

## Our Experience about Trans-Sinus Frontal Approach for Olfactory Groove Meningiomas: Technical Note

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Received: 19 January 2024 / Accepted: 13 July 2024 / Published online: 15 December 2024

**BACKGROUND:** Olfactory groove meningioma is the most frequent meningioma of the anterior skull base. It develops insidiously and its diagnosis is late when it reaches a large size resulting in visual impairment or blindness. Olfactory groove meningiomas can be surgically excised and gross total resection is possible. The choice of surgical approach is important. Surgical approaches that can be used include subfrontal, transbasal and pterional approaches. In our practice we opt for the trans-sinus frontal approach to resect these tumors.

**OBJECTIVE:** To evaluate the efficacy of the trans-sinus frontal approach for olfactory groove meningiomas

**PATIENTS AND METHODS:** Twenty-eight (28) cases of olfactory groove meningiomas who were operated by the trans-sinus frontal approach were included.

**RESULTS:** We collected 28 cases of olfactory groove meningioma over a period of 10 years from 2012-2022. The average age in our series was 54.46 years (32 to 73 years). Patient population included 8 male and 20 female patients. The presenting symptom was generally headache found in 18 of our patients. A decrease in visual acuity or bilateral blindness of progressive course was observed in 15 patients. Increased intracranial pressure was observed in 14 patients. Our patients were operated by a trans-sinus frontal approach with total resection in 96% of cases.

**CONCLUSION:** The only radical treatment for olfactory groove meningiomas (OGM) is surgery. The trans-sinus frontal approach offers the possibility of performing a total excision with less morbidity and mortality.

**KEYWORDS:** Anterior skull base, Frontal-Sinus, Meningioma.

### INTRODUCTION

The earliest description of olfactory groove meningioma traces back to Cruveilhier's "Traité d'Anatomie" in 1835. Following this, in 1938, Cushing reported on a series of 28 cases treated through a unilateral frontal craniotomy and subfrontal approach, despite encountering a mortality rate of 19%. While some neurosurgeons still prefer the unilateral frontal craniotomy, often coupled with orbital rim osteotomy to minimize brain retraction. Other neurosurgeons use pterional or transbasal approaches.

Olfactory groove meningioma stands as the most common meningioma of the anterior skull base. Its gradual development often leads to delayed diagnosis, coinciding with significant tumor volume, which could profoundly affect visual prognosis and potentially result in blindness. Despite its challenges, olfactory groove meningioma is treatable through surgical excision, aiming for total resection as the ultimate goal. Thus, the selection of the surgical approach plays a pivotal role in the therapeutic strategy. In our study, we have chosen the trans-sinus frontal approach due to its favorable surgical access.

### PATIENTS AND METHODS

We collected 28 cases of olfactory groove meningioma

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operated in the neurosurgery department of Annaba University Hospital over a period of ten years 2012-2022. The total number of intracranial meningioma cases in our records was 216 cases.

Headaches were observed in 18 patients. Visual disturbances were found in the 15 cases. In 11 cases, visual disturbances were associated with papilledema and 4 cases with optic atrophy (Blindness). All patients were operated upon by a trans-sinus frontal approach to resect these tumors.

The study was submitted to and approved by our institutional ethics committee [ethics committee of Annaba university hospital Ref 00012.23-ma-66-2016]. written and verbal informed consent were obtained from our patients.

### Surgical procedure

All patients were positioned supine with their heads secured in a Mayfield three-point fixation device. A bicoronal skin incision was made, extending from one tragus to the other, with the scalp elevated anteriorly to expose the supraorbital ridges bilaterally and the nasal process of the frontal bone up to the fronto-naso-maxillary suture at the midline. The anterior wall of the frontal sinus was removed as a single block using an oscillating saw or by drilling two symmetrically placed burr holes near the midline, followed by chiseling along the root of the nose. After elevation, the anterior wall was lifted, and the intersinus septa were broken. The mucous membranes of the sinus were excised, and both nasofrontal ducts were

occluded using bone powder, galea, and Surgicel.

Following this, the posterior table of the sinus was perforated, and the dura mater was dissected and removed. Excision of the crista galli was performed, and the dura mater was opened in a V-shape at the junction between the convexity and the base. Ligation and cutting of the falx, along with the origin of the superior sagittal sinus, were carried out. Olfactory nerves affected by the tumor were coagulated during the control of the ethmoidal vessels, while ensuring protection of the unaffected side of the olfactory tracts.

Tumor debulking involved fragmentation, followed by careful coagulation of the dural attachment. All these surgical maneuvers were performed without any risk to the frontal lobes detached away from the orbital roofs and ethmoid by gravity. The operating microscope was set up.

