Zygomatic approach for lesions in the interpeduncular cistern

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Lesions in the interpeduncular cistern include basilar tip aneurysms, craniopharyngiomas, and chordomas. The surgical approach to these lesions presents a special technical problem, particularly when they are located high in the interpeduncular fossa. For the purpose of minimizing brain retraction and achieving excellent exposure within the interpeduncular cistern, the authors have developed a new surgical technique which involves detachment of the zygomatic arch.

The patient is placed in the supine position with the head rotated 45° to the contralateral side and tilted down 30° so that the surgeon can see into the interpeduncular cistern obliquely from below. The zygomatic arch of the temporal bone as well as a portion of the lateral orbital rim (the posterior ridge of the frontal process of the zygomatic bone) is removed to expose the anterior temporal base. With posterior retraction of the temporal lobe, the arachnoid membranes covering the Sylvian stem are opened in a retrograde fashion until the tentorial edge is sufficiently exposed. The posterior communicating artery and the optic tract are elevated to enter the interpeduncular cistern, after which the oculomotor nerve is dissected free of its surrounding arachnoid membranes and displaced posteroinferiorly.

Two patients with basilar tip aneurysms were operated on with this zygomatic approach, and a subtemporal modification of the zygomatic approach was used to treat a craniopharyngioma and a chordoma in two other patients. The procedure is described and a short description of its clinical use is given.

KEY WORDS • zygomatic approach • basilar tip aneurysm • interpeduncular cistern • craniopharyngioma • chordoma • surgical approach

Within the intracranial space, the interpeduncular cistern is one of the most difficult regions to approach, even with the aid of the operating microscope. Among the lesions most frequently encountered in this cistern are basilar tip aneurysms, craniopharyngiomas with superoposterior extension, and chordomas. In an attempt to gain better exposure of the lesions in this cistern, neurosurgeons have used a variety of surgical approaches; however, the surrounding vital structures often obscure a view of the lesions, particularly when they are embedded high in the interpeduncular fossa.

We have developed a new surgical approach which involves detachment of the zygomatic arch and removal of the ridge of the lateral orbital rim (the posterior ridge of the frontal process of the zygomatic bone). This “zygomatic approach” provides a wide exposure of the anterior temporal lobe base, and allows an obliquely upward access to the interpeduncular cistern. The zygomatic approach uses the lowest possible supratentorial route, which permits excellent exposure of the lesions in the interpeduncular cistern.

Operative Technique

The patient is placed in the supine position with the head rotated 45° to the contralateral side and tilted down 30° to allow the surgeon to see into the interpeduncular cistern obliquely from below. In order to gain sufficient exposure of the zygomatic arch and the lateral orbital rim, a bicoronal scalp incision is made, beginning from just in front of the tragus over the inferior border of the zygomatic arch, extending upward and forward and then along the hairline to the contralateral side, and terminating at the uppermost level of the contralateral helix (Fig. 1 left).

The scalp flap, not including the pericranium, is reflected anteriorly, and another small incision is made frontotemporally through the pericranium and the temporal fascia. The incision into the temporal muscle is extended underneath the zygomatic arch just in front...
of the tuberculum articulare. The fascia covering the outer surface of the zygomatic arch is also incised vertically just in front of the tuberculum articulare and is pulled anteriorly in order to denude the zygomatic arch for a distance of about 1.5 cm. In this portion of the zygomatic arch, two small holes are drilled about 1 cm apart, to be used in approximating the cut bone edges at the end of the procedure. The zygomatic arch is then cut between these two holes with a craniotome. The temporal muscle, in continuity with the frontal pericranium, is detached from the skull and reflected inferiorly. At the superior as well as lateral orbital ridge, the continuity of the pericranium and the periorbita is maintained to facilitate the inferomedial displacement of the orbital contents. The supraorbital nerve can be saved by freeing it from the supraorbital canal.

