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Microsurgical Removal of Olfactory Groove Meningiomas via the Pterional Approach

Abstract—Commonly used frontobasal approaches for microsurgical removal of olfactory groove meningiomas have certain disadvantages, such as late exposure of the neurovascular complex located dorsal to the tumor, namely, the internal carotid artery, middle cerebral artery, anterior cerebral artery, and the optic nerves. In addition, the frontal sinuses are frequently opened and there can be compression of the frontal lobes from significant spatula pressure. We report our experience with the pterional approach for these tumors in 28 patients. All patients presented with hyposmia/anosmia; 20 had personality changes and 8 had visual deficits. At surgery, after dissection of the sylvian fissure, the internal carotid artery, middle cerebral artery, anterior cerebral artery, and the homolateral optic nerve were exposed before removal of the posterior tumor parts. Reduction of focal pressure was achieved by removal of the contralateral tumor following partial resection of the falx and crista galli. Total tumor removal was obtained in all but 1 patient. One patient died of pulmonary embolism. The psychoorganic syndrome resolved in all but 1 patient; visual deficits improved in 6 patients. There were no postoperative infections. We consider the pterional approach to be superior to others for these lesions because it provides early exposure of the neurovascular complex, preservation of the frontal venous drainage, and avoidance of postoperative cerebrospinal fluid fistulae. (*Skull Base Surgery, 4(4): 189–192, 1994*)

Despite the fact that the first successful surgical treatment of an olfactory groove meningioma took place more than 100 years ago in 1885,[1] these tumors still pose problems for the neurosurgeon. Diagnosed at a late stage, they usually have already reached a large size[2] and are highly vascularized and covered by stretched and swollen brain parenchyma.

In addition, they tend to be adherent to functionally important basal neurovascular structures such as the internal carotid artery and the anterior cerebral artery and/or to the optic nerves.[3] Therefore, various approaches have been used for surgical removal of these lesions. Olivecrona and Urban in 1935[4] and Cushing and Eisenhardt in 1938[5] described a unilateral frontal craniotomy followed by partial resection of the frontal lobe in order to expose the tumor. Dandy[6] used an even larger approach by performing a bifrontal craniotomy plus partial bifrontal lobectomy.

Bifrontal craniotomies and their variations were also proposed by Tönnis[7] and Morley,[8] and in the microsurgical era by MacCarty et al,[9] Ojemann,[10] Seeger,[11] and Lesoin.[12] These techniques, even when performed by skilled neurosurgeons, have in common that they require or they may lead to opening of the frontal sinuses, prolonged compression of the frontal bridging veins, and dissection of neurovascular structures at a late stage of the operation.

We report our experience with the pterional approach to olfactory groove meningiomas in 28 cases.

PATIENTS

Twenty-eight patients (18 men and 10 women) 38 to 67 years old (mean: 52 years) underwent microsurgical removal of their olfactory groove meningiomas by the senior author (W.H.) via the pterional approach. The tumors were from 3.5 cm to 6 cm in diameter. On admis-

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sion all patients (n = 28) suffered from unilateral or bilateral hyposmia or anosmia. In 20 patients a psychoorganic syndrome was noted to some degree, and in 8 patients ophthalmologic examinations revealed impairment of their visual fields.

OPERATIVE TECHNIQUE (FIGS. 1 TO 5)

The patient is placed supine and fixed in the Mayfield clamp as for a standard pterional craniotomy, with the head turned 45° to the opposite side and the neck extended and slightly elevated. A lumbar cerebrospinal fluid drainage is placed preoperatively. The craniotomy should be carried out taking care not to open the frontal sinuses. After the opening of the dura, dissection of the sylvian fissure is performed proximally. The basal arteries and the homolateral optic nerve can be visualized in close proximity to the dorsal aspect of the meningioma. Removal of this tumor part leads to decompression of the abovementioned neurovascular complex. Then attention is paid to careful removal and devascularization of the tumor nidus situated on the sphenoid plane using the bipolar forceps and a high-speed drill. To avoid postoperative cerebrospinal fluid rhinorrhea, care should be taken not to open the ethmoidal sinuses. Finally, the contralateral tumor parts should be approached and hollowed. Therefore, partial resection of the falx and crista galli are performed. The apical tumor parts come down consecutively and can be removed. This leads to good visualization of the tumor border and to facilitated dissection of the contralateral anterior cerebral artery.