Gradual establishment of the arachnoidal dissection plane freed the posterior pole of the tumor from the frontal parenchyma. Dissection and coagulation of frontopolar arteries were performed, while optic nerves in the optic foramina were identified and preserved. Meticulous dissection of tumor fragments overhanging the tuberculum sellae and impinging on the diaphragm sellae was conducted, separating them from the pituitary stalk. Placement of moistened cottonoids between the posterior pole of the tumor and the brain aided in maintaining separation and minimizing instrumental brain retraction.

## RESULTS

We collected 28 cases of olfactory groove meningiomas in the neurosurgery department of Annaba University Hospital over a period of 10 years from 2012 to 2022.

The average age in our series was 54.46 years old with ages ranging between 32 to 73 years. Including 8 men and 20 women.

Symptom duration varied between 1 and 120 months with an average of 24 months (mean and standard deviation 25.66 - 33.82 months). Eighteen cases (64%) had a symptom duration between 6 and 26 months, demonstrating the slow evolution of the disease.

The presenting symptom was generally headaches, found in 18 of our patients (64%). Visual impairment was present in 53.5% of patients, including decreased visual acuity or blindness. Vomiting was found in 4 cases.

Increased intracranial pressure was observed in 14 patients. Most often were patients who present for chronic and relentless headaches, which last for several months and are eventually associated with vomiting and visual disturbances.

In the 15 cases that presented with visual disturbances, 11 cases had visual disturbances with papilledema and 4 cases with optic atrophy (blindness). Anosmia was found in 5 patients. Anosmia must be systematically sought on clinical examination. The patient often does not perceive the deficit when it is unilateral and confuses it with taste disorders.

Frontal syndrome, characterized by apathy, amnesia, or euphoria, was found in 8 patients.

All patients had computed tomography (CT) scans and/or 20 patients had magnetic resonance imaging (MRIs) (Fig. 1). The antero-posterior diameter of the tumors varied between 18 mm and 75 mm. Our patients underwent surgery via the trans-sinus frontal approach, achieving gross total resection in 96% of cases (Figs. 2,3).

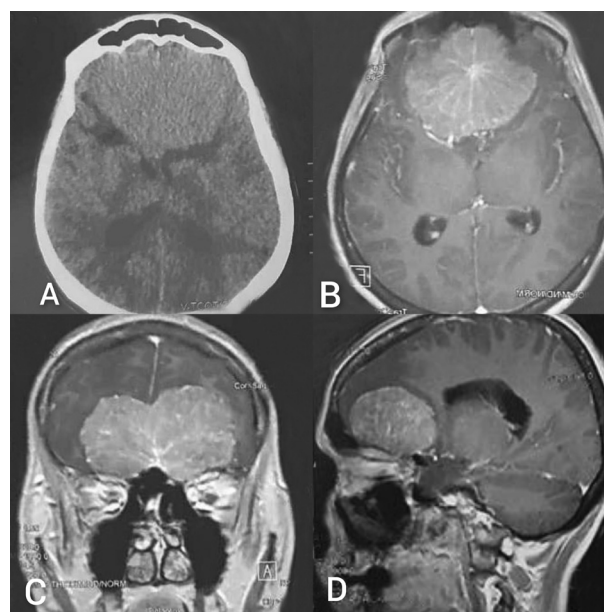
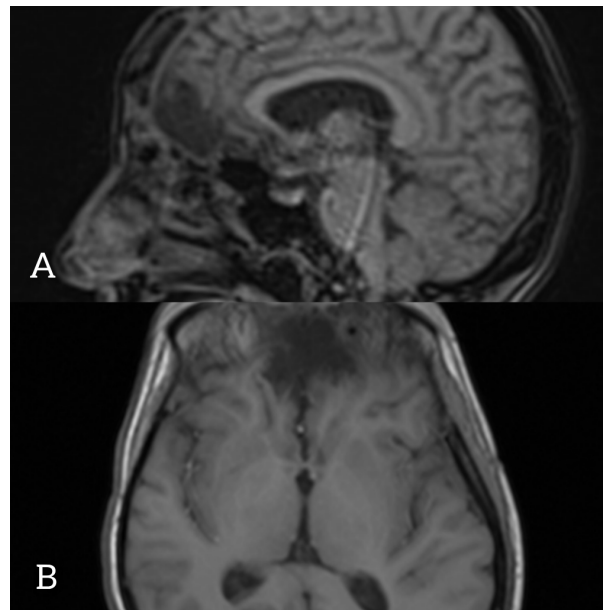
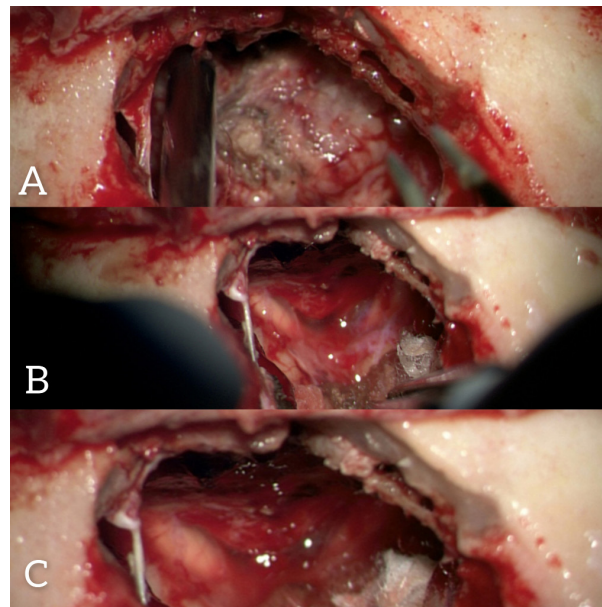