In order to gain sufficient room behind the lateral orbital rim (fossa temporalis), the temporal muscle is detached along the anterior margin of the temporal fascia and retracted posteroinferiorly (Fig. 1 right). The ridge of the lateral orbital rim (the posterior ridge of the frontal process of the zygomatic bone) is removed in a wedge-shaped fashion for the purpose of preventing this overhanging bone from obscuring the anterolateral view of the interpeduncular cistern. At the end of the procedure, this fragment of bone will be fixed back in position with Bioglue. The temporal process of the zygomatic bone is denuded of fascia, and the fascia is elevated and pulled downward. Two small holes are made in the anterosuperior portion of the temporal process in preparation for later approximation of the cut bone edges. Between these two holes, the temporal process of the zygoma is cut with a craniotome and a chisel (Fig. 1 right). Now the zygomatic arch is completely detached, and the temporal muscle may be retracted downward giving an extensive exposure of the anterior temporal base.

Four burr holes are drilled (Fig. 2 right): the first in the lateral frontal bone just behind the zygomatic process; the second in the parietal bone about 5 cm above the zygomatic pedicle of the temporal bone; the third in the temporal bone just above the pedicle of the zygomatic process; and the fourth in the anteroinferior portion of the major wing of the sphenoid bone, below the sphenoid ridge, and over the tip of the temporal lobe. The four burr holes are then connected by means of a craniotome, except that a rongeur is used between the first and fourth burr holes in order to facilitate fracture of the bone at this portion. A free bone flap is fashioned by frontotemporobasal craniotomy and is elevated, with the frontal exposure being smaller and limited to below the level of the superior temporal line. This craniotomy also permits extensive removal of the sphenoid ridge, so that the lateral end of the superior orbital fissure is often reached (Fig. 2 left). The dura is incised in a semicircular fashion, from the anterosuperior to the anteroinferior burr hole, and the dural flap is reflected and pulled over the rest of the sphenoid ridge. In the remaining dura, supplementary incisions are made toward the posteroinferior and posterosuperior burr holes (Fig. 2 left).

The bridging veins coming off the tip of the temporal lobe are divided to mobilize the temporal lobe, and the remainder of the procedure is conducted with the aid of the operating microscope (Fig. 2 right). With minimal elevation of the frontal lobe, and with posterior retraction of the temporal lobe, the arachnoid membranes covering the basal aspect of the Sylvian stern are opened in a retrograde fashion until the tentorial edge is sufficiently exposed. The posterior communicating artery and the optic tract are elevated with a malleable tip spatula, and the lateral leaf of the Liliequist membrane is opened to enter the interpeduncular cistern. The oculomotor nerve is dissected free of its surrounding arachnoid membranes and gently displaced posteroinferiorly with a piece of cotton pledge. Normally, an anterolateral view of the interpeduncular fossa, bilateral peduncles, and posterior third ventricular floor is now obtained obliquely from below (Fig. 2 right). In instances where a more anterior or more lateral view is required, the operating table may be tilted or the microscope may be swung. During closure of the craniotomy, the detached zygomatic arch is fixed in position with nylon ligatures, and the wedge-shaped fragment of the lateral orbital rim is replaced using Bioglue.

**Summary of Cases**

The first patient was a 59-year-old woman with a ruptured aneurysm of the basilar tip which was located...
FIG. 2. Left: Four burr holes are drilled and the free bone-flap craniotomy is elevated. This craniotomy also permits extensive removal of the sphenoid wing (dotted line), so that the lateral end of the superior orbital fissure may be reached. The dural opening is also indicated (solid line). Right: The bridging veins coming off the tip of the temporal lobe are divided, and the temporal lobe is retracted. The posterior communicating artery and the optic tract are elevated to provide entry to the interpeduncular cistern. Access to the basilar tip, bilateral cerebral peduncles, and the floor of the posterior third ventricle is provided in an oblique upward direction.

high in the interpeduncular fossa (Fig. 3). A right zygomatic approach was used in this case. Both the zygomatic arch and the entire lateral orbital rim were detached, and the lateral orbital wall was removed in order to compress the orbital contents inferomedially. In another case of basilar tip aneurysm the zygomatic approach was used with removal of the ridge of the lateral orbital rim.

