

# Frontal Sinus Fracture Management in The Endoscopic Surgery Era; A case report and Review of Literature

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**Abstract** Frontal bone fractures and frontal sinus outflow tract (FSOT) disruption usually approached through open reduction and internal fixation of the sinus wall with obliteration of the (FSOT) using different materials to aid in sealing the cavity away off the brain. However, in the last decades there has been an increasing trend toward preserving the intact mucosa at the sinus and the tract through the use of drug eluting stents. In our report, we present a case of an 18 years old male patient treated via open reduction and internal fixation of a displaced anterior frontal bone fracture with endoscopic tract stenting, that provided eluting corticosteroid (Kenalog) as anti-inflammatory medication of intermittent release.

**Keywords:** frontal bone, fracture, sinus outflow tract, sinus stent endoscope, steroid

**Cite This Article:** Mazen Almasri, Ebtesam Aljerb, and Hanan Shanab, "Frontal Sinus Fracture Management in The Endoscopic Surgery Era; A case report and Review of Literature." *Oral Surgery, Oral Medicine, Oral Radiology*, vol. 3, no. 2 (2015): 25-28. doi: 10.12691/oral-3-2-1.

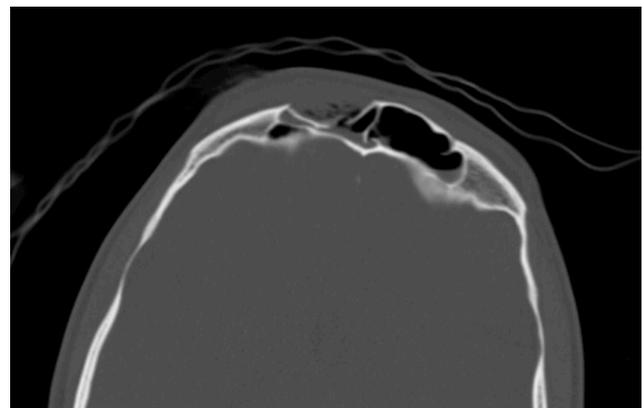
## 1. Introduction

The frontal bone is an important component of the facial skeleton since it links the cranium to the face. The frontal bone injuries commonly associated with other injuries to the skull, orbits, midface, and the overlying soft tissue [1,2]. Thus, treating a frontal sinus fracture is considered a challenge to the maxillofacial surgeons requiring multidisciplinary evaluation and planning to avoid early or late complications such as cerebrospinal fluid (CSF) leaks, meningitis, brain abscesses, sinusitis, mucoceles, mucopyoceles and osteomyelitis [2,3]. With the advanced technology in imaging and endoscopic instrumentation of the craniofacial procedures, more accurate diagnosis has been provided with increasing emphasis on preserving a "safe sinus" to restore function and ventilation especially among younger patients.

## 2. Case Report

An 18 years old male patient presented to King Abdulaziz Medical City (KAMC) in Jeddah, in sequel to motor vehicle accident (MVA). The patient is not known to have any chronic medical illness, allergy, nor history of loss of consciousness. Upon clinical and radiographic investigations he was found to have anterior frontal sinus wall fracture with moderate forehead depression and minimal epistaxis. The eye examination was insignificant, and no rhinorrhea was detected neither forehead paresthesia (Figure 1). After reviewing the patient's laboratory investigations, the patient was consented for open

reduction and internal fixation of the anterior table of frontal bone using microplates and screws in addition to plan placing a Kenalog eluting stent of the FSOT by the rhinology/ rhinoscopy team to aid in preserving the sinus function.



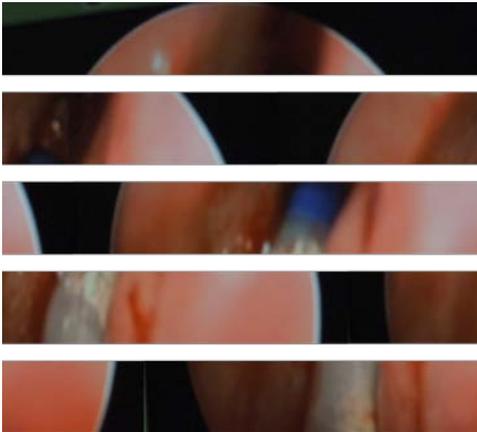
**Figure 1.** A preoperative axial cut of CT facial bone showing a displaced right anterior table frontal bone fracture and a potentially disturbed FSOT

