

Value of Surgery on the Outcome of Olfactory Groove Meningioma

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Abstract: Background: Olfactory groove meningiomas represent a difficult problem because of involvement of the arteries of the anterior circulation as well as the anterior visual pathways when increased in size. **Objective:** in my study I will discuss 12 patients with olfactory groove meningiomas regarding their clinical presentation, radiological appearance, surgical approach as well as their post operative follow-up. **Methods:** All patients had been operated in Al-Azhar university hospitals in the period between February 2005 to October 2011. Patients' data as clinical presentation, surgical approach, histopathology, outcomes and follow up were collected and recorded. **Results:** There were 10 women and two men ranging in age from 33 to 64 years with mean age of 47 years. The leading symptom was Dementia in 5 patients. The bifrontal approach was the surgical approach in all cases. Simpson grade I or II was achieved in 9 patients, and grade III or IV was attained in 3 cases. In 11 patients there was a good result. One patient had a postoperative intracerebral hemorrhage after surgery and has a permanent dysphasia. **Conclusion:** The Olfactory groove meningiomas are frequent tumor in neurosurgical practice that should be excised completely with minimum complication and good outcome.

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Key Words: Olfactory groove, Meningioma, Dementia, Bifrontal approach.

1. Introduction:

Olfactory groove meningiomas arise in the anterior cranial fossa at the cribriform plate of the ethmoid bone and the area of the suture adjoining the planum sphenoidale. Olfactory groove meningiomas account for 4.5 to 13% of all intracranial meningiomas. The tumor, which covers the entire crista galli to the posterior part of the planum sphenoidale, could grow symmetrically to the anterior sagittal sinus and falx or mainly to one side (1, 2).

In case of large Olfactory groove meningiomas surgery represents a special challenge, because of their proximity to the arteries of the anterior circulation and the optic nerves. The aim of this study was to present my series of patients with olfactory groove meningiomas concerning presenting symptoms, neurological deficits, radiological appearance, surgical approach and outcomes as well as clinical and radiological follow-up findings.

2. Material and Methods:

During February 2005 to October 2011, I prospectively followed a cohort of 12 patients with olfactory groove meningiomas in department of Neurosurgery at Al-Azhar University hospitals. Information on the patients' clinical history and signs, surgical approach, pathology and outcomes were recorded.

All patients underwent an evaluation of visual acuity and visual fields, the results of which were compared to the post operative visual acuity and visual fields.

Preoperative neuroimaging investigations consisted of computerized tomography (CT) with tridimensional reconstruction and magnetic resonance imaging (MRI) using a 1.5-tesla unit, with and without contrast. CT scans were also obtained 24 h after surgery to identify immediately the presence of postoperative hematomas, pneumocephalus, or other surgical complications. Postoperative control MRI was performed three and six months after surgery, and then annually, if necessary.

The extent of tumor resection was classified according to the **Simpson** classification (3):

1. **Grade I:** total tumor resection with excision of infiltrated dura.
2. **Grade II:** total tumor resection and coagulation of dural attachments
3. **Grade III:** gross total tumor resection without excising dural attachments or extradural extensions (e.g. infiltrated sinus or bone).
4. **Grade IV:** subtotal tumor resection.

For this study, I collected the informed consent of all patients.

Surgical procedure:

Surgery was performed with general anesthesia, with the aid of an operating microscope and microsurgical instrumentation in all cases. I recommend bifrontal craniotomy for removal of large tumors. The bifrontal approach permits adequate exposure and allows the surgeon to work on both sides, frontal and temporal, accessing the sylvian fissure.

The patients should be placed in a supine position, with the head in a neutral position and gently extended toward the floor. After the bifrontal craniotomy using

four burr holes, the bone flap is removed. The dura mater is opened in a downward turning C shape, and the sagittal sinus is closed by means of suture or ligation. Both frontal lobes are elevated with retractors in parallel and the interhemispheric fissure is dissected.

After drainage of the CSF, I try to dissect the olfactory nerves from bottom to top, up to the olfactory insertion into the bone. In large tumors this proves almost impossible. The microsurgical technique consists of debulking the tumor by means of microsurgical instruments.

The capsule is turned toward the centre of its debulked area using a tumor punch, and the cleavage plane between the superior portion of the tumor and the inferior portion of the frontal lobe is found and all feedings coagulated by bipolar forceps.

The attachment to the crista gali can be explored by a partial resection and coagulating the insertion or drilling the gali crista, and assessing the ethmoid sinus in order to remove all invaded cavities.

