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Presentation and Patterns of Late Recurrence of Olfactory Groove Meningiomas

ABSTRACT—The objective of this article is to present the recurrence pattern of olfactory groove meningiomas after surgical resection. Four patients, one female and three males, with surgically resected olfactory groove meningiomas presented with tumor recurrence. All patients underwent resection of an olfactory groove meningioma and later presented with recurrent tumors. The mean age at initial diagnosis was 47 years. All presented initially with vision changes, anosmia, memory dysfunction, and personality changes. Three patients had a preoperative MRI scan. All patients had a craniotomy, with gross total resection achieved in three, and 90% tumor removal achieved in the fourth. Involved dura was coagulated, but not resected, in all cases. Three patients were followed with routine head CT scans postoperatively, and none was followed with MRI scan. The mean time to recurrence was 6 years. Three patients presented with recurrent visual deterioration, and one presented with symptoms of nasal obstruction. Postoperative CT scans failed to document early tumor recurrence, whereas MRI documented tumor recurrence in all patients. Tumor resection and optic nerve decompression improved vision in two patients and stabilized vision in two. Complete resection was not possible because of extensive bony involvement around the anterior clinoid and inferior to the anterior cranial fossa in all cases. Evaluation of four patients with recurrent growth of olfactory groove meningiomas showed the epicenter of recurrence to be inferior to the anterior cranial fossa, with posterior extension involving the optic canals, leading to visual deterioration. This location led to a delay in diagnosis in patients who were followed only with routine CT scans. Initial surgical procedures should include removal of involved dura and bone, and follow-up evaluation should include formal ophthalmologic evaluations and routine head MRI scans.

Olfactory groove meningiomas arise in the midline from the lamina cribrosa of the ethmoid, between the cribriform plate and the tuberculum sella. These tumors enlarge slowly and silently until they reach a large size; the patient presents with anosmia, mental status changes, and vision changes.[1–5] Most investigators agree on the principles of surgical resection of these tumors, including the importance of resecting involved dura and bone when possible, although coagulation of the dural base of the tumor is still an accepted practice. The natural history of meningiomas at all locations has been addressed in the literature,[1–5] but the specific recurrence pattern of olfactory groove meningiomas has not been evaluated. We review four patients who presented to our institution with tumor recurrence, three after gross total resection and one after subtotal resection of olfactory groove meningiomas. The pattern of recurrence was consistent. We also discuss guidelines for follow-up management of these patients.

METHODS

During 1994 to 1997, four patients presented to the Indiana University Division of Neurosurgery with tu-

Skull Base Surgery, Volume 10, Number 3, 2000 Division of Neurosurgery (WES, MVS, RLC) and Division of Otolaryngology (ECW), Indiana University School of Medicine, Indianopolis, IN. Reprint requests: Dr. Mitesh V. Shah, Division of Neurosurgery, Indiana University School of Medicine, Emerson Hall, Rm. 139, 545 Barnhill Drive, Indianapolis, IN 46202-5124. 1052–1453,p;2000,10,03,131,140,ftx,en;sbs00184x

mor recurrence after resection of an olfactory groove meningioma. A retrospective review of these patients was performed. The preoperative physical examination, imaging studies, extent of surgical resection, and postoperative physical examination were evaluated (Table 1). The operative reports were reviewed to determine the extent of resection at the initial procedure. The presenting signs and symptoms at recurrence and the imaging studies showing the recurrence were reviewed as well, along with treatment and follow-up management (Table 2).

RESULTS

Three males and one female are the subject of this review; the mean age at initial diagnosis was 47 years (range 21 to 74). The duration of symptoms before initial diagnosis was 1.7 years. All four patients presented initially with vision changes, anosmia, personality changes, and mental deterioration, and all had large (>3-cm) olfactory groove meningiomas at presentation. Three patients underwent gross total tumor resection with coagulation of the dural base. In no patient were both the dura and involved bone resected. The fourth patient had a subtotal tumor resection, involving greater than 90% of the tumor. Residual tumor was present on the postoperative scan near the tuberculum sella. Postoperative examinations demonstrated improvement in mental status and stable or improved vision in all four patients (Table 1).

Postoperatively, these patients were followed with routine CT scans, along with regular neurosurgical and ophthalmologic examinations. Their examinations remained stable for an average of 6 years (range 2.25 to 10 years) before symptomatic recurrences were diagnosed (Table 2). Patient 1 first noticed changes in visual acuity and decreased peripheral vision in his left eye. Patient 2 had decreased visual acuity in the left eye only, along with severe headaches. Patient 3 had decreased acuity in both eyes. Patient 4 experienced a decline of vision attributed to progression of cataracts, but her presenting complaint was drainage from the left nostril and a nasal mass. All four patients had CT scans that had failed to diagnose a recurrence before the de-

