

# Frontal sinus osteomas: the window of endonasal endoscopic approach\*

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## SUMMARY

**Objective:** Management of symptomatic osteomas involving the frontal sinus is challenging. Traditional external approaches have been used in the surgical management of these lesions. Recently, endonasal endoscopic surgery has become a valid alternative to the traditional external approach in selected cases.

**Method of study:** Retrospective evaluation of the patients with symptomatic fronto-ethmoidal osteomas surgically managed in the last 10 years at a tertiary care facility.

**Results:** Twenty-six osteomas involving the frontal sinus were treated surgically. In 11 cases a purely endoscopic approach was performed while in 13 patients a combined procedure was used. In two patients, an exclusively external procedure was performed. No osteoma recurrence has been observed yet (mean follow up:  $40 \pm 31.75$  SD months).

**Conclusions:** Endonasal endoscopic resection of a frontal sinus osteoma is feasible when the lesion is medial to a virtual plane through the lamina papyracea and is attached in the lower portion of the posterior wall of the frontal sinus.

*Key words:* endoscopic resection, frontal osteomas, cavitation, osteoplastic flap, headache

## INTRODUCTION

Osteomas are benign tumours often involving the paranasal sinuses. Among these, the frontal sinus is the most frequent location, followed by the ethmoid, maxillary and sphenoid sinus<sup>(1)</sup>. These lesions only occasionally cause symptoms, which are related to its location and its anatomical relationship with the surrounding structures; osteomas of the fronto-ethmoidal region usually produce earlier symptoms. As a whole, the symptoms include headache localized over the area of the osteoma, facial pain or deformity, rhinorrhea and anosmia. Associated conditions, such as chronic rhino-sinusitis and mucocele, may arise with the possibility of intraorbital or intracranial complications<sup>(2)</sup>.

Conservative management with serial CT scanning is recommended for asymptomatic osteomas<sup>(3)</sup>. Sphenoid osteomas are exceptions to this rule and have to be removed as soon as possible due to the slow and gradual enlargement that can lead to compression of the visual pathways<sup>(4)</sup>; on the other hand, fronto-ethmoidal osteomas represent a unique challenge. The management of these lesions depends on the patients' symptoms as well as on the size and location of the tumour. From a surgical point of view, the use of an osteoplastic flap plus frontal sinus obliteration has been considered the best surgical

option in the past<sup>(5)</sup>. Since the first report of an endoscopic resection in 1992<sup>(6)</sup>, endonasal endoscopic management has gained popularity over the last ten years<sup>(7-9)</sup>. However, the treatment of sinonasal osteomas and the type of surgical approach remains a subject of debate.

The aim of this work is to describe our 10-year experience with the surgical resection of symptomatic osteomas of the fronto-ethmoidal region and to understand the limits and possibilities of endonasal endoscopic management in these patients.

## MATERIALS AND METHODS

### *Patient evaluation*

All cases of osteomas surgically treated in the last ten years at our Institution and involving the frontal sinus underwent retrospective evaluation. The study met the approval of the local Board of Medical Ethics.

All the patients were evaluated with nasal endoscopy and CT scan with axial, coronal and sagittal images (for the more recent cases). Evaluation of the three CT scans permits knowledge of the size, the position and the relationship of the osteoma. The sagittal plane is useful for understanding the antero-posterior diameter of the frontal sinus. In fact, if this measurement is less than 10 mm, a purely endoscopic approach

