J Neurosurg 80:575–579, 1994

Basal interfalcine approach through a frontal sinusotomy with vein and nerve preservation

Technical note

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The authors describe a new method for a frontal interhemispheric approach when treating craniopharyngiomas of the third ventricle or anterior communicating artery aneurysms. This technique ensures preservation of the bridging veins and the olfactory nerves. This "basal interfalcine approach" involves a craniotomy in the centrobasal portion of the frontal bone (the frontal sinus), removal of the inner tables and the crista galli, and splitting the basal portion of the falx into two leaves, through which the basal interhemispheric fissure is opened. The olfactory nerves are protected by the leaves of the falx, and the bridging veins are preserved because the approach is low enough to spare them. The surgical techniques are described together with a unilateral variation of this approach. The significance of preserving the bridging veins is discussed in connection with avoidance of postoperative contusional hemorrhage.

KEY WORDS · **craniopharyngioma** · **third ventricle** · **interhemispheric approach** · **bridging vein** · **olfactory nerve** · **cranial base** · **surgical technique**

A NEW surgical technique used in the management of craniopharyngiomas of the third ventricle and anterior communicating artery aneurysms is described. In an approach through the frontal interhemispheric fissure, dividing the bridging veins associated with prolonged retraction often causes contusional hemorrhage in the frontal lobe.[6,9] The "basal interfalcine approach" avoids this complication because bridging veins are not found near the frontal base.[8] The lower the approach is, however, the more the chance of damaging the olfactory nerves. This simplified basal interhemispheric approach ensures that the bridging veins and the olfactory nerves are preserved.

Surgical Approach

A coronal incision is made behind the hairline, extending on both sides to the upper level of the ear. Subperiosteal dissection is carried out over the frontal bone, and the deep temporal fascia is exposed beyond the linea temporalis. The frontal bone is exposed down to the nasion, and the floor of the supraorbital canal is chiseled bilaterally to preserve the supraorbital nerves on the scalp flap. The periorbita is detached bilaterally from the superior margin of the orbital bone. A craniotomy is performed in the centrobasal portion of the frontal bone, involving the frontal sinus and incorporating the external table of the supraorbital bar. Four paramedian burr holes are made, the upper pair 5 cm above the nasion and the lower pair just above and lateral to the glabella (Fig. 1 *left*). The frontal sinus is entered via the lower pair of burr holes and, through these holes, the mucous membranes are pushed downward to expose the inner tables of the sinus. An air drill is inserted through the lower burr holes, the midline crista is drilled off, and the inner tables are drilled across the midline. The outer table between the lower holes is not cut, but serves as the bridge between the upper and lower portions of the osteotomy flap (Fig. 1 *left* and *lower right*). The upper two holes are connected using an air drill and craniotome (Fig. 1 *upper right*). A trapezoid osteotomy (upper osteotomy) is carried out by means of a craniotome just above the supraorbital bar; the basal line of this trapezoid osteotomy involves both tables of the frontal sinus, although not the bridging external table between the lower holes.

An oscillating bone saw is used for an additional osteotomy (lower osteotomy) involving the central portion of the supraorbital bar. This lower osteotomy involves only the external table of the lower portion of the frontal sinus. Thus, the craniotomy bone flap incorporates almost the entire frontal sinus, leaving only the lower portions of the inner tables (Fig. 2 *left*). When the frontal sinus is not well pneumatized along