A pituitary curette or tumor forceps can be used to take out the tumor from the ethmoidal cavity. Closure should be in watertight fashion in order to avoid any CSF leakage. I can close the hole in the bone with a piece of bone from the sphenoid wing or a methacrylate graft, and using pericranium or dura substitutes. The large dural defect area can be microsurgically closed watertight, or add adhesive dural patch

Functional outcome:

The preoperative, postoperative (first 10 days) and the follow-up outcome were analyzed using the Karnofsky Performance Scale (KPS) to measure the degree of disability. Patients were classified into one of three groups. 1) Normal function or minimal symptoms and ability to work (KPS score 80-100), 2) Independent but not able to work (KPS score=70), and 3) Moderate or severe disability (KPS score \geq 50).

3.Results:

In this surgical series there were 12 patients (Table 1) prospectively followed from February 2005

to October 2011 in department of neurosurgery at Al-Azharl University hospitals. There were 10 women and two men ranging in age from 33 to 64 years with mean age of 47.

The leading symptom was Dementia in 5 patients followed by headache in 4 patients and symptoms of increased intracranial pressure in 4 patients. Convulsions and visual deterioration were also encountered as well as symptoms related to brain compression such as dysphasia. The presenting symptoms are summarized in (Table 1).

Neuroimaging aided in identification of ethmoid sinus invasion. 2 cases in the study group were invading the cavernous sinus. Also imaging can classify these tumors into large ones > 3cm in diameter and small ones less than 3cm in diameter. (Table 4)

The bifrontal craniotomy approach was the surgical approach in all cases. **Simpson grade I or II** was achieved in 9 patients, and **grade III or IV** was attained in 3 cases. (Table 4). A tumoral remnant (grade III or IV resection) was intentionally left in 3 patients. These 3 patients included two patients who had tumors that were adherent to the anterior cerebral artery (ACA).

Table 1: Clinical data in the study group

	No of patients (%)
Age (yrs)	47, range 33-64
Sex	
Female	10
Male	2
Symptoms and signs	
Dementia	5 (42%)
Headache	4 (34%)
Symptoms of increased ICP	4 (25%)
Visual deterioration	4 (25%)
Papilloedema	10 (83%)
Foster- Kennedy Syndrome	2 (17%)
Convulsions	2 (17%)
Dysphasia	1 (8%)
Duration of symptoms	1m – 5 yrs

Table 2: Comparison of clinical data for six recent series of olfactory groove meningioma

Authors &Year	No. of Cases	Age range in Years(mean)	Female/ Male	Headache	Mental Changes	Visual Loss	Anosmia
Mayfrank&Gilsbach, 2007	18	45-75	13:5	NA	1 0(56)	4(22)	11(61)
Paternity <i>et al.</i> ,1999	20	14-73(49)	15:5	NA	NA	NA	NA
Tsikoudas &Martine,1999	13	34-74	10:3	8(62)	8(62)	4(31)	7(54)
Turazzi. <i>et al.</i> ,1999	37	32-64(57)	22:15	NA	27(73)	16(43)	27(73)
Zevgardis. <i>et al.</i> ,2001	5	55-67(63)	2:3	NA	NA	5(100)	NA
Anderson, <i>et al.</i> ,2003	13	40-72(56)	12:1	5(38)	9(69)	6(46)	5(62)
Total	106	4-75(55)	74:32	13(50)	55(68)	35(41)	53(65)

Table 3. Complications of surgery for OGMs

Authors&Year	No.of Cases	Visual loss	CSF Leak	Infection	Seizure	Infarct
Mayfrank&Gilsbach,1996	18	0	0	1	0	1
Paternity et al,1999	20	0	0	0	0	0
Tsikoudas &Martine,1999	13	1	3	1	1	0
Turazzi. et al,1999 ⁽¹³⁾	37	0	0	0	0	0
Zevgardis. et al,2001	5	NA	NA	NA	NA	NA
Anderson,et al,2003	13	0	0	0	0	0
Total	106	1	3	2	1	1

Table 4: Clinical outcomes: 12 patients

Tumor Size	
Large > 3cm	6
Small < 3cm	6
Tumor Extension	
Ethmoid sinus	2
Planum sphenoidale	1
Grade resection	
Simpson 1	4 (33%)
Simpson 2	5 (42%)
Simpson 3	2 (17%)
Simpson 4	1 (8%)
Visual outcomes	
Visual stationary	8
Visual deterioration	2
Visual improvement	2
Post operative complications	
Visual deterioration	2
Post – operative hematoma	1
Brain edema	4

Table5. Preoperative, postoperative, and follow-up functional status

functional status	KPS	preoperative	immediate postoperative	follow up
N° of patients		12	12	12
Normal or minimal symptoms &working	80-100	8 (66.7%)	7 (58.3%)	7(58.3%)
Independent,not working	70	3 (25%)	4 (33.3%)	4 (33.3%)
Moderate or severe disability	50	1 (8.3%)	1 (8.4%)	1(8.3%)

* There was no significant difference for patients that returned to work (KPS 80-100) for all evaluations (Chi-Square test, df=2; p=0.2733).