Fig 1: Preoperative CT scan.



**Fig 2: Postoperative MRI brain.**



**Fig 3: Intraoperative photos showing trans-sinus approach.**

Postoperative complications included cerebrospinal fluid (CSF) leaks in 10% of patients and infections in 7%. For the CSF leaks, patients received lumbar punctures and medical treatment with Diamox (250 mg). For infections, we administered broad-spectrum antibiotics for two weeks. We observed improved visual function in 10 cases, and the cosmetic results were satisfactory.

In our series, the meningotheial type was the most frequent, occurring in 86% of cases, which is above the literature rate of 79.2%. Meningioma type II accounted for 14% of cases (including one anaplastic meningioma and three atypical meningiomas).

We had three deaths. This was an initial study, and the deceased were elderly patients (over 65 years old) who were hypertensive and diabetic. One patient had

an atypical image of an olfactory groove meningioma (OGM) on the CT scan. The pathological diagnosis was anaplastic meningioma. This patient died on the first postoperative day.

#### **DISCUSSION**

Twenty-eight (28) patients were included in the study, 20 patients are females and 8 are males. The Average age in our series was 54,46 years, ranging from 32 to 73 years. Reporting an average age of 55 years with extremes of 16 years to 85 years. In the series of 85 cases by Nakamura et al,<sup>2</sup> the age ranged between 33 years and 91 years with an average of 57 years. Thus, meningioma is a frequent pathology after the age of 50 years, which makes its surgery a challenge. Mortality is variable according to age; its incidence increases with age.<sup>3</sup>

Spektor et al,<sup>4</sup> in a series of 80 cases of olfactory groove meningiomas, reported 58 women against 22 men with sex ratio 0.38. Our results were similar to those of the literature. Female predominance was reported in most series, which confirms that meningiomas are more common in women. According to Perry et al,<sup>5</sup> the gender was a prognostic factor. Indeed, atypical and malignant meningiomas are observed more frequently in men.

The time interval between onset of symptoms until diagnosis was 25.66 months ranging from 1 to 120 months. Hassler and Zentner<sup>6</sup> reported a delay ranging from 0 to 168 months. Diagnosis is usually made at a very late stage after the tumor has reached a large size, which makes it a challenge for a neurosurgeon.

In addition to the few clinical signs at the beginning caused by the benign behavior of the tumor, patients generally complain of long lasting headaches that are repetitive and relentless. These headaches rarely have a localized character and are usually associated with visual disturbances and vomiting at variable times. In our series it is around 50%, Spektor et al<sup>4</sup> reported 11% and Nakamura et al<sup>2</sup> reported 19.5%.

Behavioral problems in our series were 28.5% that is close to that of Spektor et al,<sup>4</sup> who reported 27%. Tsikoudas and Martin-Hirsch<sup>7</sup> reported 62% and Turazzi et al.<sup>8</sup> 73%.

Visual impairment in our series was 53.5%, including decrease in visual acuity or blindness. Tuna et al,<sup>9</sup> in a series of 25 patients operated upon for olfactory groove meningioma, reported that 52% of cases suffered from visual disturbances, and ophthalmological examination revealed papilledema in 68% of patients.

Headaches and visual disturbances are the main common clinical signs of olfactory groove meningioma.<sup>8,10</sup> Slow development of olfactory groove meningiomas allows good tolerance in patients for a long period before signs of intracranial hypertension start. The first symptom was the change in behavior.<sup>10</sup>

The antero-posterior diameter of the tumors in our series varied between 18 mm and 75 mm with an average of 46.92 mm. Spektor<sup>4</sup> reported sizes varying between 20 mm and 80 mm with an average of 46 mm, being greater than 40 mm in 72%.<sup>6</sup>

The greater the size of the tumor, the greater the operative difficulties. According to Jan et al,<sup>11</sup> postoperative mortality is 11%. This mortality was greater when the subject was old, the size of the tumor was large and the neurological state was altered. Completed surgical excision should be the goal in olfactory groove meningioma treatment.