Table 1. Initial Treatment

Patient No.	*Age/Sex*	*Presentation*	*Examination*	*Treatment*	*Postoperative Examination*	*Follow-up*
1	35,M	Blurred vision Memory loss Personality changes Loss of smell bilaterally	Anosmia Poor concentration Papilledema VA normal VF normal bilaterally	Gross craniotomy Total resection Dura coagulated Bone intact	Anosmia Normal mental status VA normal bilaterally VF normal bilaterally	Yearly CT scans
2	74,F	Memory loss Personality changes	Anosmia Poor concentration VA 20/30 bilaterally VF normal bilaterally	Gross craniotomy Total resection Dura coagulated Some bone removed	Anosmia Normal mental status Improved memory VA 20/30 bilaterally VF normal bilaterally	Yearly CT scans
3	21,M	L eye vision loss Morning headaches	Anosmia VA R 20/20 VA L light perception Constricted visual field in left eye	Craniotomy (2 stages) Gross total resection Dura coagulated Bone intact	Anosmia Normal mental status Mild bilateral optic atrophy VA R 20/20 VA L 20/30 VF constricted bilaterally	Yearly CT scans
4	61,F	Flat affect Personality changes Declining vision	Anosmia Poor concentration VA R light perception VA L 20/200 VF constricted bilaterally	Craniotomy (2 stages) Subtotal resection (90%) Dural base coagulated Bone intact	Anosmia Normal mental status Bilateral optic atrophy VA R counts fingers VA L 20/200 VF constricted bilaterally	Lost to follow-up for 2 years

VA = visual acuity; VF = visual-field testing; L = left; R = right.

Table 2. Recurrence

Patient No.	*Recurrence*	*Symptoms*	*Examination*	*MRI*	*Treatment*	*Post-op exam*	*Follow-up*
1	10 yr	L eye vision deterioration (right eye already had poor vision)	Anosmia VA R 20/200 VA L 20/30 VF bitemporal hemianopsia	Recurrent tumor posteriorly displacing chiasm and extending inferiorly through the ethmoid into nasopharynx	Combined craniofacial resection; subtotal tumor removal obtained	VA R 20/200 VA L 20/30 VF improved bitemporal fields on perimetry testing	MRI every 6 months; at 3 years, no recurrence
2	9 yr	Nasal discharge	Anosmia L nasal mass VA poor bilaterally (cataracts) VF undetermined	Recurrent tumor inferiorly into ethmoids and L nasal cavity, and into frontal sinus; also extended posteriorly to sphenoid sinus	Transfacial approach to resect tumor in the ethmoid and frontal sinuses	Resolved nasal discharge Vision unchanged	MRI every 6 months; at 1.5 years, no recurrence
3	3.5 yr	L eye vision deterioration Headache	Anosmia L afferent pupil defect Bilateral optic atrophy VA counts fingers bilaterally VF constricted bilaterally	Recurrent tumor inferiorly in ethmoids, and posteriorly over anterior clinoids with tumor in the optic canals bilaterally; left worse than right	Staged craniofacial resection with right optic nerve decompression and subtotal tumor resection	VA R 20/30 VF R superior field intact L eye blind	MRI every 6 months; at 15 months of follow-up, size of residual tumor is unchanged
4	2.25 yr	Bilateral vision deterioration	Anosmia Bilateral optic atrophy VA counts fingers bilaterally VF constricted bilaterally	Recurrent tumor inferiorly in ethmoids and posterior nasal cavity; also involves sphenoid sinus and cavernous sinus and encases optic nerves and chiasm	Craniotomy, subtotal tumor resection, with bilateral optic nerve decompression	Bilateral optic atrophy VA counts fingers bilaterally VF constricted fields bilaterally	MRI every 6 months; at 28 months of follow-up, tumor progression into cavernous sinuses bilaterally

VA = visual acuity; VF = visual-field testing; L = left; R = right.

velopment of these symptoms, as the CT scans were performed with the first image starting at the anterior fossa floor. These studies were not low enough to image the inferior recurrence of tumor. MRI obtained after symptoms had occurred showed tumor recurrence. All these tumors extended inferiorly into the ethmoid sinuses and the epirhinopharynx, along with extension posteriorly, to involve the optic canals. Only the patient with subtotal resection of tumor had significant intracranial extension of tumor.

Surgical reexploration and tumor resection were carried out for all four patients. The goal of surgery was total resection of tumor, involved bone, and dura when possible. However, complete resection of tumor was not possible in any case because of extensive bony infiltration. The second goal of surgery was decompression of the involved optic canals and of the optic nerves and chiasm, to permit recovery of vision. A craniofacial approach was used in three cases. The postoperative results were encouraging. Three patients with visual decline showed visual stablization (Table 2).