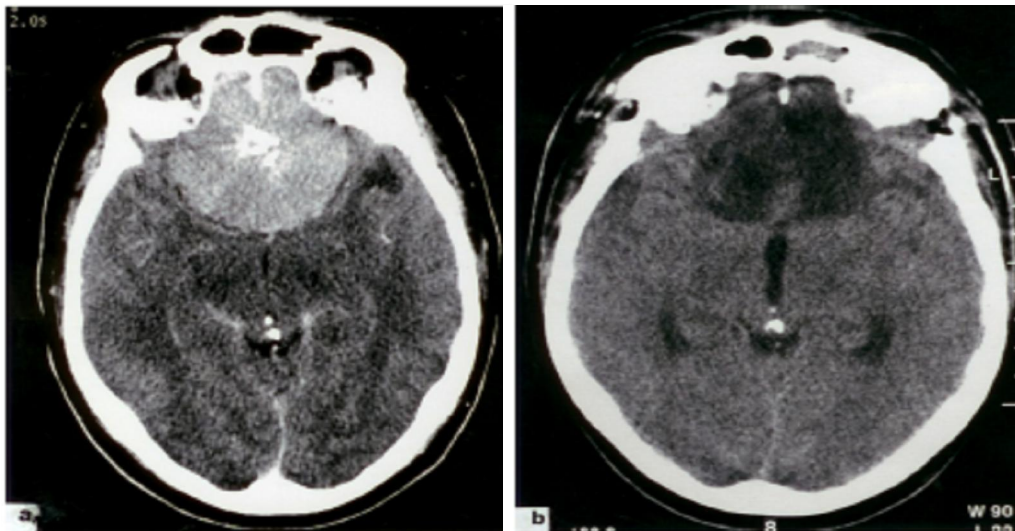


Figure 1 a) Preoperative axial CT scan with contrast enhancement showing a large olfactory groove meningioma in a 53 years old female, with mental and visual disturbances b) Postoperative contrast axial CT scan after tumor removal through the bifrontal approach.

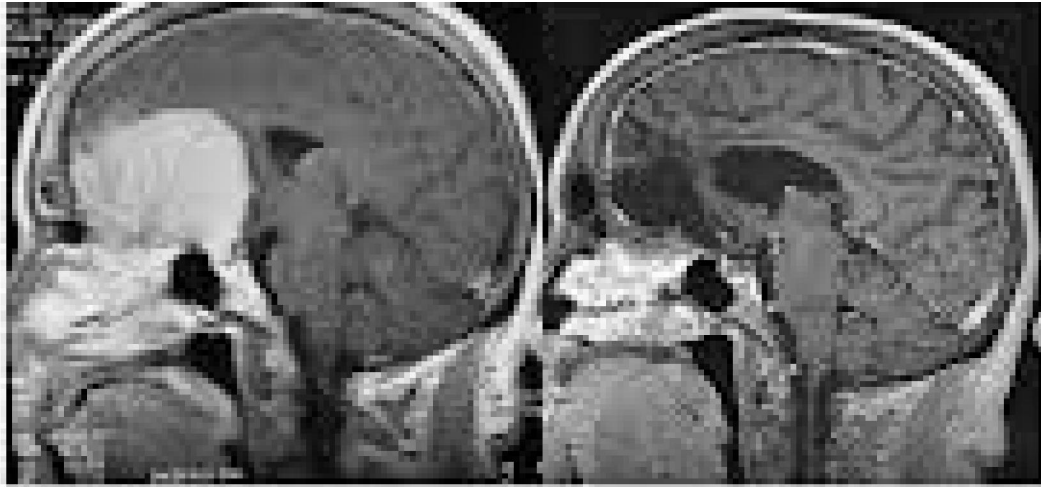


Figure 2. Pre and postoperative MRI sagittal cuts

Morbidity:

One patient had a postoperative intracerebral hemorrhage after surgery and has a permanent dysphasia and hemi paresis. Visual deterioration occurred in 2 patients.

Postoperative functional outcome:

Preoperative, immediate postoperative and follow-up functional disabilities assessed by KPS are presented in (Table5), The scores were similar (Chi-Square test, $df=2$, $p=0.2733$), for patients that returned to work (KPS 80-100)

4. Discussion

The first complete resection of an olfactory groove meningioma, was done by **Francis** in 1895 (4). Cushing published later resection of these lesions in 28 patients in classic work on meningiomas with **Louise Eisenhardt** collaboration (4). In 1938 **Tonnis** line described an approach fronto-orbital half-section of the breast longitudinal top and front of the sickle for exposure of tumors in this region. After these initial experiences several authors as **Derome** (5), **Symon** (6), **Ojemann** (7) or **Solero** (8), have published their results.