In the operating room, the patient was placed in 15 degrees reverse Trendelenberg supine position, the monitors were installed, and an orotracheal intubation was accomplished. The patient prepped and draped in the routine fashion and local anesthesia of 2% Lidocaine with 100:000 epinephrine concentration was injected at the coronal / frontal incision site. A coronal incision was attempted, Ryne's clips inserted, and the coronal flap was reflected to expose the fractures at the anterior table of frontal bone. All the comminuted bony pieces were collected and oriented in an outside table to be used later

on for reconstructing the anterior table. The comminuted pieces were fixated together using microplates then preserved in normal saline. Then, the ENT rhinoscopy team evaluated the FSOT through nasal endoscopy, which found to be damaged and obstructed. After careful attempts the tract was reopened and a stent was inflated then left in situ. The Silastic stent has Kenalog intermittent drug eluting criteria aiming to reduce the chances of future fibrosis (Figure 2, Figure 3). Thereafter, reconstruction of the anterior table was established using 2 pieces of 1.5mm microplates and screws (Figure 4, Figure 5). Next, copious irrigation using normal saline was performed, hemostasis was confirmed, Jackson Pratt (JP) suction drain was inserted and primary closure was achieved in layers.



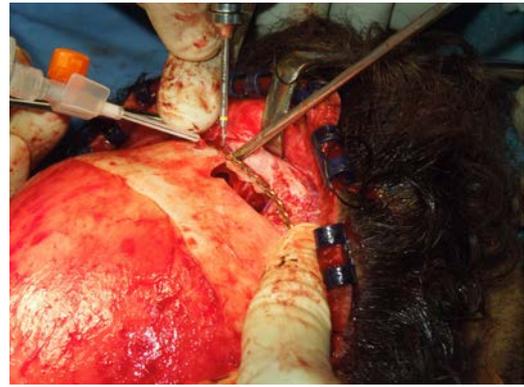
**Figure 2.** the drug eluting stent armamentarium



**Figure 3.** An endoscopic view showing the drug-eluting stent in the FSOT

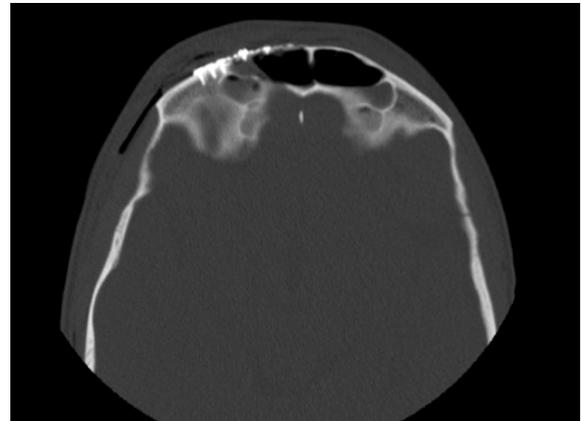


**Figure 4.** Reconstruction of the anterior table of frontal bone with microplates after placement of the drug-eluting stent



**Figure 5.** Reconstruction of the anterior table of frontal bone with microplates after placement of the drug-eluting stent

The patient immediate follow up visits were uneventful, and 4 weeks later the ENT team removed the stent. Follow up visits continued for 12 months with satisfactory esthetic and functioning results (Figure 6).



**Figure 6.** A postoperative axial cut of the patient's CT-facial bone showing the reconstructed anterior table fracture with decompressed FSOT

### 3. Discussion

Frontal sinuses usually asymmetrical bilateral cavities and in small percentage of people could be unilateral or not existed [1]. The nasofrontal duct (NFD) is a misnomer anatomical term because of the lack of the tubular appearance of the duct in almost 80% of the cases, so it was replaced with better term, the frontal sinus outflow tract (FSOT). Anatomically, the FSOT includes the frontal infundibulum, frontal sinus ostium and frontal recess just inferior to the ostium [1,3].

Fractures of the frontal sinus represent 5-15% of all fractures of facial skeleton [2,3,4]. However, in Saudi Arabia it ranges between 1.8 to 22%, commonly seen in male adults of 20 to 40 years of age and mainly caused by motor vehicle accidents [2,4]. The anterior table frontal sinus fracture (AFSF) is the most common type of frontal sinus fractures mostly involving the FSOT, reaching the ethmoids, and medial side of superior orbital rim. CT scan is considered to be the gold standard to investigating the cranial injuries having the sagittal images to be superior over the coronals [1,2]. However, the FSOT integrity should be confirmed intraoperatively, either by nasal endoscopy or clinically by examining the flow using saline, methylene blue dye, radiopaque dye, and/ or Indigo

Carmines. Suspected injuries of FSOT should be identified and managed properly as it can lead to obstruction of the tract drainage system, impairment of the mucosal function and sinus aeration, accumulation of mucous secretion and subsequently lead to the formation of mucocele and mucopyocele.

