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Delayed endoscopic assisted percutaneous reduction of anterior table frontal sinus fractures

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ABSTRACT

Endoscopic approaches to the management of frontal sinus fractures continue to become more commonplace. Anterior table fractures amenable to reduction by these techniques are optimally managed within the first five to ten days to avoid fibrosis of the injury. We present a case of endoscopic transnasal reduction of an anterior table frontal sinus fracture over six weeks after the injury.

Introduction

Frontal sinus fractures comprise 5–15% of all facial trauma, a third of which are isolated to the anterior table [1]. Management necessitates protection of intracranial structures, maintenance of sinus function and drainage, and restoration of facial aesthetics. These goals have classically required a bicoronal incision for management of the fracture.

Improved endoscopic techniques have made their way into craniomaxillofacial trauma. In frontal sinus fractures, applications range from placement of overlay implants for camouflaging contour, assisting reduction through trephine incisions, to complete transnasal reduction, including fractures of the posterior table and frontal sinus outflow tract (FSOT) [2].

However, not all anterior table fractures are easily reduced transnasally. We present a case of an anterior table fracture that, despite the ease of exposure via transnasal techniques, required external reduction through a minimally invasive approach.

Case report

A 24 year old male was in an unhelemeted all terrain vehicle (ATV) accident. He presented with headache and obvious forehead deformity. Facial CT scan demonstrated a depressed fracture of the right anterior table of the frontal sinus (Fig. 1a). A non-displaced fracture of the left frontal sinus with a small posterior table component (small arrow) was also present. No other significant maxillofacial trauma was identified.

Clinic follow up occurred over two weeks after the injury. After some additional delay, the plan was to proceed with endoscopic transnasal reduction of his fractures. Outpatient scheduling and patient related factors resulted in the procedure occurring 45 days after the injury.

Intraoperatively, a Draf IIb frontal sinusotomy was performed under image guidance [3]. This involved an anterior ethmoidectomy with exposure of the frontal sinus ostium. The insertion of the middle turbinate and the medial floor of the frontal sinus was removed using an angled burr (Fig. 2a), allowing wide access to the frontal sinus (Fig. 2b). A 70° endoscope was inserted into the frontal sinus identifying the fracture (Fig. 2c). The fracture, although readily visible, was not readily mobile. Multiple attempts with numerous frontal sinus instruments were unsuccessful in reducing the fracture. Balloon catheter reduction was also unsuccessful. A stab incision was then made directly over the fracture and a hole was drilled into the depressed fragment. A Carroll Girard screw (Fig. 3a) was inserted under transnasal visualization (Fig. 2d) and the fracture was mobilized and successfully reduced. The posterior table fracture in the contralateral sinus was simply observed.

The patient was seen in follow up one week later. The stab incision was healing well (Fig. 3b), and postoperative CT demonstrated successful reduction of the fracture (Fig. 1b). The frontal sinusotomy is seen in Fig. 1c.

Discussion

The endoscope has changed the management of frontal sinus fractures [4]. While classic management paradigms still hold true, the endoscope provides a more conservative approach.

Classic goals of frontal sinus fracture management include restoration of frontal sinus contour, establishment of normal sinus ventilation,
Fig. 1a. Anterior table frontal sinus fracture at presentation. Small, non-displaced posterior table fracture (arrow) also present.

Fig. 1b. Axial postoperative CT demonstrating reduction of the fracture.

Fig. 1c. Coronal postoperative CT demonstrating fracture reduction and patent frontal sinus outflow tract.

Fig. 2a. Transnasal Endoscopic Draf IIb frontal sinusotomy. FS (arrow): Frontal sinus opening. MT: Middle turbinate. NS: Nasal Septum.

Fig. 2b. Close up endoscopic frontal sinus access. Curved suction is seen inferiorly.

Fig. 2c. Fracture (arrow) as seen through the frontal sinus ostia with a 70° endoscope. AT: anterior table. PT: posterior table.
isolation of intracranial contents, and avoidance of late complications such as mucoceles, mucopyoceles, cerebrospinal fluid leaks, sinusitis, and meningitis [5]. This frequently necessitated an open approach, usually through a bicoronal incision, with exploration of the sinus. Frontal sinus fractures in conjunction with naso-orbito-ethmoid fractures (NOE) still necessitate open repair [4].

In the era of endoscopic sinus surgery, the need to aggressively obliterate or cranialize the anterior table fracture with involvement of the frontal sinus outflow tract is questioned. Smith et al., followed a series of seven patients with anterior table fractures and FSOT involvement. Standard repair of the anterior table fractures was performed, but the FSOT was left alone. Five fractures demonstrated normal postoperative ventilation. The remaining two, which had a NOE involvement to the injury, were managed with endoscopic frontal sinusotomy having failed medical management [2]. Alternatively, the FSOT may be opened through the sinus from above during repair of the fracture, rather than obliterating the sinus.

Transnasal endoscopic management of frontal sinus fractures continues to gain traction. In a recent survey of maxillofacial trauma surgeons, 61.7% felt that endoscopic sinus surgery changed their management of frontal sinus fractures [1]. Initially, these techniques were limited to isolated posterior table fractures for cerebrospinal fluid leak repair [6]. However, given the wide access to the frontal sinus through a Draf IIb or III approach, it became apparent that the anterior table could also be reduced through this approach.

After wide endoscopic access to the frontal sinus is obtained, visualization of the fracture segments is performed using a 70° endoscope. Reduction of posterior fracture segments and repair and coverage of any cerebrospinal fluid leaks can be performed. The anterior table can be bluntly reduced using a frontal sinus curette or any other curved instrument. Alternatively, the fracture can be reduced with a balloon or foley catheter, exercising caution in the setting of concurrent posterior table fractures. Smaller, medially located fractures can be reduced through smaller openings in the frontal sinus using balloon sinusplasty techniques [7].

Advantages of this technique are several. It eliminates the need for a bicoronal incision, with a broad applicability across a wide spectrum of fractures. One of the biggest concerns is the integrity and function of the

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Fig. 2d. Carrol Girard Screw (arrow) as inserted into the fracture seen in the sinus.

Fig. 3a. Carroll girard screw.

Fig. 3b. Stab incision anterior forehead one week postoperatively.
FSOT. This approach ensures adequate function of the sinus as wide opening of the outflow tract is inherent in the approach for repair. Very lateral fractures, particularly in the larger sinus, are difficult to access with this method.

Transnasal reduction is optimally performed within 10 days of injury to avoid fibrosis of the fracture segments, which leads to increased difficulty of reduction. In this case, repair took place well over six weeks after injury. In difficult cases such as these, the addition of a stab incision over the fracture for placement of a hook or screw for reduction. These techniques have been previously described [8,9]. Alternatively, a small trephine can be performed for better endoscopic evaluation or reduction, usually with a Foley catheter [10]. This technique was actually published in the 1960’s [11].

Conclusion

Endoscopic transnasal surgery allows for management of fractures of the frontal sinus. For difficult or delayed cases, adjunctive, minimally invasive techniques such as stab incisions may be incorporated to facilitate reduction while still avoiding a bicoronal incision.

Ethical statement

Both authors, Thomas J. Gal and Robin Pappal, were involved in all aspects of the case report. This includes conceptualization, data acquisition, and manuscript preparation. This is an original work that has not been presented elsewhere.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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