The olfactory groove meningioma arises in the midline of the anterior skull fossa on the cribriform plate of the ethmoid near the fronto-sphenoid suture. It may arise in this region at any area from the crista gali to the planum sphenoidal (9). Often they cause tumor hyperostosis in the bone where it arises, and in up to 15% of cases may grow through bone in the ethmoid sinus (10). The blood supply comes from these lesions of the anterior ethmoid artery and subsequent branches of the artery above middle meningeal and meningeal branches of the ophthalmic artery. According to the tumor will increasing in size, can also vascularization

receive small branches of anterior cerebral artery and the anterior communicating artery (11).

There are similarities between the Olfactory groove meningiomas with rear extension and tuberculum selle meningiomas, however there noticeable differences (12). With regard to location, as we have Olfactory groove meningiomas that arise from the cribriform plate and frontoesphenoidal suture, but the tuberculum selle meningiomas will grow initially from the planum sphenoidale and sellar tubercle. As to the vasculature, the tuberculum selle meningiomas receive input from predominantly posterior ethmoid arteries, unlike Olfactory groove meningiomas of the receiving also the anterior ethmoid, middle meningeal and meningeal branches of the ophthalmic. The olfactory nerves are going to be displaced upwards and outwards in the case of Olfactory groove meningiomas, and instead inferiorly by tuberculum selle meningiomas. Finally the optic nerves and chiasm are displaced downward by the olfactory groove meningiomas and the otherwise the tuberculum selle meningiomas compress and displace upwards to such structures.

Given the location of these subfrontal injuries, the olfactory groove meningiomas can reach a large size before producing symptoms (13). The presentation is often insidious in the most series (4, 5, 8, 9) (**Table 2**). The clinic picture is personality and mental changes, loss visual acuity, headache and seizures. The anosmia is rarely a symptom important presentation, since it usually goes unnoticed by patients. The rearmost location of the tuberculum selle meningiomas, causes visual symptoms are more precocious than that in the Olfactory groove meningiomas.

For this reason the olfactory groove meningiomas typically reach a size greater than the tuberculum selle meningiomas.

As in any meningioma, testing basic picture is the Computerized Tomography (CT) and magnetic resonance imaging (MRI). CT is particularly useful to define the bony anatomy, including areas of hyperostosis or erosion, which may change the surgical approach (12). The extension to the sinuses through the floor of the groove shown adequately by coronal CT.

By MRI and magnetic resonance angiography we define the relationship of the tumor with optic chiasm and the cerebral arteries. The role of angiography is controversial. The Preoperative embolization is not necessary because one of the initial objectives surgical intervention is the interruption of blood supply by of the ethmoidal arteries (14,15).

The treatment of olfactory groove meningiomas aims the complete surgical excision of the tumor and involved meninges, though the resection difficulty exists in certain cases. The most important complications reported in the reviewed literature, (**Table 3**) and based on our experience are: loss of sense of smell, seizure, CSF rhinorrhoea, infection and medical complications. Occasionally, visual loss might be observed in large tumors due to excessive traction, surgical bed hematoma and hydrocephalus (1). In patients with large tumors, a frontal lobe syndrome may develop as a result of edema or cerebral ischemia. If the patient does not recover promptly from anesthesia, an immediate computed tomography scan should be done to ascertain the possibility of hematoma, edema, hydrocephalus, anterior cerebral artery infarction and pneumocephalus. Post-operative seizure is unusual, but could occur. Post-operative steroids may be needed for at least 2 weeks after the surgery. In large tumors, hypopituitarism and diabetes insipidus can occasionally be observed. If there is an opening into the ethmoid and sphenoid sinus, both should be repaired, and a lumbar drain is inserted and left for almost 5 days. If the leak remains, an endoscopic transnasal approach is performed. If the leak persists, a closure is best accomplished using a transsphenoidal approach. The main post-operative infections include meningitis, cellulites and bone flap osteomyelitis. Rarely is it necessary to remove the bone flap. Hydrocephalus may be observed due to venous thrombosis, infection after brain ischemia, hematoma or normal-pressure hydrocephalus in the elderly in the post-operative period. A shunt might be necessary useful in these cases. (1, 2)

Postoperative functional outcome

Functional neurological outcome for patients with olfactory meningiomas generally is good. There was no

significant difference between the number of patients able to work (KPS 80-100) preoperatively and at 6 months postoperative.

Conclusion

The meningiomas of the olfactory groove are a frequent tumor encountered in the central nervous system. Its main treatment is surgical resection with good results and liability to complications. The knowledge of the microsurgical anatomy of the region is essential for the good outcome.

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