

Frontal sinus osteoplastic flap: is it relevant today?

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Received 30 September 2015

Accepted 2 June 2016

The Egyptian Journal of Otolaryngology
2018, 34:229–233

In the present era where frontal sinus surgery is synonymous with functional endoscopic sinus surgery, we present a case series comprising six cases of varied frontal sinus pathology that were managed with an external approach using an osteoplastic flap technique. The study was carried out in the ENT Department of Calcutta National Medical College, a tertiary care center in Kolkata. A unilateral osteoplastic flap approach was adopted in three cases, of which two were reported as osteomas and one was that of inverted papilloma. Bicoronal osteoplastic flap was raised in another group, which included a case of communitated fracture of the anterior wall of the frontal sinus with obvious cosmetic facial deformity, a case of fracture of the posterior wall of the frontal sinus with traumatic cerebrospinal fluid rhinorrhea with pneumoencephalus, and a case of plasmacytoma of the frontal sinus. The mean follow-up period ranged from 1 to 3 years. There was no recurrence of disease and no significant postoperative complications have been reported during the follow-up period so far.

Keywords:

external approach, frontal sinus, frontal sinus obliteration, osteoplastic flap

Egypt J Otolaryngol 34:229–233

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1012-5574

Introduction

Frontal sinus surgery has come a long way since eighteenth century when the first frontal sinus procedure was described in 1750 [1]. More than two centuries have passed since then and the management of frontal sinus disorders is still a matter of debate. Its variable anatomy and proximity to critical structures such as the orbit and the anterior skull base make the frontal sinus surgery different from the relatively more straightforward surgical approaches to the rest of the paranasal sinuses. Although recent advances in imaging and endoscopic techniques have led to resurgence in intranasal endoscopic procedures, in certain frontal sinus diseases such as frontal/frontoethmoid osteoma, posterior table erosion, failed endoscopic approaches, laterally placed disease, and absent or distorted intranasal landmarks, open approach is still the modality of choice [2]. Time and again, osteoplastic anterior wall approach to the frontal sinus has proved to be one of the most effective, simple, and reliable procedures with excellent success rate and good cosmesis [3].

Case history

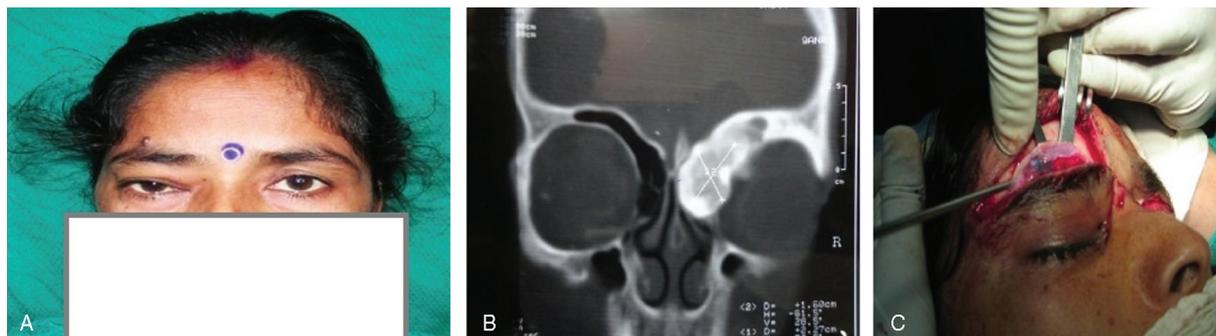
After taking a relevant and informed consent from the patients or guardian (whichever applicable), each patient was treated under general anesthesia. Both cases of osteoma were managed with a unilateral osteoplastic flap raised by means of a supraorbital incision that extended to the level of nasal process of the frontal bone, followed by elevation of the

musculocutaneous flap superiorly (Fig. 1a–c and Table 1).

The osteoma was then chiseled out, clearing the frontal sinus, whereas in case of inverted papilloma the unilateral osteoplastic flap was raised in continuity with the Weber–Ferguson incision. In three cases, the flaps were raised using bicoronal incision made behind the hairline and just anterior to the tragus bilaterally. The dissection proceeded beneath the galea, with elevation of the frontalis muscle. The scalp flap was pulled caudally on both sides, leaving behind the periosteum and the bone, thus preserving the supraorbital and supratrochlear vascular bundle. A template of the frontal sinus excised from the occipitofrontal plain radiograph, preserved in a disinfectant solution was positioned on the root of the nose and borders of the frontal sinus were estimated. The pericranium was incised and elevated using blunt as well as sharp dissection up to the supraorbital ridge and over the root of the nose slightly, being pedicled caudally at the bone. The anterior wall of the frontal sinus was downfractured and elevated as inferiorly based bony flap after joining the burr holes drilled along the outline of the frontal sinus with an $\sim 30^\circ$ angulation directed toward the

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Figure 1



(a) Right supraorbital swelling (osteoma). (b) Radiodense shadow occupying the right frontal sinus. (c) Downfractured anterior wall of the frontal sinus after elevation of right-sided musculocutaneous flap (unilateral) through a right supraorbital skin incision to gain access to the osteoma.

