The use of the microscope in neurological surgery has made it possible to approach intracranial lesions with minimum retraction of normal neural structures and, when possible, without touching or even exposing them. This is the best way to preserve these structures intact and to diminish risk and complications for the patients.8–10 Surgical approaches to intracranial lesions previously could only be achieved with significant retraction of cerebral tissue and consequent complications.1,15 We agree completely with Perneczky’s keyhole philosophy and the futility of conventional approaches.4,11 Although radical cranial base approaches are well established and their features are widely recognized, the extent of surgical invasion can be reduced as a result of better illumination and magnification, thus diminishing risk to the patients. In 1981, at the Seventh International Congress of Neurological Surgery in Munich, Sanchez-Vazquez14 described the transciliary subfrontal approach for tumors of the sellar region. Since that time, more than 260 patients with different tumors and vascular lesions of the anterior cranial fossa. The modification set forth in this article makes better exposure possible, allows more space for instrument handling, and improves cosmetic results. This particular report was based on the treatment of 41 patients who were observed for longer than 3 months. All of the patients were satisfied with the cosmetic result.

**Materials and Methods**

**Patient Population**

We reviewed hospital charts and clinical outpatient records for the period between January 1, 1993 and August 31, 1998. Of 60 consecutive patients in whom the transciliary approach was used, we eliminated those who had undergone surgery that was performed using the original technique and those who had not undergone follow-up examination during a 3-month period.

Of the 41 remaining patients who had undergone surgery performed using the modified technique, nine were male and 32 were female, ranging in age from 14 to 54 years with an average age of 36 years. Diverse tumors in 33 patients involved the sellar, presellar, and suprasellar structures possible. It also permits vital neurovascular structures to be dissected and preserved, without injuring the first cranial nerve and/or the orbital surface of the frontal lobe. Prompt recuperation and improved cosmetic results are additional benefits.
Transciliary subfrontal craniotomy

TABLE 1
Summary of patients with anterior skull base lesions who underwent surgery via the transciliary subfrontal approach

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No. of Patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pituitary adenoma*</td>
<td>31 (75.61)</td>
</tr>
<tr>
<td>meningioma of olfactory groove</td>
<td>2 (4.88)</td>
</tr>
<tr>
<td>craniopharyngioma of third ventricle</td>
<td>1 (2.44)</td>
</tr>
<tr>
<td>ophthalmic segment aneurysm</td>
<td>1 (2.44)</td>
</tr>
<tr>
<td>ACoA aneurysm</td>
<td>3 (7.32)</td>
</tr>
<tr>
<td>PCoA aneurysm</td>
<td>2 (4.88)</td>
</tr>
<tr>
<td>sellar arachnoidocele</td>
<td>1 (2.44)</td>
</tr>
<tr>
<td>total</td>
<td>41 (100)</td>
</tr>
</tbody>
</table>

* Includes one case (2.44%) of Cushing's disease.

Surgical Technique—Patient Positioning and Incision

The patient is placed supine on the operating table. The head is rotated between 15˚ and 20˚ to the side opposite the surgical incision. Rotation is increased in cases in which there are tumors or vascular lesions of the anterior or middle fossa and decreased in cases in which there are tumors of the third ventricle. The patient’s neck is slightly extended to angle the head backward toward the floor so that the malar eminence is the most superior point in the operative field (Fig. 1). This position allows the frontal lobe to detach away from the orbital roof. The head is secured with skeletal fixation, and the position of the table or the angle of the microscope is changed if multidirectional views are needed.

The incision begins in the midline. From there it extends over the line of the eyebrow and continues up to the tail of the eyebrow, where the anterior edge of the temporal muscle should be revealed. One should be careful to make the incision while holding the scalpel in an oblique position in relation to the surface of the skin so that cutting is parallel to the pilose follicles. This avoids alopecia in the cicatrix and, consequently, a visible scar. If the incision is not made in this manner, alopecia will occur, which has been the case in patients treated by other neurosurgeons.