These patients have now been followed up for an average of 25 months (range 17 to 36 months). Two patients have done well without recurrence of symptoms. Patient 3 has had very little change in tumor size on MRI but has had progressive visual loss requiring additional surgery to decompress the right optic nerve, in an effort to preserve vision superiorly and laterally in the only eye with vision. Patient 4 has had continued tumor growth into both cavernous sinuses and now has bilateral ophthalmoplegia. All patients are followed with routine ophthalmologic and neurosurgical examinations, along with biannual MRI scans. With limited follow-up, recurrent surgery led to stabilization of radiographic and clinical pictures in two patients.

CASE ILLUSTRATIONS

Case 1

Patient 1 experienced memory loss, personality changes, anosmia, and blurred vision at the age of 35. An MRI scan showed a large olfactory groove meningioma. The patient underwent a bifrontal craniotomy with gross total tumor resection at another hospital, with coagulation of the dural base, but no involved dura or bone was removed. The patient tolerated this procedure well; all symptoms resolved except for continued anosmia. He was followed with yearly head CT scans and neurologic examinations. This patient did well for 10 years after initial resection. Decreased near vision then developed in his left eye, and he noticed decreased peripheral vision in the left temporal field. Physical examination showed anosmia, but intact memory and higher cortical functions. His visual acuity was 20/30 in the left eye and 20/200 in the right eye; he had bilateral temporal field deficits. Head CT scans had been read as normal before these symptoms had developed (Fig. 1). However, an MRI scan showed recurrent tumor inferior

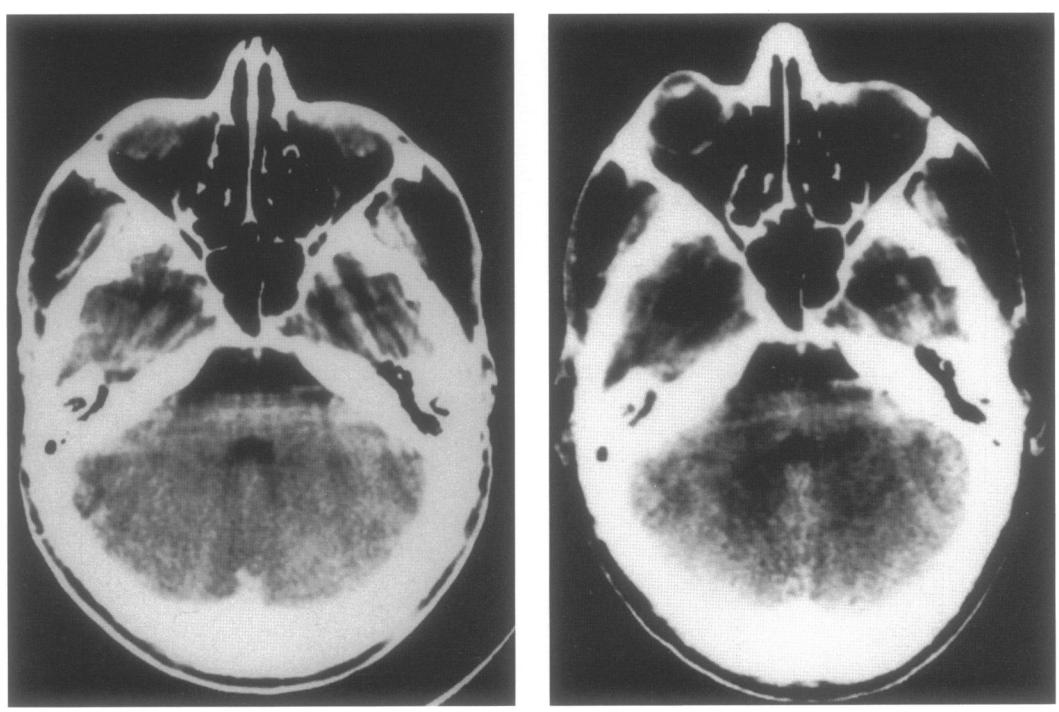


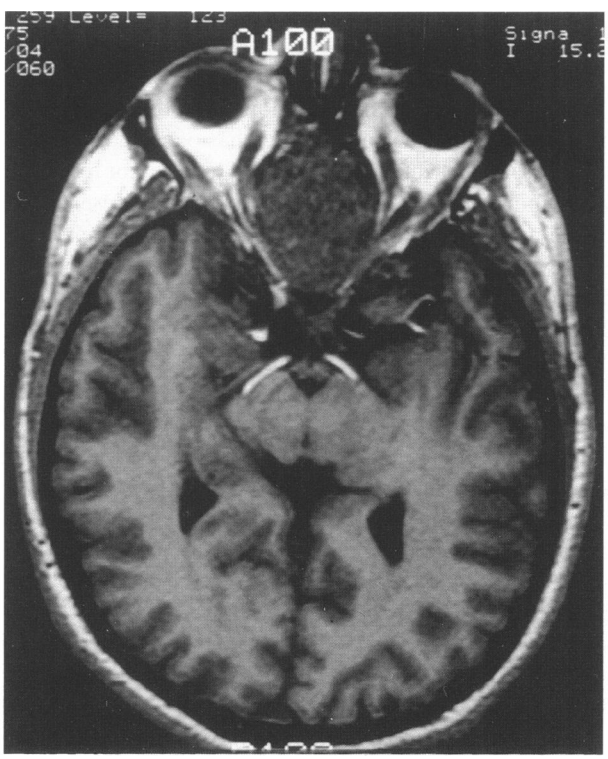
Figure 1. Axial head CT scan 7 years before **(A)**, and 1 year before **B** patient returned with recurrent tumor of patient 1.