Table 1 Brief history, positive features on examination and radiology, diagnosis, and management of the cases

Case	Age (years)	Sex	Chief complaints	Computed tomography finding	Diagnosis	Treatment modality
1	40	Female	Swelling near the right eyelid just above the medial canthus	Radiodense opacity in the right frontal sinus	Frontal osteoma Fig.1a–c	Osteoplastic flap (unilateral)
2	59	Male	Supraorbital swelling and proptosis of the left eye, pain, recent-onset diminished vision	Homogenous opacity, left frontal sinus with erosion of the roof and the medial of the wall left orbit	Plasmacytoma Fig.2a–c	Osteoplastic flap (bicoronal)
3	38	Male	CSF rhinorrhea	Fracture of the posterior table of the left frontal sinus and pneumoencephalus	CSF leak with fracture of the frontal sinus Fig.3	Osteoplastic flap (bicoronal)
4	22	Male	Left supraorbital swelling	Radiodense opacity in the left frontal sinus	Frontoethmoid osteoma	Osteoplastic flap (unilateral)
5	52	Male	Unilateral proptosis, nasal mass discharging sinus with maggots	Opacified ipsilateral maxillary, ethmoids and frontal, intracranial but extradural extent	Inverted papilloma	Osteoplastic flap (modified Weber–Ferguson)
6	30	Male	Facial disfigurement	Comminuted fracture of the anterior table of the frontal sinus	RTA with fracture of the frontal sinus	Osteoplastic flap (bicoronal)

CSF, cerebrospinal fluid; RTA, road traffic accident.

frontal sinus maintained to ensure a wide surface for the later replacement of the bony flap.

Discussion

External approach accounts for about 5% [4] of all frontal sinus surgeries, with the osteoplastic flaps usually being reserved for those disorders that cannot be successfully treated endonasally [5,6]. This approach provides an optimal view of the entire frontal sinus and allows complete microscopic removal of the mucosa as well as obliteration of frontal sinus with abdominal fat [7]. The various surgical approaches to deal with frontal sinus disorders can be either external, intranasal, or combined depending on the type and extent of disease. External approach includes frontal sinus trephination, frontoethmoidectomy (Lynch–Howarth) or osteoplastic bone flap. Intranasal approach for all practical purpose means endoscopic sinus surgery

ranging from Messerklinger technique with special emphasis on mucosa preservation to more radical endoscopic approaches such as the modified Lothrop [8,9] (frontal sinus drill out) and balloon sinuplasty [10]. Availability of such a wide variety of treatment modalities makes the optimal management protocol for frontal sinus disorders a matter of conflict and debate. In addition, no single approach has been able to fulfill the criteria for the modality of choice in terms of excellent results, no recurrence or residual disease, minimal morbidity, short hospital stay, uneventful long-term postoperative course, and good cosmesis in cases of extensive disease and extrasinus involvement.

In 1884, Ogston [11] described trephination through the anterior table to evacuate the frontal sinus and placed a tube in the nasofrontal duct. However, this technique had high failure rate due to frontonasal duct stenosis [12]. Riedel's procedure in which the anterior

table was removed to clear disease was marred by postoperative cosmetic forehead deformity and thus abandoned. In 1908, Knapp [13] performed an extensive ethmoidectomy through the medial orbital wall, leaving the anterior wall of the frontal sinus intact but removing the diseased mucosa and enlarging the frontonasal duct. Lothrop [14], resected the frontal sinus floor between the frontal recess and the intersinus septum along with the upper aspect of the nasal septum after an ethmoidectomy using an external approach. Lynch [15] and Howarth [16], entered the frontal sinus through an external approach through the medial orbital wall. The osteoplastic bone flap procedure was described by Tato and Bergaglio [7], which permitted an optimal view of the frontal sinus allowing complete removal of the mucosa, followed by obliteration of the sinus with abdominal fat with no cosmetic deformity. Goodale and Montgomery claimed excellent success rates with uneventful postoperative recovery using osteoplastic flaps for various indications in their case series reported in 1958 and 1976. The procedure gained popularity and became the standard procedure during that period [17,18].

In our case series of different pathologies involving the frontal sinus, the use of an endoscope was not feasible, given the nature of the disease, and hence the osteoplastic flap technique was resorted to as the procedure of choice. In both cases of frontal osteoma, wide exposure of the frontal sinus was the key to complete removal of the disease. Although endoscopic modified Lothrop alone [19] has been used for removal of osteoma, the literature is suggestive of its role being limited to cases in which the lesion is medial to a virtual plane through the lamina papyracea and in cases of attachment in the lower portion of the posterior wall of the sinus [20].