With the advancing technology and instrumentation in the surgical field, it is not uncommon of aiming toward conservative approaches over invasive maneuvers. The treatment always based on the complexity and degree of the osseous displacement, the FSOT involvement and the intracranial conditions (CSF leak and dural tear). The choice of observation is considered in case of minimally displaced AFSF with intact FSOT and no CSF leak, as it turns the objectives toward cosmetic goals. While surgical treatment is indicated in displaced (more than a table width) or comminuted frontal bone fractures with considerations toward sinus obliteration and canalization [1,3]. The surgical plan is designed according to the degree of injuries and involvement of the FSOT. Hence, due to the rarity of the cases, controversies do exist between obliterations versus preservation and sinus stenting.

Ioannides et al was the first to apply the drainage system technique for sinus preservation using stents

aiming to restore the sinus function and ventilation [6]. The results were promising but the major drawback was the postoperative restenosis after stent removal due to granulation and fibrosis [3,7,8]. Afterward, more attempts took place and improving stenting materials, criterion, removal strategy, and involved medications such as triamcinolone, dexamethasone, and doxycyclin took place and started showing better outcomes along the years (Table 1). Especially that such stents can be easily followed up clinically by the use of nasoscope and radiographically using cephalometric images and CT scans when compared to the obliterated sinuses that can be misleading and present further necrosis of the obliterate materials, sinusitis, or infection [9,10,11]. Such stents can be of bioabsorbable characteristic that can be left in situ or removed in 3-6 weeks [13,14,15]. Placement of the stents can be in association with the coronal incision that is a favorable environment to examine and place such stents, or it can be placed endonasally via Draf type 2 (Frontosinusotomy) or three (modified Lothrop procedure), or through transcuteaneous lateral nasal approach [16]. Postoperatively, systemic antibiotic for 10-21 days, nasal decongestant, saline sprays and sinus precaution instructions are commonly prescribed as needed. [12,15,16].

**Table 1. Reported cases of frontal sinus fracture and simultaneous outflow tract catheterization. (ORIF: open reduction and internal fixation, CSF: cerebrospinal fluid)**

Author	Total Number of cases / time frame	Catheter Management	Outcome
Luce E.A. et al, 1987 [7]	78 cases over 9 years period: 39 had anterior wall fractures 24 had anterobasilar fractures 15 had frontal skull fractures extended to the sinus	40 patients - ORIF plus indwelling catheter (2 weeks)	1 patient had infection 1 patient had prolonged CSF leak
Ioannides CH, et al, 1994 [6]	71 patients over 10 years: 26 cases anterior and posterior table	10 patients - ORIF and silicon stent (4-6 weeks)	2 patients- meningitis managed with conservative treatment
Gerbino G. et al, 2000 [4]	158 patients: 46 patients had both tables fractured	4 patients - ORIF and drainage tube (Portex tube) (30-40 day)	No complication
Smith T.L. et al, 2002 [9]	14 cases over 2 years: Anterior frontal sinus fracture involving the FSOT.	7 patients: Sinus preservation	2 patients- persistent FSOT obstruction with sinusitis needed endoscopic management. 4 patients had sinusitis.
Gossman D.G. et al, 2006 [17]	96 cases: -48 cases of anterior table fractures -48 combined cases	3 cases of ORIF, stenting ORIF	2 patients Needed extended endoscopic frontal sinusotomy (modified Lothrop procedure)
Carboni A. et al, 2009 [18]	132 patients: 3 cases (isolated FSOT)	ORIF and stent (40 days)	No complication
Thong J.F. & LEE J. 2011 [19]	5 cases	ORIF and transnasal endoscopic frontoethmoidectomy, stent (1 month)	No complication
Kwek et al. 2015 [20]	1 case anterior and posterior table fracture	ORIF and Silastic Stent	No complication

## 4. Conclusion

In the endoscopic surgery era, more conservative management and approaches should be considered when managing frontal sinus injuries especially in younger patients where better healing is a factor of better healing and RTA is still a major threat in areas over another. Hence, using endoscopy for assessing such injuries and management in coordination with a Rhinology/ ENT team might improve the quality of care to such patients. However, long-term follow up is still needed to confirm the functioning sinuses.

## Acknowledgment

The authors would like to thank Dr. Essam Alzumaiti and Dr Talal Andejani (ENT Rhinology team, KAMC-Jeddah), Dr Bandar Alharbi (Dentistry – Head of Department), Dr. Abdullah Jawharji (OMFS resident, KAMC), and Dr. Abdulaziz Alghamdi (OMFS-resident, KAMC), for their continuous support toward the maxillofacial reconstruction cases. Furthermore, our deep gratitude to the administration of King Abdulaziz Medical City, KAMC (National Guard Hospital / Jeddah) for their

usual cooperation toward advancing the health care in Saudi Arabia.

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