The zygomatic approach was used in two tumor patients. One was a 7-year-old girl with an intrasellar chordoma (Fig. 4). She underwent two separate procedures, both involving a subtemporal modification of the zygomatic approach, to attack the tumor from each side. Each time the “Parkinson’s triangle” was entered, but control of bleeding was not difficult, presumably because the greater portion of the cavernous sinus had been obliterated by long-standing compression. The second patient had a craniopharyngioma, and was operated on with a subtemporal modification of the zygomatic approach.

Fig. 3. Preoperative vertebral angiogram showing an aneurysm at the distal bifurcation of the basilar artery. The basilar tip is rather high-placed in this case.

Fig. 4. Preoperative computerized tomography scan showing a huge intrasellar chordoma encroaching upon the interpeduncular cistern and distorting the upper pons.
Zygomatic approach for interpeduncular cistern lesions

In all four cases, the zygomatic approach and its modification provided excellent exposure and satisfactory results.

Discussion

Surgical treatment of basilar tip aneurysms can be one of the most difficult surgical procedures, particularly when the basilar tip is located high in the interpeduncular fossa. Several approaches have been used in an attempt to achieve sufficient exposure of the interpeduncular cistern, including subtemporal,1-4,10-12 and temporopolar6,8 approaches. A classical subtemporal approach usually requires deep retraction of the temporal lobe, whereas a pterional approach allows only limited exposure. Sano5 modified the pterional approach by retracting the temporal tip and gaining wider exposure. In order to gain sufficient exposure of high-placed basilar tip aneurysms, however, the surgical approach needs to be in the direction in which the surgeon can see the interpeduncular fossa from below.

In view of the direction of approach, an interclival or transsphenoidal procedure theoretically might be the best technique, but would be technically complex when used for basilar tip aneurysm surgery. The transclival approach7,9 can be employed only in cases where the aneurysm is located on the lower clivus.

Detachment of the zygomatic arch and removal of the ridge of the lateral orbital rim provides extensive exposure of the anterior temporal lobe base. This zygomatic approach permits obliquely upward access to the interpeduncular fossa using the lowest possible supratentorial route without involving much technical complexity. Earlier in our series, we removed the entire rim of the lateral orbit and compressed the orbital contents medially. Later, however, we found that entire removal was not necessary and that removal of a wedge-shaped fragment from the ridge of the lateral orbital rim was sufficient to expose the anterior temporal lobe base.

In approaching basilar tip aneurysms, the temporal lobe is retracted backward and the interpeduncular cistern is approached via the anterolateral route obliquely from below. A more lateral approach may be required in patients with a craniopharyngioma or choroid involving anteroposterior extension; in these cases, manipulation under the optic chiasm is usually needed. In such cases, a subtemporal modification of the zygomatic approach may be employed. Detachment of the zygomatic arch greatly facilitates downward displacement of the temporal muscle, allowing wide exposure of the temporal base; this approach minimizes temporal lobe retraction. For extensive exposure of the zygomatic arch, a bicoronal skin incision is used, but care should be taken not to injure the frontalis and orbicularis branches of the ipsilateral facial nerve. To preserve these branches of the facial nerve, subperiosteal dissection of the zygomatic arch and the orbital rim should be confined to where the bone is cut (Fig. 1).

The principal advantage of the zygomatic approach is that the surgeon is able to view the interpeduncular fossa, both cerebral peduncles, and the posterior third ventricular floor with an exposure wide enough to permit safe manipulation. Our experience with this approach is still limited, but we are encouraged by our excellent results. We consider it to be the approach of choice for lesions in the interpeduncular cistern, especially when they are located high in the interpeduncular fossa.

References


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