Besides being time consuming, transnasal removal of osteomas is convenient to perform only in spongy type as compared with ivory variety [21–23]. The possibility of incomplete resection, especially in cases of very large tumors [24], and the difficult endoscopic approach in cases of osteoma(s) located far lateral in the frontal sinus or having a widely based attachment to the base of the skull make external approach a preferred treatment modality [21–25].

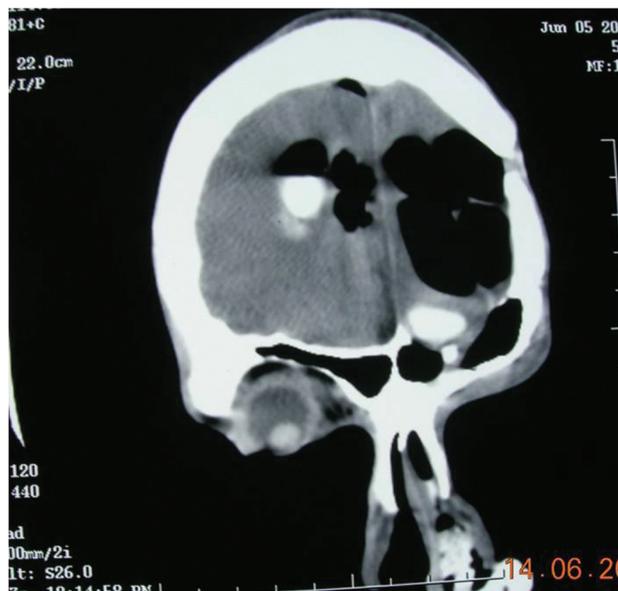
In case of plasmacytoma, the patient had presented with painful and deteriorating vision with increasing proptosis, as the mass in the left frontal sinus was compressing the globe following erosion of the medial orbital wall and the orbital roof (Fig. 2a and b). Opening up the frontal sinus under direct vision helped in disease clearance, thereby reducing the pain and resulting in orbital decompression with improved vision (Fig. 2c). In cerebrospinal fluid rhinorrhea, the patient had a posterior table fracture with pneumocephalus (Fig. 3), which could not be dealt with using the endoscopic approach. The fractured segment was removed under direct vision and dural defect repaired. The fifth case was that of inverted papilloma in which the mass was also filling up the ipsilateral frontal sinus with radiologic evidence of minimal intracranial but extradural extent. In this case, the modified Weber–Ferguson [26] incision was made for proper exposure and best possible access. In the sixth case of comminuted fracture of the anterior table, the osteoplastic flap technique helped in wide exposure of the area of defect so that it could be repaired by means of plate–screw fixation following obliteration of the sinus. The use of a radiographic plate to outline the frontal sinus as was described by Becker [27] was a great advantage to safely elevate the bony flap. The estimate of the outline prevents complications such as injury to the meninges or brain tissue while ensuring a

Figure 2



(a) Supraorbital swelling and proptosis of the left eye (plasmacytoma). (b) Homogenous opacity of the left frontal sinus with erosion of the roof and medial wall of the left orbit. (c) Early postoperative appearance of the patient after external approach through osteoplastic flap (bicoronal).

Figure 3



Computed tomography scan showing fracture of the posterior table of the frontal sinus with pneumoencephalus.

safe entry into the frontal sinus. Although image guidance outlines the whole frontal sinus area giving it a higher degree of safety, its cost factor and hence limited availability is a hurdle.

With the advent of computed tomography scans and endoscopes, it has now become possible to open the frontal recess with mucosal preservation, depending on the extent of disease. Several surgeons nowadays combine both the endoscopic and external approaches to address the frontal sinus, resulting in better management. However, the review and analysis of various authors has revealed that only the osteoplastic flap has borne better results as compared with endoscopic approaches in terms of reducing recurrence and need for revision procedures, and therefore remains the gold-standard technique [28].

Conclusion

Osteoplastic bone flap procedure is one of the most relevant external approaches to frontal sinus surgery even today, which we can advocate for laterally placed frontal sinus pathology, narrow sinus anteroposterior diameter, posterior table fractures or anterior table fractures with deformity, neo-osteogenesis of the frontal recess, etc. While more emphasis is being given to endoscopic approaches in the present era, osteoplastic flap approach still needs to be a part of the teaching curriculum keeping in mind its cost-effectiveness, with almost no need for a specialized infrastructure and the relative ease for beginners.

Osteoplastic flap is thus here to stay until the time endoscopic setup and navigation system is widespread in every level of healthcare delivery system.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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