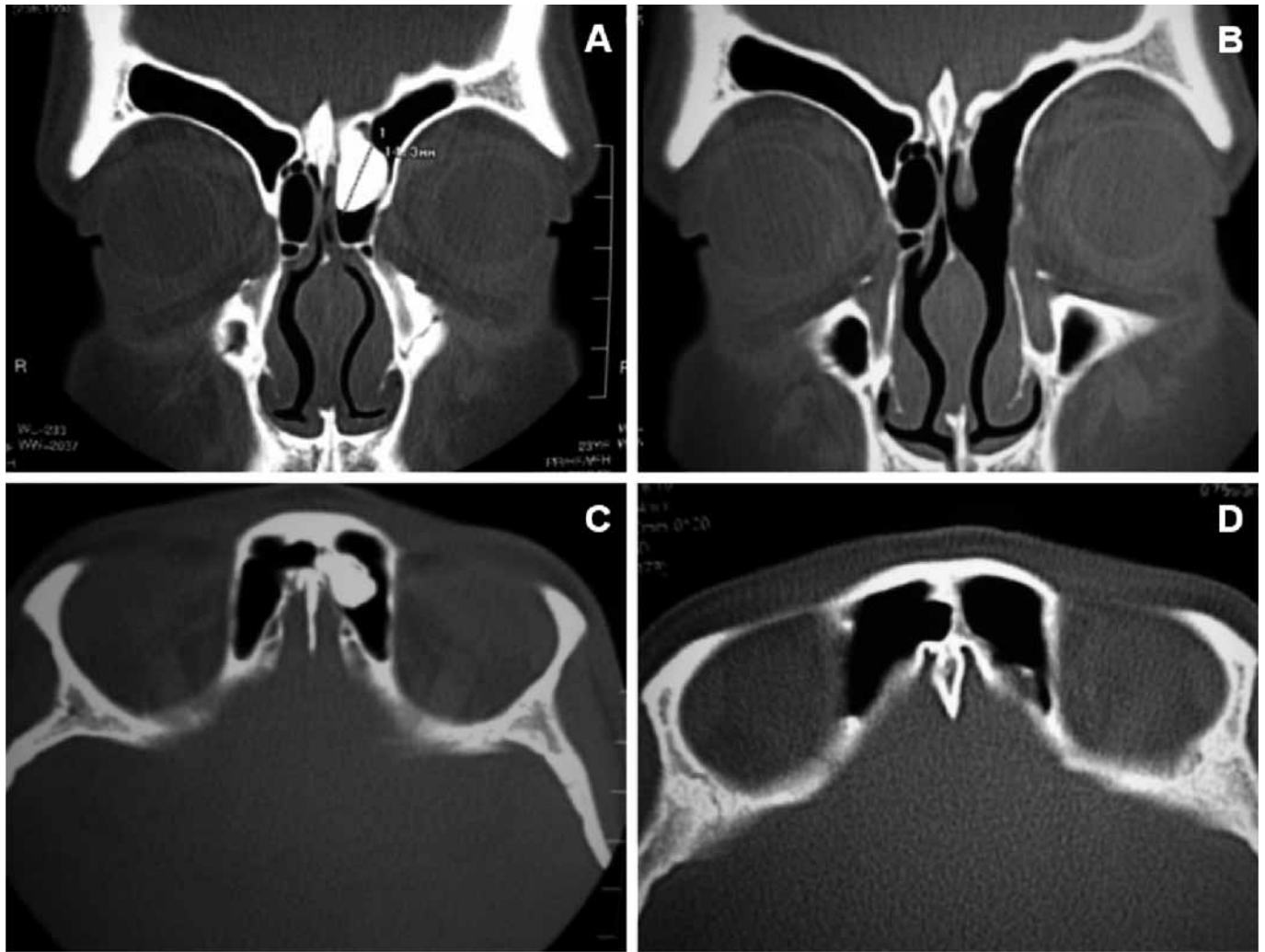


Figure 1. CT images of a patient with a left fronto-ethmoidal osteoma. A-Pre-op coronal view; B-Post-op coronal view; C-Pre-op axial view; D-Post-op axial view.

becomes very hard to perform. Moreover, it allows us to understand the superior attachment of the lesion and/or the superior extension of the lesion. In our opinion, a lesion located in the superior part of the posterior wall of the frontal sinus can be difficult to manage endoscopically. On the other hand, if the lesion occupies the superior part of the sinus, without any clear relationship with the sinus wall, it can be tackled via an endoscopic approach. The coronal and the axial planes are used to evaluate the lateral position of the osteoma. Moreover, the coronal plane is also useful to evaluate the relationship to the skull base, mainly the lateral lamella of the cribriform plate, in order to plan a skull base plasty in the event of a cerebrospinal fluid leak. A coronal scan can also be used to evaluate the percentage of frontal recess occupied by the tumour<sup>(9)</sup>. All together, these sections are useful to create a 3D vision of the lesion and of the surgical anatomy in the mind of the surgeon. In this sense, a clear understanding of the cellular structure and the drainage pathway of the frontal recess represent essential steps in the surgical planning<sup>(10)</sup>. For the osteoplastic procedure, an occipital-frontal radiograph of the frontal sinus was deemed suitable for creating a template for safely opening

the sinus itself. During the follow-up, patients were evaluated with nasal endoscopy. CT evaluation was performed only in selected cases.