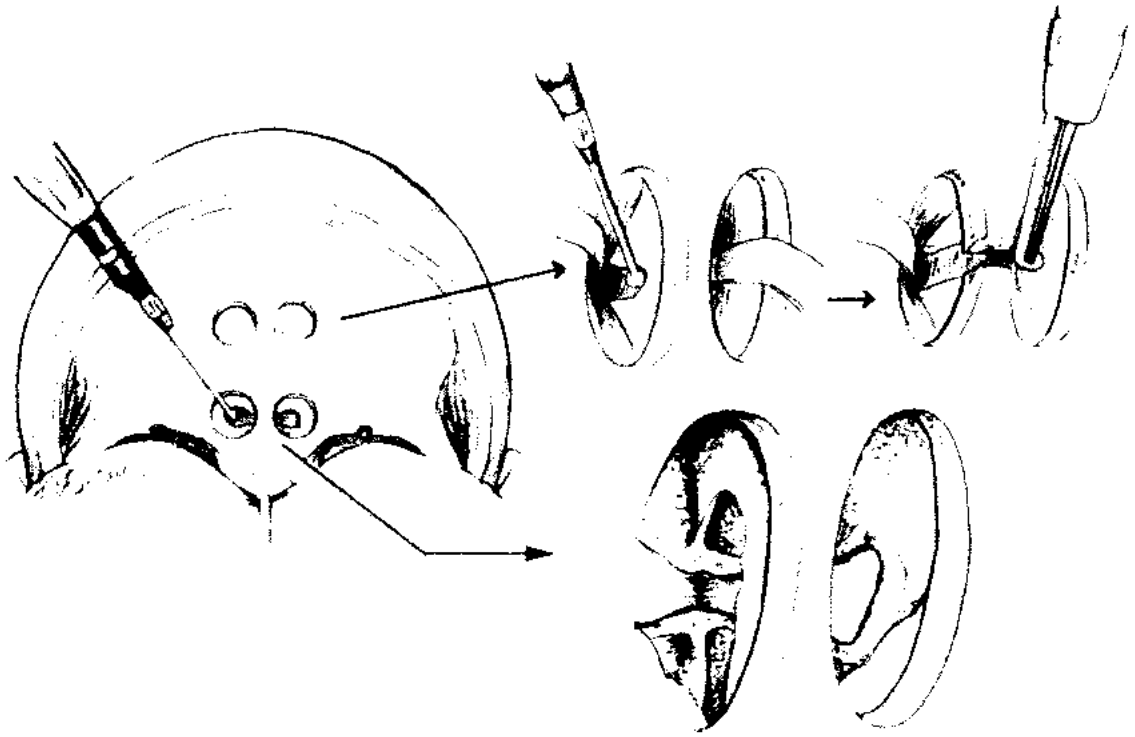

FIG. 1. Drawings of the first stage of the basal interfalcine approach. Four paramedian burr holes are made, and the external table of the frontal sinus *(striped area)* is drilled through the lower pair of holes. An air drill is inserted through the lower holes, the midline crista of the frontal sinus is drilled off, and the inner tables are drilled across the midline (*left* and *lower right*). The upper burr holes are connected by an air drill and osteotome *(upper right)*.

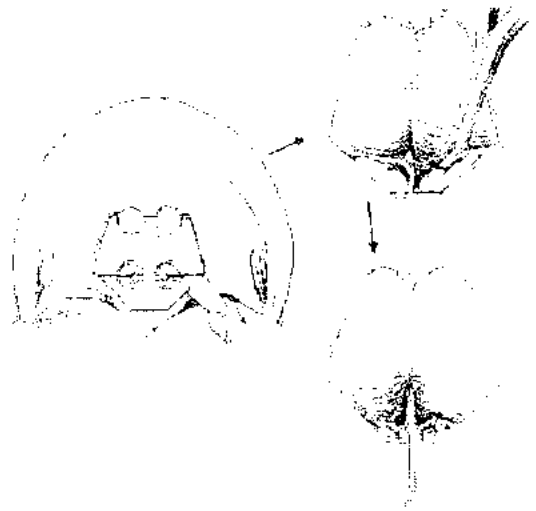

FIG. 2. Drawing of the next step. *Left:* A lower osteotomy involving the central portion of the supraorbital bar is made using an oscillating bone saw. The external table between the lower holes is not cut and serves as the bridge between the upper and lower osteotomy flap. *Right:* The crista galli and inner tables of the frontal sinus are removed with rongeurs and an air drill.

the supraorbital bar, incorporation of the external tables in the craniotomy bone flap is difficult. In such cases the craniotomy bone flap is first elevated above the supraorbital bar; then an oscillating bone saw is used to split the external tables from the supraorbital bar. The mucous membranes are removed from the craniotomy bone flap and from the rest of the frontal sinus. The bone flap is rinsed in an antibiotic solution and preserved for osteoplastic closure of the craniotomy. The frontonasal ducts are sutured, packed with pieces of muscle, and covered by fibrin glue. The operative field is then washed with antibiotic solution, and the surgeons change their gloves. All instruments that have any chance of contamination are also replaced.