to the anterior cranial fossa in the ethmoid sinuses, and extension posteriorly involving the optic canals (Figs. 2 and 3). Surgical resection of the entire tumor was attempted, but complete tumor removal was impossible because of the extensive bony involvement. The majority of the tumor was removed and the optic canals were decompressed. Postoperatively, the patient's visual acuity was unchanged, but he had improvement in the temporal field deficits. He has been followed with biannual head MRI scans and ophthalmologic examinations, and his examination and imaging studies have remained stable over the past 3 years.

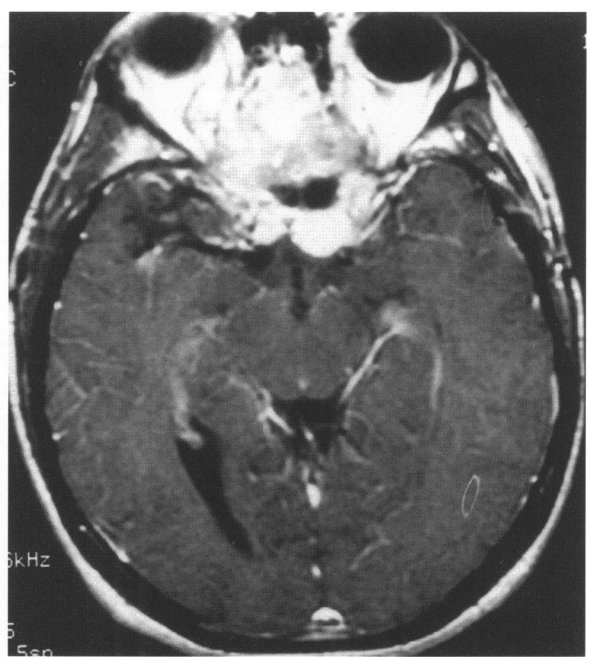
Case 2

Patient 3 presented to an outside facility with a 1-year history of headaches, anosmia, memory changes, and vision loss in the left eye. Examination showed 20/20 vision in the right eye and a normal visual field, but the left eye had only central vision intact, and he was unable to count fingers with that eye. Visual evoked potentials were performed that showed no response in the left eye, and mild prolongation in the right eye. An MRI scan showed a large olfactory groove meningioma (Fig. 4). This patient had a gross total tumor resection requiring two procedures over a 1-week period. The optic nerves and chiasm were free of tumor and the dural base was coagulated, but the involved dura and bone were not removed. The patient felt that he had improved vision after the surgery; visual acuity testing showed 20/20 vision in the right eye and 20/25 vision in the left eye.

CT scans of the head done immediately postoperatively and 2 years later were negative for tumor recurrence (Fig. 5). At 3 years post-resection, the patient presented with complaints of decreased vision in the left eye and frontal headaches. Physical examination showed 20/20 vision in the right eye in the upper temporal quadrant only, and he was blind in the other quadrants. His left eye was blind with the exception of asmall area of light vision, and the left optic disc showed severe atrophy. MRI of the head showed recurrent tumor growing inferiorly into the ethmoid sinuses and posteriorly to involve both optic canals and the anterior clinoids (Figs. 6 and 7). This patient was referred to our institution and underwent a two-stage procedure with intracranial tumor resection and decompression of the right optic nerve. Total tumor resection was not possible owing to the extensive bony invasion, including the anterior clinoids bilaterally. He had some improvement in vision in his right eye initially, but he has continued to have progressive loss of vision in the right eye with minimal increase in tumor. He has since undergone another craniotomy with right optic nerve decompression to stabi-