Data concerning presenting symptoms, associated pathologies, surgical approach, duration of stay in hospital, tumour characteristics, complications and recurrences were all gathered and analysed in detail. Lateral tumour extension and site of the attachment was evaluated by means of CT scan. All the surgical specimens were histologically evaluated with a response of osteoma.

#### *Exclusion criteria for an endoscopic approach*

Intracranial extension, large intraorbital involvement, antero-posterior diameter of the frontal sinus less than 10 mm, lateral extension behind a virtual plane through the lamina papyracea and erosion of the posterior or anterior wall of the frontal sinus. These criteria derive from a previously published study<sup>(7)</sup>. Given the fact that to completely remove an osteoma it is necessary to control all the tumour boundaries, patients with the above-mentioned features are not suitable for a purely endoscopic approach and need at least a combined procedure.

*Endonasal approach*

The procedure begins with a standard anterior ethmoidectomy and, when necessary for reaching the frontal osteomas, a Draf II or III procedure is performed. When deemed appropriate, an endonasal endoscopic dacryocystorhinostomy is performed. The extension of the surgical dissection is proportional to the surgical necessity and it is tailored to the patient's condition. In other words, the same surgical approach is used in all the patients but not with the same extension. If the osteoma is small it is resected without the use of a drill. Otherwise, in larger lesions we perform a cavitation of the osteoma with an endonasal drill in order to make its removal easier. In this way we obtain thin bone boundaries that can be removed easily. At the end of the surgical procedure the nasal cavity is usually packed with lyofoam.

*Osteoplastic flap with coronal incision*

The coronal skin incision is made behind the line of the hair-line in order to conceal it; then the flap is dissected over the pericranial plane, which is carefully preserved. Thereafter, once the frontal table is fully exposed, we perform a pericranial flap, based inferiorly, in order to expose the frontal bone. Usually we use a template (see above) in order to make the frontal osteotomy safer. Once the sinus is fully exposed, the osteoma is drilled out using the cavitation technique and by removing the bone boundaries of the lesion. Sinus mucosa is spared whenever possible. No fat obliteration is performed. At the end of the procedure, the bone plate is replaced and anchored.

**RESULTS**

Between June 1996 and June 2006, we treated 26 cases of paranasal osteomas involving the frontal sinus. In 8 cases the osteoma was not limited to the frontal sinus but also involved the anterior ethmoid.

There were 16 females and 10 males and their age at surgery ranged from 19 to 77 years (mean  $43.8 \pm 14.2$  SD years). Mean follow-up has been  $40 \pm 31.75$  SD months (minimum 5, maximum 116).

*Presenting symptoms*

Ten patients (38%) presented monolateral nasal obstruction while 5 patients (19%) complained of nasal rhinorrhea (in three cases it was purulent). Seven patients complained of facial pain and in 4 of these it was located to the orbital region. In sixteen cases (61%), headache was present, almost in the frontal area, while 4 patients (14%) complained of hyposmia. In two cases (7%) there was an epiphora while in 4 cases (14%) a swelling of the internal cant or in the frontal area was seen. Neither proptosis nor diplopia was observed; in fact, we had only one case with moderate orbital involvement.

*Associated pathologies*

Polypoid chronic rhino-sinusitis was observed in six patients. No mucocele or other sinus pathologies was seen in our series.

*Surgical approach*

A purely endoscopic approach was performed in 11 patients. A Draf IIa drainage was performed in 2 patients and a Draf IIb drainage in 3, while in one case a Draf III drainage was necessary. In 13 cases a combined procedure was used while in two patients a purely external approach was performed (one osteoplastic flap with coronal incision and one Howart-Lynch fronto-ethmoidectomy).

*Duration in hospital*

For the endoscopic group the mean stay was 4.5 days (range: 3-7 days) while in the combined and external group the mean stay was 6.3 days (range: 4-13 days).