RESULTS

Complete tumor removal was achieved in 27 patients. In 1 patient (see below), only subtotal removal could be achieved.

Anatomic preservation of the contralateral olfactory nerve was possible in 10 patients. There was functional preservation of the contralateral olfactory nerve in 4 patients, in whom the tumor showed unilateral preponderance.

Tumor removal led to improvement of the preexisting visual field deficits in six out of eight patients. The psychoorganic syndrome improved significantly in all but one affected patient at the time of follow-up. The patient who did not show improvement had surgery in another institution before he was admitted to our department. In this patient we achieved only subtotal removal of the tumor because the meningioma had already grown through the base of the skull into the ethmoidal cells.

One patient had a postoperative rebleeding, which did not lead to permanent neurological deficits, and another patient died of pulmonary embolism after an uneventful initial recovery.

DISCUSSION

The pterional approach, described and popularized by Yasargil, was originally intented to be applied for microsurgical treatment of cerebral aneurysms. Yasargil stated that

> A craniotomy must take advantage of those natural planes and spaces which nature has provided to expose the base of the brain without significant brain retraction. One such plane is provided by the sphenoid ridge as it separates the frontal and temporal lobes. Another is provided by the roof of the orbit as it projects superiorly and indents the basal surface of the frontal lobe.[13]

The same principles should be beneficial for microsurgical removal of frontobasal tumors. We have already demonstrated the usefulness of the pterional approach for treatment of olfactory groove meningiomas in a smaller series.[3] The philosophy behind it is to reach the dorsal tumor surface during an early stage of the operation and

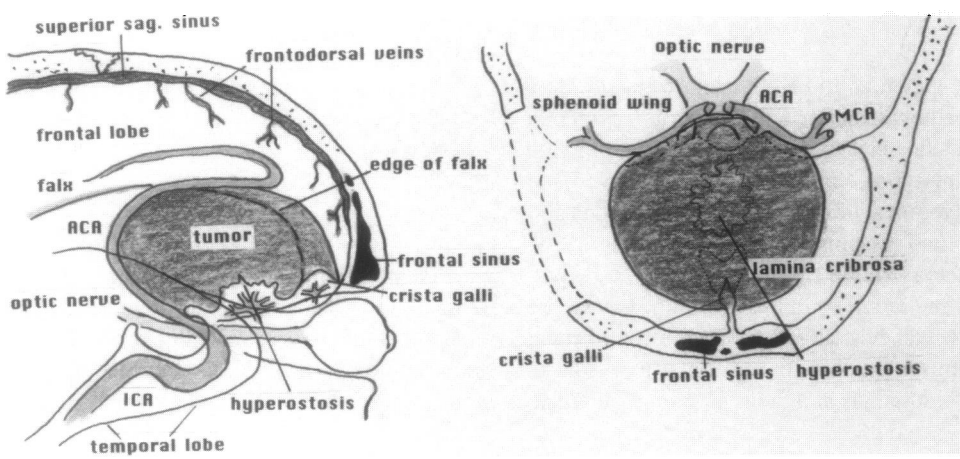

Figure 1. Illustration of preoperative situation. Note the relationship of the dorsal tumor border to the neurovascular complex.

