orbital wall are avoided. The technique has been performed in seven patients treated for medially located skull base neoplasms or complex anterior circulation aneurysms without postoperative enophthalmos or other cosmetic problems. The authors believe this cranioorbital approach, with its simpler, less invasive surgical technique, offers a definite advantage by avoiding postoperative enophthalmos.

Key Words • operative complication • enophthalmos • cranioorbital approach • surgical approach

Description of Surgical Technique

The patient is placed supine, with head secured in a three-pin headholder turned 45° toward the contralateral side, with elevation and extension. A curvilinear scalp incision behind the hairline is extended from the inferior end of the base of the earlobe to the midpoint between the midline and the contralateral superior temporal line. It is safe to make the incision along the anterior margin of the ear cartilage without injuring the temporal and zygomatic rami of the facial nerve. The scalp flap, including the frontal peristeum, is reflected anteriorly with the superficial temporal fascia and the temporal fat pad, which are separated from the temporal muscle. The temporal muscle is incised in front of the scalp incision from the level of the zygoma to the superior temporal line leaving a 2-cm cuff of the temporal muscle on the bone above the incision and then dissected free from the temporal bone. The supraorbital nerve is preserved by freeing it from the supraorbital notch or foramen, which is opened with a chisel. While maintaining continuity of the pericranium and the periorbital fascia, the periorbital fascia is dissected off the superior and lateral walls of the orbit to the superior orbital fissure and lateral aspect of the inferior orbital fissure.
Avoidance of postoperative enophthalmos

Fig. 1. Illustrations showing the cranioorbital approach. Burr holes and osteotomy incisions are shown on (A) outer aspect and (B) inner aspect. Note that the key hole is made on the major wing of the sphenoid bone approximately 2.5 cm inferior to the pterion, which becomes the station connecting the osteotomies on the lateral and the posterolateral walls of the orbit.

Five burr holes are made (Fig. 1). The key hole is opened on the major wing of the sphenoid bone approximately 2.5 cm inferior to the pterion, while retracting the dissected temporal muscle inferoposteriorly. If necessary, the zygomatic arch can be detached to reflect laterally without dissecting the masseter muscle. The frontal hole 2 cm above the upper margin of the orbit and 2 cm lateral to the midline and the temporal hole just above the pedicle of the zygomatic process are made. After removing a free frontotemporal bone flap, the frontal dura is reflected off the orbital roof. By using a sagittal saw, the superior orbital rim is cut vertically down to the orbital roof, and this may open the frontal sinus with a considerable mucosal injury. The posterior part of the orbital roof is chiseled down to the lateral end of the superior orbital fissure. Another osteotomy is made on the base of the frontal process of the zygoma (inferolateral corner of the lateral orbital rim), which is extended over the lateral wall of the orbit and down to the key hole while protecting the eyeball with a tapered spatula. The last osteotomy is made by a chisel on the temporal aspect of the greater wing of the sphenoid bone, consisting of the posterolateral orbital wall, to connect the key hole with the superior orbital fissure.

The techniques described above allow en bloc removal of the second bone flap without resulting bone defects on the superior and lateral orbital walls (Fig. 2). Thus, it is unnecessary to reconstruct the orbital walls in the closing procedure. The lesser wing of the sphenoid and the anterior clinoid process can be removed with rongeurs and/or a high-speed drill. This is done under the operative microscope because great care must be taken not to injure the subclinoid portion of the internal carotid artery located inferomedially to the anterior clinoid process. A small incision on the lateral end of the dura of the superior orbital fissure allows the surgeon to obtain a wider working space. The optic canal is opened with a small rongeur in cases in which the optic nerve is to be mobilized or when the orbital apex is involved with tumor. The sphenoid sinus may be opened in this procedure.

At closure of the osteotomy, the opened frontal sinus is filled with a mixture of bone dust and fibrin glue after exenteration of the mucosa as much as possible to prevent cerebrospinal fluid rhinorrhea and infection. When the sphenoid sinus is opened, it is treated similarly, but an exenteration of the mucosa is frequently unnecessary because the mucosa is usually not injured in most patients. The bone flaps are fixed in position with titanium plates and screws, and the detached temporal muscle is resutured on the cuff left in the frontotemporal bone flap. A subcutaneous drain is placed, and the galea and the scalp are closed in standard fashion.