*Tumour characteristics*

All the osteomas we approached through a purely endonasal route were medial to a virtual sagittal plane through the lamina papyracea. In 5 of these, the lesion was quite small (around 1 cm at its greatest point) and located at the level of the frontal recess. In these cases, no extended frontal sinus procedure was performed. Another 4 patients present with medium-sized lesions (less than 2 cm at the greatest point) mainly attached at the inferior part of the posterior wall. In the other two patients, the lesion was mainly attached at the lateral lamella of the cribriform plate. One of the two patients we approached through an external route had the osteoma mainly located laterally in a wide frontal sinus, and we performed the Howart-Lynch procedure. It was one of our first cases and after this we changed our minds and started the osteoplastic procedure. The other one had a large osteoma that completely filled a frontal sinus and with moderate lateral extension, the reason for which we performed an osteoplastic approach. Among the 13 cases of combined procedure, we observed 6 cases in which the lesion was mainly located at the posterior wall of the frontal sinus and 3 cases in which the lesion was attached at the anterior wall (nasofrontal beak with a moderate extension into the sinus), while in the other 4 the lesion was greatly diffused in the sinus. In one of these patients, a moderate orbital involvement was observed. Eight of these 13 cases were lateral to the sagittal plane through the lamina papyracea. The largest tumour operated endoscopically was 2.9 cm at its greatest point, with a large component in the anterior ethmoid. As a whole, the tumours ranged in size from 0.6 cm to 4.1 cm, at their greatest points, while the median size was 1.9 cm. In the endoscopic group, median size was 1.3 cm (ranging from 0.6 to 2.9 cm). In the external and combined group, taken together, the median size was 2.4 cm (ranging from 1.6 to 4.1 cm).

*Complications*

No serious complications were observed after surgery. No cerebrospinal fluid (CSF) leak was observed in this group. In the patient with orbital involvement, no lesion of the periorbit occurred during surgery and the follow-up has been uneventful.



Figure 2. CT images of a patient with a left fronto-ethmoidal osteoma associated with chronic rhino-sinusitis. A-Pre-op coronal view; B-Post-op coronal view; C-Pre-op axial view; D-Post-op axial view.

#### Recurrences

At the time of writing we have observed no recurrence.

#### DISCUSSION

Osteomas are the most common benign tumours of the paranasal sinuses and they are seen in about 3% of CT scans<sup>(1)</sup>. Their incidence in the general population has been shown to be in the range between 0.43% and 1.0%<sup>(3,6)</sup>. The frontal sinus is the most frequent location while the maxillary and sphenoid sinuses are seldomly involved with the ethmoid sinus in a middle position. From a clinical point of view, they are usually asymptomatic and are found incidentally on radiographic examination but in some cases they produce symptoms related to invasion of the surrounding structures. Osteomas rarely cause severe orbital or cerebral complications. In our series, the most frequent complaints were headache/facial pain (61%), nasal obstruction (38%), rhinorrhea (19%) and hyposmia (14%). Fortunately, neither cerebral nor orbital complications have been observed in our patients. Regarding the relationship between the symptoms and the location of the lesions, no firm conclusion can be drawn given

the fact that most of our patients complained of facial pain and/or headache. Furthermore, we observed that huge lesions can be associated with minor discomfort while some smaller lesions, located mainly in the frontal recess, can be responsible for severe pain and discomfort. All our patients with lateral extension complained of fronto-orbital discomfort and/or pain, of different intensity. After surgery, we observed no worsening of the symptoms and most of the patients experienced an improvement, at least partial, of the pain and/or discomfort.

Based on these considerations and given their benign nature, management of osteomas must be well pondered. Moreover, when surgical treatment of benign lesions is taken into consideration one must keep in mind the safety and efficacy of the surgical procedure as well as patient morbidity. Surgery has been advocated for osteomas extending beyond the boundaries of the frontal sinus, with progressive enlargement, or for cases that are localized in the region adjacent to the frontal recess or which are associated with chronic rhino-sinusitis and for osteomas of the ethmoid sinus irrespectively of their size<sup>(12)</sup>. Furthermore, until now it is not fully clear if an osteoma

can recur after incomplete removal. In this sense it has been proposed that growth begins centrally in osteomas with increasing maturation of bone toward the external surface. Hence, given this theory, it is logical to think that excision of the central part of the lesion may lead to a steady state of the neoplasm<sup>(13)</sup>. However, the recurrence of an osteoma that had been only partially removed has been described<sup>(14)</sup>. Notwithstanding, most authors prefer, when possible, a complete resection of the lesion<sup>(7-9)</sup> and we, too, recommend complete removal of the osteoma.