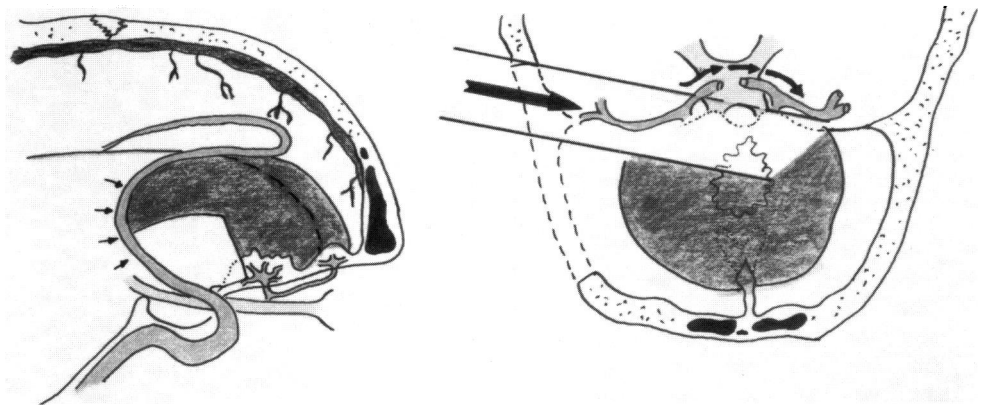

Figure 2. Dissection of the neurovascular complex (first step of the operation after dissection of the sylvian fissure).

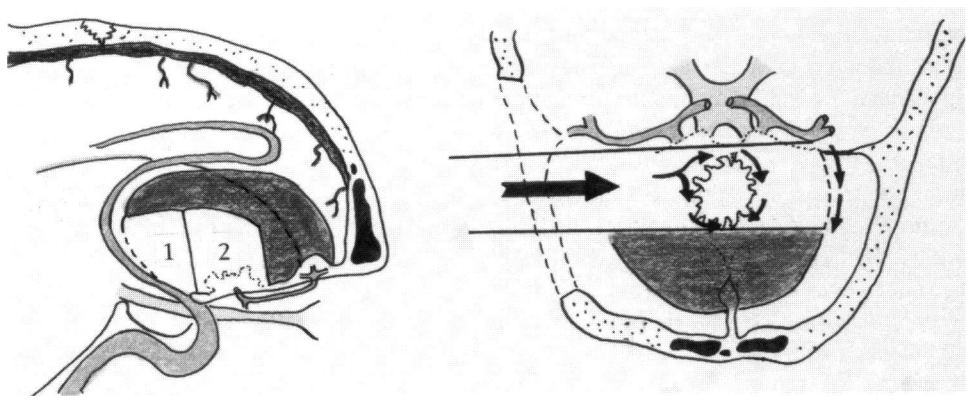

Figure 3. Devascularization of the tumor and removal of the hyperostotic nidus.

thereby visualize the neurovascular complex consisting of the internal carotid artery, middle cerebral artery, and optic nerve. These structures can be safely dissected, which is important in retaining their functional integrity.

The use of bifrontal or unifrontal approaches[5,6,8,9,11,14–16] leads to late exposure of these structures at a maximal distance from the site of the craniotomy. In addition, there may be substantial compression of the frontal bridging veins when the tumor dissection requires elevation of the frontal lobe, as in the so-called supraorbital approach proposed by Al-Mefty.[15]