Results and Complications

Seven patients underwent surgical treatment via the technique described here. These included five patients with medially located skull base neoplasms and two with large carotid–ophthalmic aneurysms. Follow-up review ranged from 6 months to 1 year, and all patients had postoperative follow-up neuroimaging reviews. In all patients, a removal of the anterior clinoid process and unroofing of the optic canal were made. Detachment of the zygomatic arch was performed in one patient. Surgical results were judged excellent or good in all patients.

Immediate postoperative complications specifically related to this approach included upper facial weakness in one patient, eyelid ptosis in three, and ocular motor disturbance in one, but they were transient and disappeared by the end of the 3rd postoperative month. Although a mild concavity in the temporal fossa was found in most of the patients, it was not noticeable. No patient developed cerebrospinal fluid leak, wound infection, pulsating orbit, or enophthalmos.

Discussion

Postoperative Enophthalmos

Postoperative enophthalmos seems to be one of the most bothersome complications in the cranioorbital or orbitozygomatic approach. Although part of the orbital walls was more or less resected in most of the approaches reported previously,\textsuperscript{1,5–10,13,14,16–19,21} the incidence of postoperative enophthalmos has not been fully described.\textsuperscript{23} Sekhar et al.,\textsuperscript{18} removed the superior orbital rim with preservation of at least two thirds (2.5–3 cm) of the anteroposterior length of the orbital wall in their subfrontal and transorbital approach and experienced no complication of enophthalmos even after rongeuring away the remaining roof and lateral wall of the orbit. In a series by Maroon et al.,\textsuperscript{11} pulsating enophthalmos occasionally occurred for the first several days following radical resection of the sphenoorbital bone and then was no longer noticeable. Mickey et al.,\textsuperscript{22} reported that complete removal of the lateral wall of the orbit produced mild, if any, enophthalmos and no functional deficit. Fujitsu (K. Fujitsu, personal communication, 1995) stated that postoperative enophthalmos occurred in most patients in...
whom the posterolateral wall of the orbit had been resected, but removal of the lesser wing of the sphenoid bone and the anterior clinoid process caused no enophthalmos. Although the incidence of postoperative enophthalmos is variable, it seems to be important to preserve the lateral wall of the orbit to avoid this condition. Regardless of the incidence of postoperative enophthalmos, preservation of anatomical continuity in surgery appears to be a proper goal.

Surgical Technique

In our frontotemporal orbitozygomatico-alar approach reported elsewhere, en bloc removal of the superolateral orbital walls was accomplished without any resulting bone defects. Although we have not encountered postoperative enophthalmos in the patients in whom this approach was applied, this approach appeared to be technically more complex and somewhat invasive. Furthermore, it may have included excessive removal of the zygoma for medially located skull base tumors or complex cerebral aneurysms of the anterior circulation or the basilar quadri
cification. Thus, we have revised our frontotemporal orbitozygomatico-alar approach to lessen the extent of osteotomy, leading to less invasive surgery.

The approach described here is midway between the cranioorbito and orbitozygomatic approaches. We made a frontotemporal craniotomy first in the same manner as Sekhar, et al., or McDermott, et al. This technique appeared to be much easier than that of the “orbitocranial approach,” which involves the removal of the frontotemporal bone along with the orbital rim, because the removal of frontotemporal bone flap enabled us to use chisels and a sagittal saw with greater ease, allowing the osteotomy on the orbital roof and the temporal aspect of the greater wing of the sphenoid bone without bothersome lacerations on the periorbital fascia or the temporal dura.

The key point of our revised approach is to open a burr hole on the greater wing of the sphenoid bone approximately 2.5 cm inferior to the pterion. This enabled us to make an osteotomy on the lateral wall of the orbit from the inferolateral corner of the orbital rim to the key hole in a straight fashion. Because the osteotomies are made on the orbital roof and the temporal aspect of the greater wing of the sphenoid bone, similar to our previous approach, the superolateral orbital wall can be removed without any bone defects in the orbital wall. This removal provides a wide working space to resect the roof of the optic canal or the anterior clinoid process. We rarely used a high-speed drill to perform the procedure described above. A small dural incision on the superolateral corner of the superior orbital plate can be made to widen the working space because the superolateral corner includes no major neurovascular structures except the superior ophthalmic vein.

Although the small number of patients treated with our revised approach, as well as the short follow-up period, provide insufficient data to draw a conclusion, we nevertheless believe this approach offers a definite advantage in cranioorbit approach by avoiding postoperative complications and by offering a simpler, less invasive surgical technique, in addition to the advantages already provided by the other cranioorbito or orbitozygomatic approaches that improve the angle of the surgeon’s vision and the space available for working.

References

Avoidance of postoperative enophthalmos


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