It is recommended that a few No. 1 silk stitches be placed on each end of the surgical incision to avoid skin tear due to excessive retraction occurring when the craniotomy is performed. Because the incision is made several millimeters from the edge of the orbit, periorbital scraping should always be performed in a cephalic direction.

The scalp flap is brought backward using hooks; this opens a greater field in which to place the burr holes (Fig. 3A). In the original technique, three burr holes were made and united using a Gigli saw. One burr hole was placed in the nasion area, the second before insertion of the temporal muscle, and the third partly centered above the other two. In the modified approach set forth in this report, only two burr holes are made: the first burr hole is drilled just behind the zygomatic process of the frontal bone, 5 mm above the MacCarty keyhole and below the line of the temporal muscle (Fig. 3); the second burr hole, created in the manner recommended by Al-Mefty, is placed at a site 5 mm from the glabella and 5 mm from the midline. This hole should be kept as small as possible for cosmetic reasons. In adults, this burr hole will pass through the anterior and posterior walls of the frontal sinus. The mucus of the frontal sinus is packed with a piece of temporal muscle. In some cases we have used Gelfoam to tighten the sinus and have obtained the same results. The paramedian frontal burr hole and the temporal burr hole are connected using a craniotome, forming the basal line of a triangle. The bone incision is extended superiorly and medially to form a triangle, as shown in Fig. 3C.

The craniotomy is completed using the craniotome, forming a triangle with blunt vertices and its base on the edge of the orbit. This incision is achieved without difficulty and with no greater retraction than the one produced by the hook retractors (Fig. 3A). Creation of the cut that closes the triangle is a bit complicated because of retraction. The hooks do not produce sufficient retraction and our experience has shown that retraction of the soft tissues should be made in parts, that is to say, retraction should be made only where the cutting line courses over the craniotome, as shown in the drawings in Fig. 3. Attempts to uncover the whole field often produce skin tears. The result is a triangular craniotomy with a base of 55 mm and a height of 35 mm.
The dura mater is opened with the aid of the microscope and crosses at the center of the craniotomy, which facilitates stitching at the end of the procedure. At this moment the subarachnoid lumbar drainage is opened. The orbital surface of the frontal lobe constitutes the upper (cephalic) limit of the operative field and the orbital ceiling the lower (caudal) limit. This is achieved with minimal and sometimes no brain retraction at all.

This approach provides excellent exposure of sellar, suprasellar, and parasellar structures (Fig. 4). In cases of sellar tumors, we have been able to achieve intracapsular removal of tumor. After this we use the diamond drill to remove the planum sphenoidale, which permits entrance into the sphenoid sinus and allows subtotal removal of the capsule in cases in which there is a prefixed optic chiasm. Exposure of the anterior cerebral artery, the A segment, the ACoA, and the M segment of the middle cerebral artery is possible through careful dissection and by varying the direction of the microscope.

Surgical Closing

The dura is closed in a watertight fashion. The bone flap is replaced and fixed in position. We place a Gelfoam bed in the burr holes, which are then filled with osseous shavings collected when the burr holes were created. The temporal muscle is repaired. The skin is closed with subdermal stitches for cosmetic reasons, leaving a one-eighth-inch Penrose drain, which is withdrawn in 24 hours.

Results

The average hospital stay in our series was 5 days; the shortest stay was 3 days and the longest was 30 days. In the latter case, a patient with a craniopharyngioma of the third ventricle had to undergo surgery twice. None of the patients in whom this approach was used needed a blood transfusion during surgery.