Opening of the frontal sinuses also can be avoided by

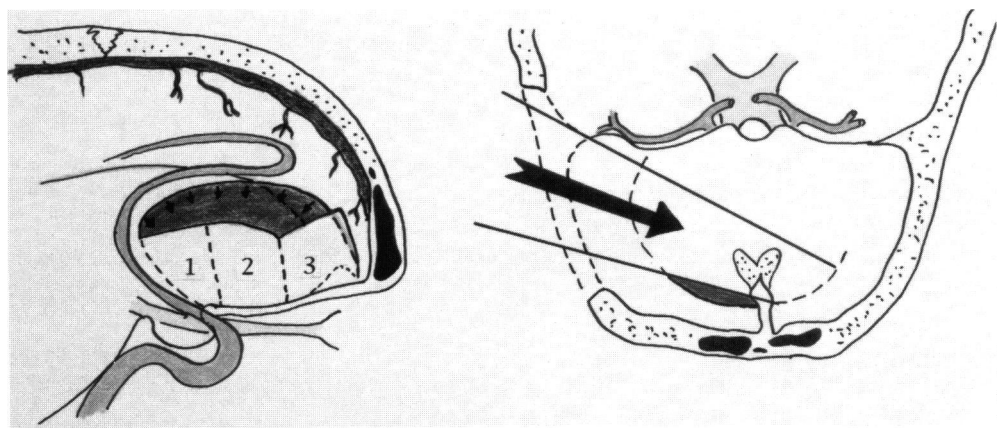

Figure 4. Removal of crista galli, incision of the falx, and hollowing of the tumor.

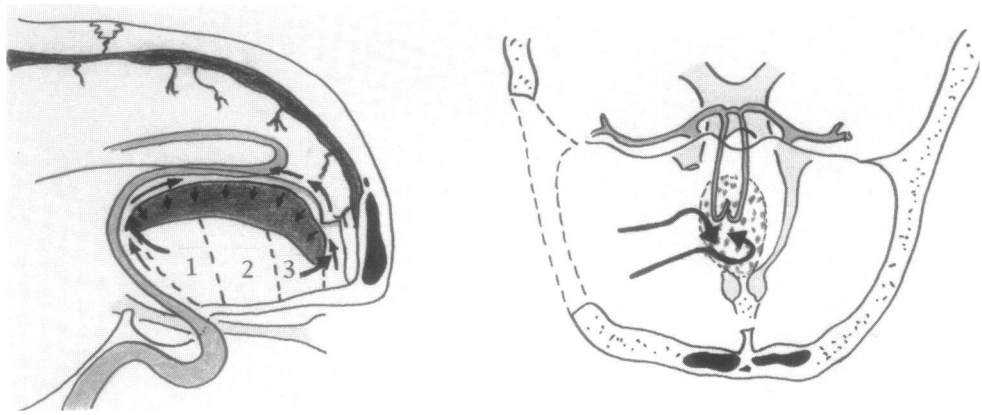

Figure 5. Dissection of the tumor surface and of the contralateral anterior cerebral artery (final step).

the use of a pterional craniotomy. This should lead to a decrease of the postoperative infection rate and of cerebrospinal fluid rhinorrhea. Al-Mefty highlights the importance of early tumor devascularization by coagulation of its base.[14] However, we have encountered no problems from significant intraoperative bleeding from the anterior blood supply to these tumors. In Bakay's series in 1972, there was still a mortality rate of 12% from frontal lobe infarction.[17] The one patient who died in our series did so from fulminant pulmonary embolism, not from a sequela of our surgical management. It is our impression that patients operated upon for removal of olfactory groove meningiomas are at an especially high risk for pulmonary embolism. After we lost that patient, we performed postoperative phlebograms in another five patients and found occult venous thrombosis in all of them (unpublished data).

In treatment of olfactory groove meningiomas the neurosurgeon is confronted with the problem that these tumors usually have already reached a large size at the time of diagnosis.[2,17] This is true even in the computed tomography/magnetic resonance imaging era, and only subtotal tumor removal can be achieved in some cases.[18] In our series, total removal was achieved in all but one patient, and we encountered no postoperative neurological deficits due to our treatment strategy. There were also no diencephalic complications, which may occur after removal of these tumors.[18] This may possibly be attributed to our strategy of dissection *from* the neurovascular complex *to* the tumor, which facilitates visualization and preservation of the small perforating arteries from the anterior cerebral artery to the hypothalamus.

In conclusion, we consider the pterional approach as an alternative, if not superior, to standard subfrontal approaches. This is backed by our experience with a series of some 28 patients and the following advantages:

- Unilateral approach
- Preservation of the frontal sinus
- Low pressure of brain retracting spatula
- Preservation of frontal venous drainage
- Early exposure and decompression of the neurovascular complex
- Possible preservation of the contralateral olfactory nerve in certain cases.

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