In our approach, we performed a simpson's grade 1 or 2 resections in 96% using the trans-sinus frontal approach. Hallacq et al<sup>12</sup> reported a 100% rate of Simpson's grade I while Paterniti et al<sup>13</sup> reported 100% using the pterional approach. Turazzi et al,<sup>8</sup> and Spektor et al<sup>4</sup> respectively

achieved 100% and 90% using the bifrontal approach.

Postoperative complications were mainly represented by CSF leak in 10% and infection in 7%.

Operative mortality in our series was 3 cases. In the series of Tsikoudas and Martin-Hirsch<sup>7</sup> mortality was 15%, while Bassiouni et al,<sup>14</sup> reported 9% mortality, however it is nil in the series of Mayfrank and Gilbach,<sup>15</sup> Spektor et al,<sup>4</sup> and Nakamura et al.<sup>2</sup>

Postoperative mortality varies between 0, 17%, and 22.7% in old series.<sup>1</sup> It continues to decrease due to progress in microsurgical techniques, resuscitation, and postoperative nursing.

In our series, the meningothelial type was the most frequent (86%), meningioma type II represented 14% (one anaplastic meningioma, 3 atypical) which poses a problem of recurrence and need for adjuvant (therapeutic) radiotherapy.

According to Lee et al,<sup>16</sup> meningothelial meningioma was the most common type for basal meningiomas 84.9%.

We opted for the trans-sinus frontal approach for the OGM. In our opinion the advantages include the following: [Hallacq].<sup>12</sup>

It is quick to perform and the intervention time is therefore reduced, on average by four hours in our series. A definite advantage for the elderly, compared to other approaches.

Moreover, it will allow a fairly direct approach to the lesion in its anterior part and good visibility including that at its lateral part and parts at midline, the roofs of the orbits and behind the level of the optic canals and the tuberculum sellae. The flap is facilitated by the width of the sinus. The lateral extension of olfactory meningioma is not the rule, so there is no need to extend the approach laterally to the external frontal pillars.

The absence of cerebral retraction helps to reduce edema, contusions or cerebral ischemia produced by the compression and/or the sacrifice of the frontal drainage veins. The ethmoidal vascular supply is rapidly controlled. The early devascularization of the tumor makes it possible to evolve into a bloodless operating field and the dissection of the posterior part of the tumor is facilitated. There is no need to open the lateral fissure or the sylvian valley which thus remains at a distance from the operative cavity. The tumor resection is generally complete, producing a Simpson I or II. Anosmia is often pre-existing to the intervention and it is not reversible because the olfactory strips are invaded and distended by the tumor tissue and are carried away during the excision. On the other hand, the olfactory strips are sectioned in case of extension in the nasal cavity.

The disadvantages of the approach are infection and postoperative CSF leak. Infections are favored by the communication of the intracranial contents with

the aeric ones (frontal nasal canal). Another cause is detachment under the periosteum depriving the bone of its vascularization. The existence and importance of dead space and the difficulty of cerebral expansion in the elderly can increase the risks. Infectious complications are prevented by canalization of the frontal sinus with complete curettage of the mucosa, and filling of the frontal nasal canals. A lasting waterproof closure on periosteum, the tightness of the basal dura being also ensured by a periosteum glued on the dural defect particularly at the level of the hyperostosis if it is removed. This durable closure prevents CSF leak. When the dura cannot possibly be closed at the basal level, the closure is ensured by opposition of several periosteal flaps, between the dural plane and the bone, which makes it possible to avoid CSF leak.

## CONCLUSION

The only radical treatment for olfactory meningioma is surgery. The choice of approach is the cornerstone of this surgical strategy. The trans-sinus frontal approach offers the possibility of performing a total excision with less morbidity and mortality. For olfactory groove meningiomas (OGM) larger than 30 mm, minimally invasive surgery is not suitable. A direct approach via the trans-sinus frontal route is indicated if the sinus is well pneumatized. It is a quick and simple approach that reduces operating time. The meningioma is addressed at its base of insertion, which allows for rapid devascularization and progression in a bloodless surgical field. The trans-sinus frontal approach must be widened for other tumors of the anterior skull base in its middle part.

## List of Abbreviations

CSF: Cerebrospinal fluid.  
CT: Computed tomography.  
MRI: Magnetic resonance imaging.  
OGM: Olfactory groove meningioma.

## Disclosure

The authors report no conflict of interest in the materials or methods used in this study or the findings specified in this manuscript.

## Funding

The authors received no financial support for the research, authorship, and/or publication of this paper.

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