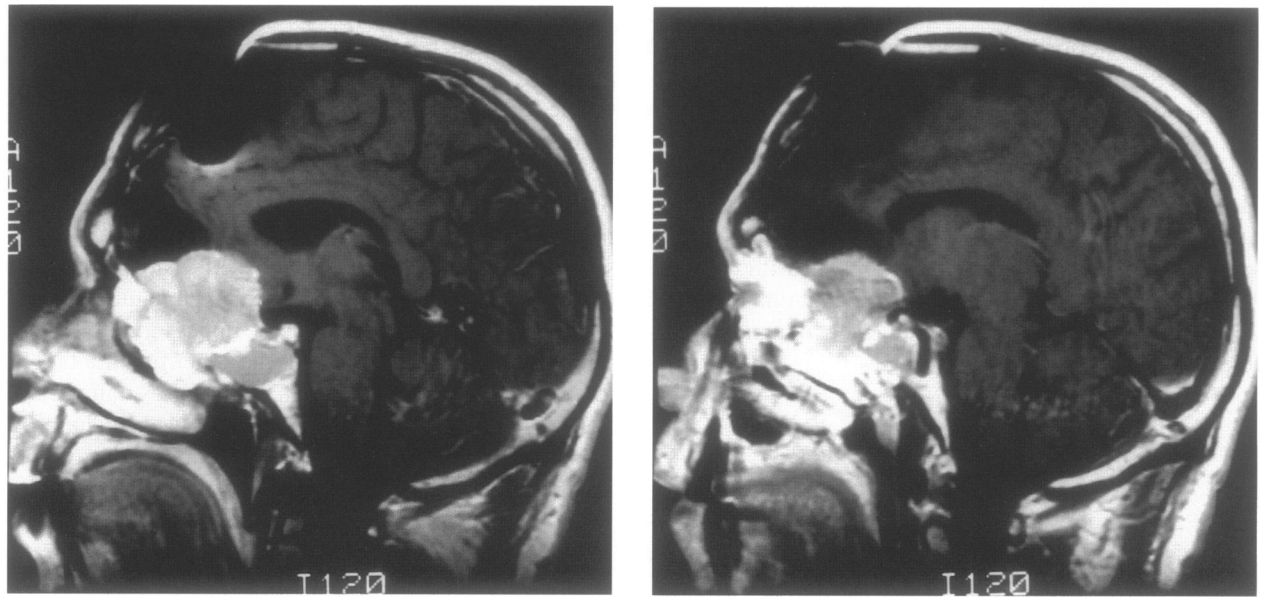


A



B

Figure 2. Axial noncontrasted head MRI **(A)**, and axial contrasted head MRI (**B**) of patient 1, showing recurrent tumor in the ethmoid sinuses, causing a mass effect on the medial aspect of both orbits, with extension posteriorly to involve the optic canals.



A B

Figure 3. Sagittal contrasted head MRI (**A** and **B**) of patient 1, showing tumor growth inferiorly into the ethmoid sinuses and posteriorly to involve the anterior clinoids.

lize the vision in his right eye, but he is completely blind in the left eye.