The crista galli and the inner tables of the frontal sinus are removed by means of rongeurs and an air drill (Fig. 2 *right*). In the space created by removal of the crista galli, the basal portion of the falx is split into two leaves with a dissector. Usually, splitting the falx up to 2 cm above the cranial base is not difficult. Above this level, the falx often splits into thin leaves with multiple tears and holes.

The basal leaves of the falx protect the olfactory nerves bilaterally. A midline dural opening is made near the free edge of the falx (Fig. 3). Venous bleeding, if any, from the sagittal sinus is easily controlled by packing oxidized cellulose into the sinus. Venous drainage into the sinus, however, is not disturbed because the

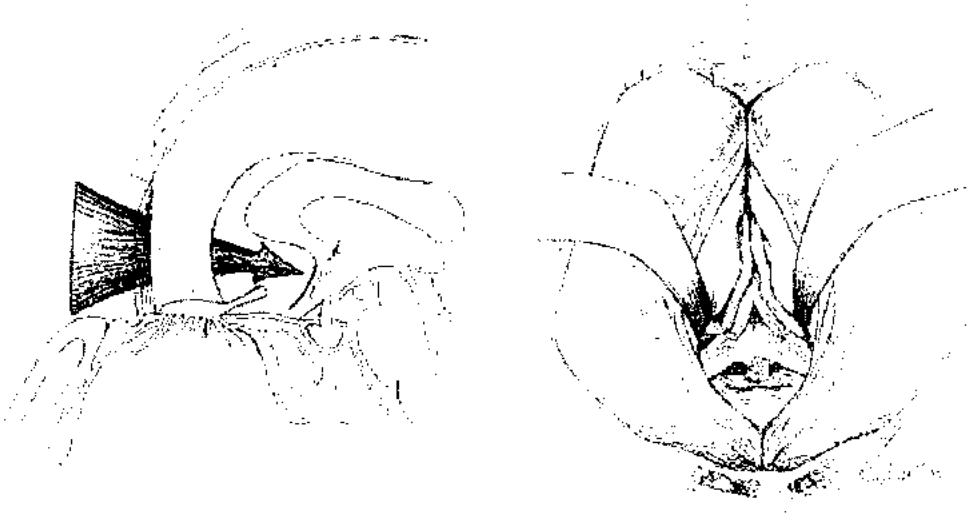

FIG. 3. *Left:* The basal portion of the falx is split into two leaves, which help to protect the olfactory nerves bilaterally. The bridging veins are not divided because the approach *(arrow)* is low enough to spare them. *Right:* Access to pathology in the anterior third ventricle.

craniotomy is low enough to spare the frontal bridging veins. The basal aspects of the interhemispheric fissure are opened and the optic chiasm, the lamina terminalis, and the anterior communicating artery complex are approached. When wider exposure is needed, supplementary dural opening is made across the midline and one or both of the falcine leaves are cut. However, this supplementary dural opening should be limited to within 1 cm on each side of the midline because too large a horizontal opening leads to excessive retraction of the frontal lobe and of both olfactory fila.

When there is a large tumor in the anterior portion of the third ventricle, dividing the anterior communicating artery helps to obtain sufficient room for manipulation (Fig. 3 *right*). Anatomical variation is quite common in the anterior communicating artery complex, however, and precise preoperative evaluation of the arteriograms and careful intraoperative inspection of all vessels originating from this complex are mandatory to avoid possible postoperative ischemic complications. When the anterior communicating artery is to be cut, the authors use 8–0 nylon ligatures to preserve all perforating vessels from this artery. After the intradural procedure is completed, the dura is easily closed along the superficial edge of the falx. For cosmetic purposes, all burr holes are filled with an acrylic button or with bone dust and fibrin glue.