Diagnosis is based especially on CT images, which are also necessary for making a decision and planning surgery. Differential diagnosis includes fibrous dysplasia and ossifying fibroma, the CT aspects of which are generally less defined than those of paranasal osteomas<sup>(15)</sup>. A CT scan is a fundamental tool that not only permits diagnosis but also allows the correct surgical approach to be planned<sup>(10)</sup>. In this sense, the lateral extension of the lesion and the base of its attachment must be well evaluated. We believe that a lesion mainly extending laterally beyond a plane through the lamina papyracea cannot be managed successfully through an endonasal access due to the difficulties encountered when working in the supraorbital recess. As far as the site of attachment is concerned, we believe that a lesion attached to the anterior wall or to the upper portion of the posterior wall is difficult to remove via the endonasal route. In this sense, according to others, we think that the surgeon's ability to 3-dimensionally reconstruct the frontal region anatomy and the relationships of the lesion with the surrounding structures should improve the surgical outcome<sup>(10)</sup>.

From a surgical point of view we believe, in agreement with others<sup>(7)</sup>, that in order to remove completely a lesion occupying space it is necessary to control all the tumour boundaries. This is particularly true when the surgical approach is minimally invasive, such as with the endonasal endoscopic approach. In this respect, and when there is no significant involvement of the orbit, ethmoidal osteomas can be completely removed via an endonasal approach. Moreover, if the osteoma is massive it can be reduced in size with a drill in order to facilitate complete resection<sup>(16)</sup>.

In the past, osteomas located in the frontal sinus have been managed by means of an osteoplastic flap with frontal sinus obliteration<sup>(9)</sup>. But it must be pointed out that endoscopic frontal sinus surgery has advanced significantly over the last few years. The two main reasons for this are improved surgical skills and the development of advanced instrumentation. However, when an osteoma is attached superiorly in the frontal sinus, its removal can create a defect in the posterior wall of the frontal sinus and consequently a CSF leak that is difficult to repair endoscopically. For these reasons, an open approach is advisable in these cases. Obviously, an external open approach presents greater morbidity for the patient and

the criteria for choosing this surgical approach must be sure. Whenever feasible, an endonasal approach is obviously advisable for the fact that it causes lower morbidity and a shorter hospital stay, and our data seem to confirm this latter statement; in our series, in fact, the patients operated endonasally stayed in the hospital less than the patients operated via an external route (mean 4.5 days vs 6.3 days) with lower morbidity in the post-operative period.

Unfortunately, until now there is no consent regarding which criteria are the most appropriate for choosing the surgical approach. The location of the osteoma in relation to the lamina papyracea, the point of attachment and the size of the osteoma in relation to the size of the frontal recess are considered very important aspects when planning the surgical approach<sup>(8)</sup>. Other authors consider endoscopically removable an osteoma that is located medially to a virtual sagittal plane through the medial orbital wall and based inferiorly on the posterior frontal sinus table<sup>(7)</sup>. Our experience as well, as mentioned previously, seems to confirm this last opinion. In fact, 11 patients in our series presented these features and they could be managed well via an endonasal route. An extended endonasal frontal approach was necessary in 6 cases to control all the boundaries of the osteoma. These two criteria are more important than the dimension of the osteoma itself; in fact, we were able to remove endoscopically even a lesion of 2.9 cm at its greatest point, favourably located, but on the other hand we were unable to endoscopically remove smaller lesions located too laterally in the frontal sinus. Furthermore, the effectiveness of these selection criteria is confirmed by the fact that, in our series, there was no need to convert an endonasal procedure into an external one and that we encountered no surgically-related complications. Moreover, to date we have seen no recurrence during the follow-up period (mean follow-up  $40 \pm 31.75$  SD months) thus witnessing complete resection in all cases. Moreover, the use of the cavitation technique allows the removal of large osteomas as well, due to the possibility of reducing the lesion and easily removing the residual thin bony boundaries. In effect, it is not difficult to understand that it is easier to remove a thin bony boundary than a large bony mass. All the same, we wish to stress the concept that a lesion that involves a large portion of the posterior wall is difficult to remove endonasally.

Finally, having made all these observations, we believe that the appropriateness and feasibility of the endonasal procedure in the management of a frontal osteoma should be assessed carefully with the aid of CT scan. We strongly assert that in the management of such lesions, observance of these planning strategies makes the endoscopic approach not only feasible but also advisable with a minimum risk of failed procedures.

## CONCLUSION

The role of endonasal endoscopic surgery in the management of frontal sinus osteomas has been expanding over the last few

years. Proper surgical planning allows identifying the patients in whom an exclusively endoscopic procedure will be applicable. The absence of a significant extension laterally to a plane through the lamina papyracea and the inferior attachment on the posterior wall represent pre-operative features that consent planning an endonasal procedure. In addition, the cavitation technique is a very useful solution for the removal of large frontal sinus osteomas.

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