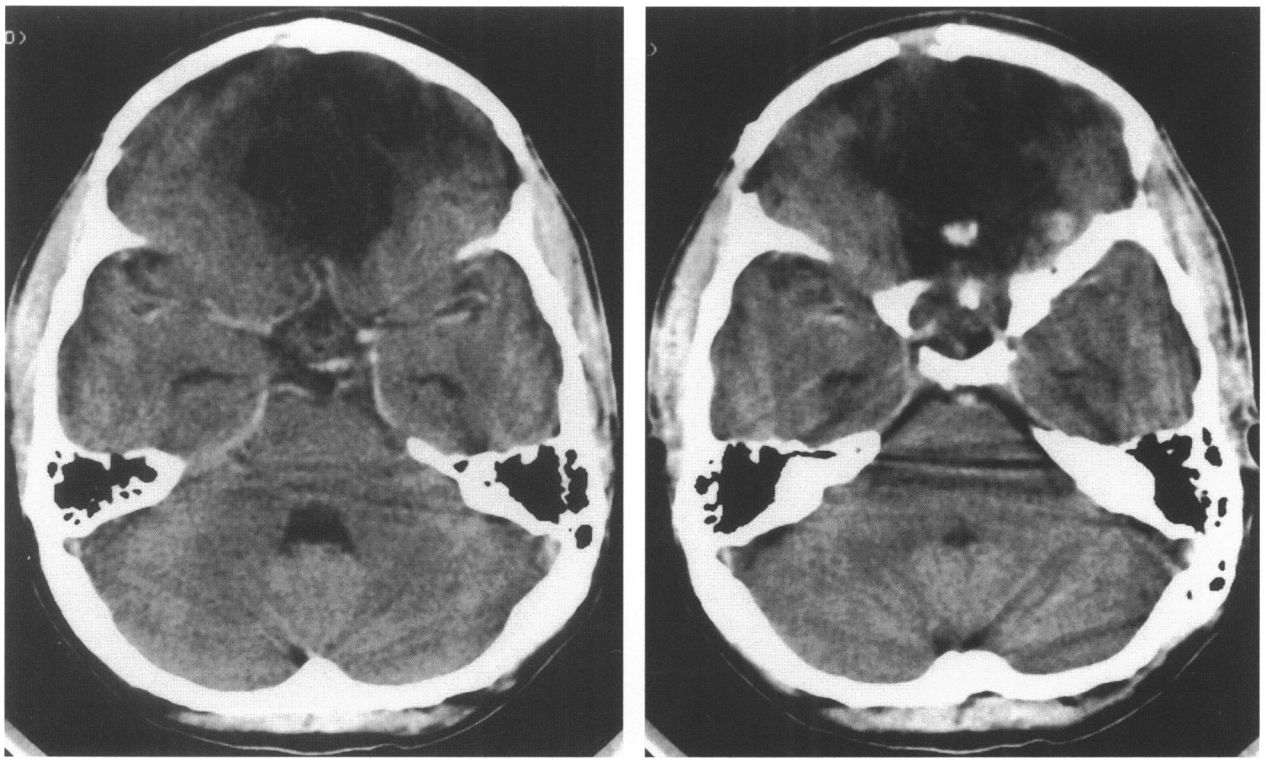
DISCUSSION

Olfactory groove meningiomas arise from the floor of the anterior cranial fossa and are often large at presentation.[2] The most common reason for seeking medical attention is failing vision.[6–8] Vision loss results from progression of the tumor posteriorly, pushing the chiasm inferiorly and invading the optic canal.[5,9] Symptoms often progress asymmetrically, losing visual acuity and developing a field deficit in one eye before changes in the opposite eye.[9–11] Cushing and Eisenhardt[12] stressed the importance of diagnosing olfactory groove meningiomas while they were still small to reduce the morbidity and mortality associated with tumor resection.[14] Bakay[6] believed that these tumors should be diagnosed before irreversible visual damage has occurred.

Figure 4. Preoperative sagittal contrasted head MRI of patient 3, showing a large olfactory groove meningioma elevating the frontal lobe, with no extension inferiorly.

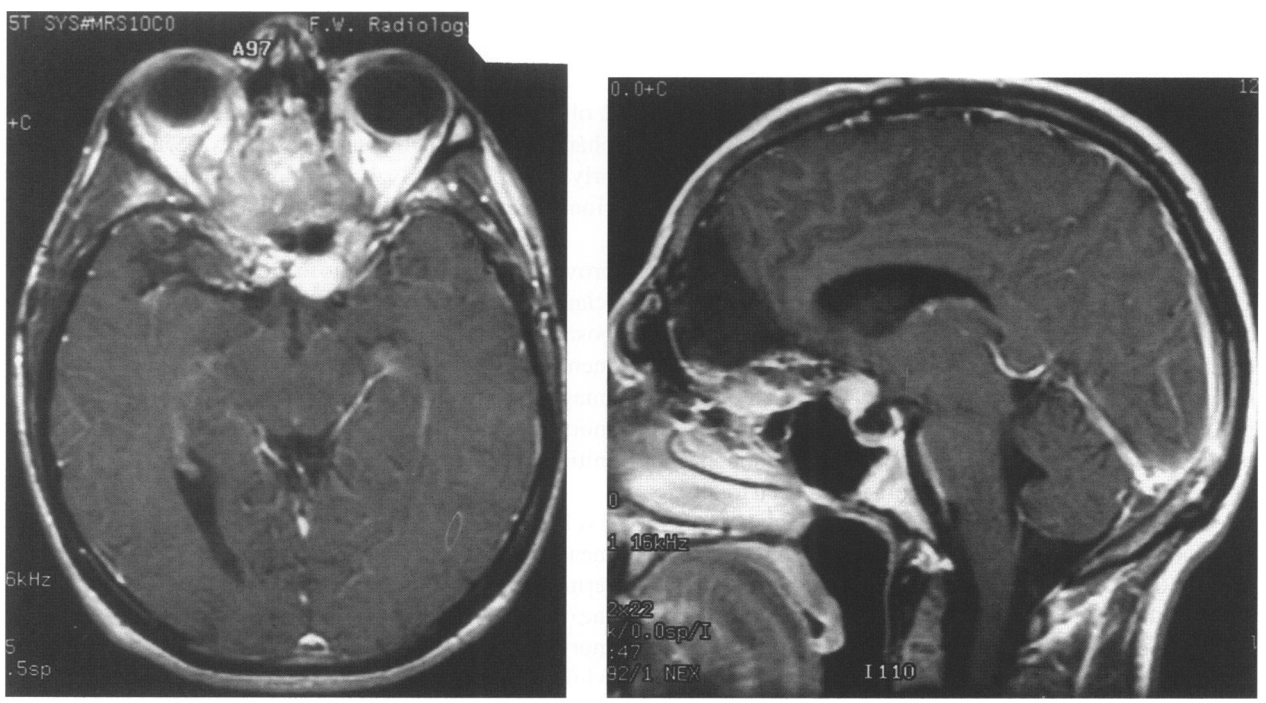
Surgical resection is directed at total tumor resection while minimizing frontal lobe retraction and preservation of the anterior cerebral vessels and the optic apparatus. However, what usually limits complete resection is the fear of creating a cerebrospinal fluid (CSF) fistula. Olivecrona[13] used coagulation of the dural base without removing it to prevent CSF leak; Simpson[3] used this method to prevent entry of ethmoid air cells. Others advocate resection of involved dura with placement of a dural graft, while leaving involved bone in place, maintaining that the recurrence rate is extremely low and that the bone is often not involved with tumor.[7,14,15] Currently, most surgeons attempt complete resection of the dura and tumor, along with removal of involved bone.[1,9,16,17] Because of the size of these tumors at presentation, many surgeons can achieve successful gross total resection of tumor and coagulation of the dural base, but they do not remove involved dura and bone.