If the lesion is small or located paramesially, a unilateral variation of this approach may be used. In such cases, contralateral osteotomy is limited such that the lateral borders of the contralateral upper and lower burr holes are connected in a straight line. The crista galli is also removed, but it is not always necessary to split the falx. The dural opening is made unilaterally. Removal of the crista galli makes the basal portion of the falx flexible and helps to provide sufficient room for an approach between the falx and the unilateral frontal lobe. An advantage of the unilateral variation is that the contralateral olfactory nerve can always be preserved without splitting the falx.

Summary of Cases

Two patients with craniopharyngioma of the third ventricle were operated on via the basal interfalcine approach. In both cases, the anterior communicating artery was cut after ligation with 8–0 nylon monofilament, and the lamina terminalis was opened to enter the third ventricle. The tumors were totally removed without injuring either the olfactory nerves or the frontal bridging veins; in both cases the patients returned to their former activities. Pre- and postoperative magnetic resonance images for one patient are presented in Fig. 4. Three cases of anterior communicating artery aneurysms pointing upward or backward were operated on either by the basal interfalcine approach or by its unilateral variation. In all cases early bilateral control of the proximal segment of the anterior cerebral artery was obtained without significant retraction of the frontal lobes. All patients returned to their previous activities with preserved olfactory nerve function. A postoperative angiogram is presented to show preservation of the frontal bridging veins (Fig. 5).

Discussion

Among the most common lesions that are operated on via the frontal interhemispheric approach are anterior communicating artery aneurysms and craniopharyngiomas of the third ventricle. Anterior communicating artery aneurysms projecting upward and

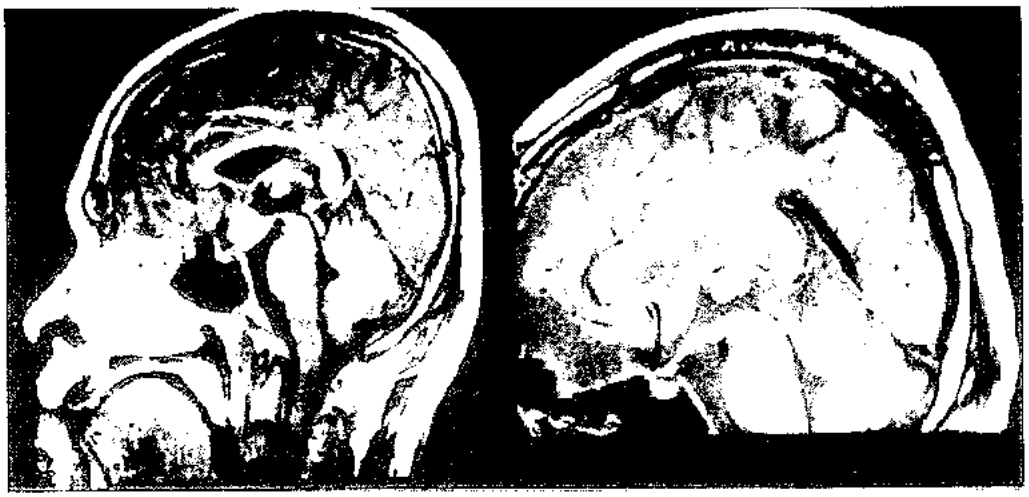

FIG. 4. Preoperative *(left)* and postoperative *(right)* magnetic resonance images in a patient with craniopharyngioma of the third ventricle operated on via the basal interfalcine approach.

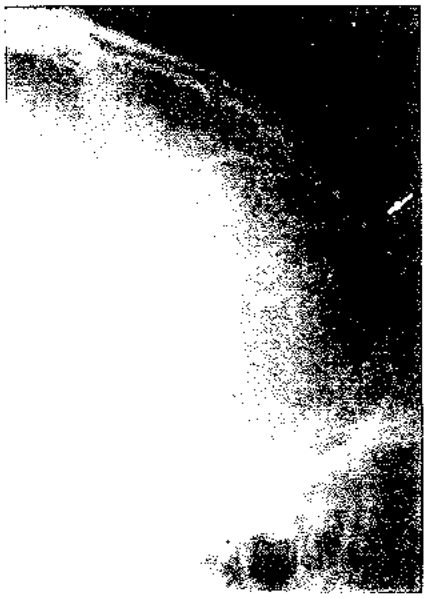

FIG. 5. Postoperative angiogram of a patient treated for anterior communicating artery aneurysm. Preservation of the frontal bridging veins *(arrow)* is demonstrated in the venous phase. Note also the oblique upward direction of the aneurysm clip.

backward can be operated on by the interhemispheric approach with less retraction than by the pterional approach.