Thus far we have not had a single incident of mortality due to the approach. All patients in our series were observed for 3 months or longer. Table 2 summarizes the postsurgical deficits and complications. Hypesthesis of the frontal region appeared on the side of surgery on which surgery was performed in all patients, and this is a frequent reason for indisposition reported by patients. However, it disappeared completely in all patients, in some as early as the 2nd month after surgery. Inability to raise the eyebrow immediately after surgery was a complaint in all patients; however, in five the defect disappeared during the 1st month after surgery, in eight others it disappeared after the 2nd month, and in the remaining patients it disappeared completely after the 3rd month following surgery. We attribute this paralysis to detachment of the frontal epicranial aponeurosis because it was not a permanent condition in any patients. Unilateral hyposmia or anosmia was present in 21 cases (51.2%). Of these, on-
ly two patients were permanently afflicted, both of whom were found to have olfactory groove meningioma. We systematically looked for rhinorrhea and rhinorrhagia in all patients immediately following surgery and during each follow-up examination, but these conditions were never detected in spite of the fact that the frontal sinus had been opened. We believe that occlusion of the frontal sinus with muscle or Gelfoam is sufficient to avoid development of rhinorrhea or rhinorrhagia.

No patients had visible defects after the 3rd month follow-up examination. We highly recommend the use of bone waste to fill the burr holes, because this is a good osteogenic material. There were no episodes of infection involving the cranial bone flaps.

Discussion
For some authors the transcranial surgical approach to lesions of the anterior fossa is the best one. Shillito and Maira and Anile consider use of the subfrontal approach to be mandatory in children with pituitary adenomas. Pospiech, et al., have pointed out the necessity of using methods of minimum invasion with less blood loss in elderly patients. Marinov and colleagues insist on the usefulness of the subfrontal surgical approach for suprasellar cysts in children. Pernecky, Fries, Taniguchi, and others have pointed out all the advantages of microsurgical approaches, which eliminate the futility of major surgical exposures used in conventional approaches.

The tendency toward minimally invasive surgery is the result of technology, which increasingly provides opportunities to view the operative field through improved illumination. Although they pose a great challenge to the surgeons’ ability, minimally invasive surgical approaches allow better and faster patient recovery, particularly in high-risk patients who must undergo major surgery. Historically, the surgical approach to the anterior cranial base evolved from the pioneering work of Cushing through the efforts of a number of innovative neurosurgeons—Dandy, Frazier, Heuer, and McArthur—who, according to Al-Mefty, have approached different lesions in different ways.

After completing microneurosurgery training in Zurich, the senior author (M.A.S.V.) initiated in cadavers surgical approaches to the sella turcica through supraciliary microcraniotomy with minimum brain shifting. When he applied this method to live patients, satisfactory results were achieved, which allowed him to present this technique at the “Seventh International Congress of Neurological Surgery.” In 1996, he introduced a new version of the original technique that has made it possible to remove larger tumors and, above all, uncover vessels in the anterior portion of the circle of Willis.

The transciliary subfrontal approach has made it possible for us to approach lesions in the anterior third ventricle with almost no retraction of the frontal lobe. As stated by Apuzzo and colleagues, this is the shortest way to reach the terminal plate. We have also been able to remove intracranial foreign bodies located in the frontal lobe. Aneurysms of the ACoA can be dissected without sacrificing healthy brain tissue. Wakai approaches these aneurysms without sacrificing the straight gyrus, an accomplishment we have confirmed by using the present approach.

The modification presented in this article offers certain advantages: it makes detachment of the dura mater simpler; it widens the craniotomy, allowing better handling of instruments; it makes it possible to dissect sellar and parasellar structures with minimum retraction; it produces better cosmetic results because the temporal burr hole is hidden by the temporal muscle, which is treated in the manner recommended by Spetzler and Lee; and placement of the medial burr hole can be optional, depending on the surgeon’s ability to perform the craniotomy by using just one burr hole.

Conclusions
The transciliary subfrontal craniotomy is a procedure involving a microsurgical approach that is useful in treat-
ing high surgical risk patients, elderly patients, and children. It results in minimum bleeding with no damage to structures, such as the first cranial nerve and straight gyrus, related to retraction or compression. With changes in the direction of the microscope one can perform dissection on vessels of the anterior circle of Willis. This technique reduces the risks of morbidity, length of hospital stay, and undesirable cosmetic effects. It is an excellent approach for minimally invasive surgery in which the endoscope can be used.

References