The recurrence rate of meningiomas has been examined in the literature. Simpson[3] presented a review of 256 cases from the pre-CT era, found a 21% symptomatic recurrence rate for all meningiomas, and devised



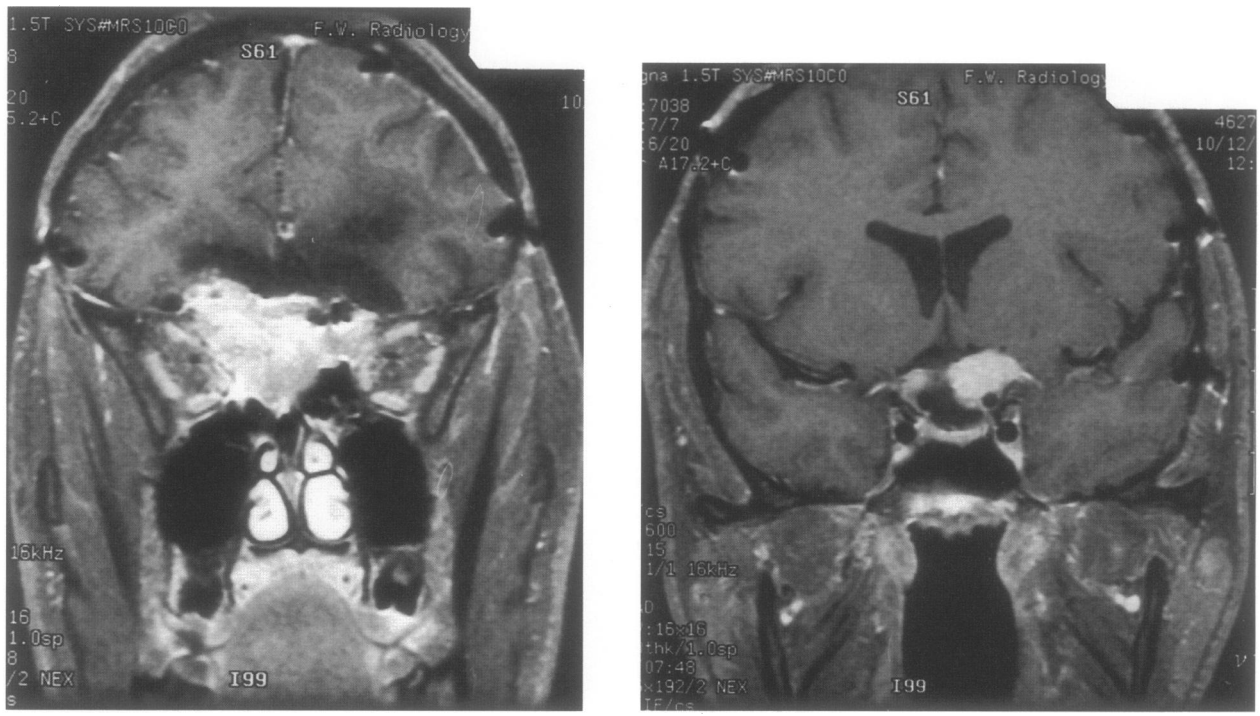
A B

Figure 5. Postoperative axial contrasted head CT of patient 3, done 3 months **(A)** and 2 years **(B)** after surgery, showing bifrontal encephalomalacia, but no evidence of tumor recurrence.



A B

Figure 6. Axial contrasted head MRI **(A)**, showing tumor recurrence in the ethmoid sinuses with posterior extension involving both optic canals, and a sagittal contrasted head MRI **(B)**, showing tumor recurrence inferiorly and posteriorly, but no recurrence superior to the floor of the anterior cranial fossa in patient 3, at 3 years after initial resection.



A B

Figure 7. Coronal contrasted head MRI (**A** and **B**) of patient 3, showing tumor recurrence in the ethmoid sinuses and involving the anterior clinoids. Note minimal superior extension.

a grading scheme based on the surgical resection of the tumor. All olfactory groove meningiomas in his series were grade II (total tumor resection, with coagulation of the dura). Histologic examination on one patient 1 year after resection showed no tumor cells in the previously coagulated dura, but nests of tumor cells were present in the underlying bone. Simpson[3] concluded that dural coagulation did sterilize the dura, but was not successful at sterilizing any more remote spread.