Various approaches are proposed for suprasellar craniopharyngiomas (the pterional approach,[10] the interhemispheric translamina terminalis approach,[6,10] and the transsphenoidal approach[1,7]) and for cranial-base surgery (including the transpetrosal approach,[5] the orbitozygomatic approach,[2,3] and the cranionasal median splitting approach[4]). For craniopharyngiomas of the third ventricle, however, the interhemispheric translamina terminalis approach appears to be the most rational technique. When the frontal craniotomy is placed high to avoid entering the frontal sinus, the interhemispheric approach is apt to injure the fornices. Moreover, the conventional high frontal interhemispheric approach often requires division of bridging veins that connect the medial superior aspects of the frontal lobe and the superior sagittal sinus. Division of these veins, when combined with prolonged retraction of the frontal lobe, increases the risk of postoperative contusional hemorrhage.[6,9]

The basal interhemispheric approach[11] with frontal base craniotomy is less likely to require sacrifice of these veins because no veins of significant size are found near the frontal base.[8] However, the basal interhemispheric approach is a rather complicated approach, which requires detachment of the supraorbital bar. In addition to this disadvantage, it often damages both olfactory nerves when the basal portions of the interhemispheric fissure are opened widely. In the basal interfalcine approach, the complicated craniotomy is replaced by a less complicated technique of frontal sinusotomy, and only a portion of the supraorbital bar is detached. The olfactory nerves are always protected by the leaves of the split falx and are not injured by retraction. The unilateral variation of this approach is more simple and may be used in small or paramedian lesions such as upward- or backward-projecting anterior communicating artery aneurysms.

References

1. Ciric IS, Cozzens JW: Craniopharyngiomas: transsphenoidal method of approach — for the virtuoso only? **Clin Neurosurg 27**:169–187, 1980
2. Fujitsu K, Kuwabara T: Orbitocraniobasal approach for an-

terior communicating artery aneurysms. **Neurosurgery 18:** 367–369, 1986
3. Fujitsu K, Kuwabara T: Zygomatic approach for lesions in the interpeduncular cistern. **J Neurosurg 62:**340–343, 1985
4. Fujitsu K, Saijo M, Aoki F, et al: Cranio-nasal median splitting for radical resection of craniopharyngioma. **Neurol Res 14:**345–351, 1992
5. Hakuba A, Nishimura S, Inoue Y: Transpetrosal-transtentorial approach and its application in the therapy of retrochiasmatic craniopharyngiomas. **Surg Neurol 24:**405–415, 1985
6. Kanno T, Kasama A, Shoda M, et al: A pitfall in the interhemispheric translamina terminalis approach for the removal of a craniopharyngioma. Significance of preserving draining veins. Part I. Clinical study. **Surg Neurol 32:** 111–115, 1989
7. Laws ER Jr: Transsphenoidal microsurgery in the management of craniopharyngioma. **J Neurosurg 52:**661–666, 1980
8. Oka K, Rhoton AL Jr, Barry M, et al: Microsurgical anatomy of the superficial veins of the cerebrum. **Neurosurgery 17:** 711–748, 1985
9. Tsutsumi K, Shiokawa Y, Sakai T, et al: Venous infarction following the interhemispheric approach in patients with acute subarachnoid hemorrhage. **J Neurosurg 74:**715–719, 1991
10. Yaşargil MG, Curcic M, Kis M, et al: Total removal of craniopharyngiomas. Approaches and long-term results in 144 patients. **J Neurosurg 73:**3–11, 1990
11. Yasui N, Suzuki A, Sayama I, et al: [A basal interhemispheric operative approach for anterior communicating artery aneurysms.] **Neurol Med Chir 27:**756–761, 1987 (Jpn)

Manuscript received April 14, 1993.
Accepted in final form July 29, 1993.
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