Others have addressed the recurrence of meningiomas after surgery in the post-CT era. An extensive review of the literature by Black[1] found that the recurrence rate at 10 years varied from 9% to 20% for totally resected meningiomas, and from 18.4% to 50% for meningiomas after subtotal resection. Chan and Thompson[18] reviewed their experience with a series of 257 meningiomas, including 20 cases of olfactory groove meningiomas. Their recurrence rate at 9 years was 15% when all 20 olfactory groove meninioma were included. In a review of 225 meningiomas, Mirimanoff et al.[4] found that although 77% of their olfactory groove meningiomas had been totally resected, 41% had recurred within 10 years, making them the second most likely tumor to recur after sphenoid wing meningiomas. These studies show that with long-term follow-up, the recurrence rate of olfactory groove meningiomas is not insignificant.

Size and location are critical factors in determining the pattern of meningioma recurrence following surgery. DeMonte[16] reviewed the surgical approaches to anterior basal meningiomas, and found that 15% of olfactory groove meningiomas involve the ethmoid sinuses at the time of initial presentation. Holub[19] reported a single case of recurrence that was diagnosed by nasal examination, and Bakay and Cares[7] described a recurrent tumor that grew inferiorly, destroying the cribriform plate and presenting as an epipharyngeal mass 15 years after the initial surgery. In reviewing 98 cases of olfactory groove meningiomas, Solero et al.[8] found that 2 olfactory groove meningiomas recurred in the rhinopharynx. All four of our cases show recurrence inferiorly and posteriorly with minimal intracranial extension, except for involvement of the optic canals.

The development of the CT scan has greatly improved the ability to diagnose these tumors once the clinician is concerned about an intracranial process, being positive in 87 to 100% of cases.[8,20] The MRI is complementary to CT scanning.[1,16] However, these advances in imaging have not resulted in significantly smaller tumors at diagnosis, as all our patients had large tumors at initial presentation.

Imaging studies are also important post-operatively to identify recurrences at an early stage. The mean time to recurrence of meningiomas has been determined to be 2.5 years to 5 years.[3,21] Reoperation is the treatment for recurrence; therefore, morbidity and mortality are reduced when the tumor is diagnosed while it is still small. Chan and Thompson[18] found that with annual CT scans the average time required to diagnose recurrence was 2.9 years, compared with 5.7 years during the pre-CT era. Despite routine CT scans in our

patients, the average tumor size was 5 × 5 cm by the time the recurrence was diagnosed. This was because the recurrences were inferior and posterior and did not extend above the base of the anterior fossa. This pattern of recurrence leads us to recommend MRI scans for follow-up evaluation of patients who have had olfactory groove meningioma resection; this approach will permit earlier diagnosis of recurrence, as the MRI scan images the sagittal and coronal planes, facilitating visualization of inferior and posterior extension.

Although radiologic follow-up is crucial in patients with this condition, we believe that the clinical evaluation of vision is even more important. Visual deterioration in our patients was the most common presentation of recurrence, often antedating changes on imaging studies. Vision changes experienced preoperatively can resolve after surgery.[5,7,8,11,11,22] Gregorius et al.[5] evaluated 23 cases of suprasellar meningiomas and found that 17 of 21 eyes that improved had symptoms for less than 2 years. In evaluating visual outcome in 101 cases of suprasellar meningiomas, Rosenstein and Symon[22] found that visual recovery was likely if (1) duration of symptoms was less than 2 years, (2) the tumor was <3 cm, (3) a preoperative visual loss of <50% was noted, and (4) the optic discs were normal. Early detection of subtle visual changes allows for the diagnosis of tumor recurrence when they are small; clearly, early surgical resection of recurrent tumor will improve the prognosis for visual recovery.

CONCLUSIONS

We present four cases of recurrent olfactory groove meningiomas, three after gross total resection with coagulation of the dural base (Simpson grade II resection), and one after subtotal resection (Simpson grade III resection). All cases recurred both inferiorly and posteriorly. There was minimal intracranial extension except for involvement of the optic canals. Three patients presented with vision changes, and the fourth patient presented with a nasal mass. The average time to recurrence was 6 years, and the average size of the tumor at recurrence was approximately 5 × 5 cm. Two of the four patients were younger than 35 years of age at initial diagnosis. Routine CT scans failed to diagnose recurrent tumor until the tumors were large, because the tumors extended inferior to the anterior cranial fossa. We maintain that routine MRI will most likely show evidence of smaller recurrence at an earlier stage than will a CT scan.

We recommend total resection of involved dura and bone at initial resection of olfactory groove meningiomas, even if it requires reconstruction of the floor of the anterior fossa. In our experience, gross totally resected olfactory groove meningiomas recur inferiorly and posteriorly below the tuberculum sellae and planum sphenoidale. Patients present with subtle changes in vision that would be detected with a thorough ophthalmologic evaluation. MRI is the imaging study of choice to follow these patients and should be done every 6 months for the first 2 years, and annually thereafter. Recurrences should be treated surgically with attempts at total resection. If total resection is not possible, the surgeon should address decompression of the optic canals to permit stabilization of vision. Cure cannot be assumed with short-term follow-up of young patients with olfactory groove meningiomas that have undergone total gross resection.

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