

Preservation of Frontal Sinus Anatomy and Outflow Tract Following Frontal Trauma with Dural Defect

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Summary: Our case report describes a young male mechanic who was hit in his face by a spring while repairing a car, resulting in traumatic injury to the frontal sinus, with fractures of both the anterior and the posterior tables with dural defect and cerebrospinal fluid leak. Current guidelines recommend that comminuted and/or displaced fractures of the posterior table of the frontal sinus with dural defects should be either cranialized or obliterated. In this patient, instead of cranializing or obliterating the frontal sinus, we managed to preserve the frontal sinus anatomy and its outflow tract using a combined open bicoronal and nasoendoscopic approach. This avoids the long-term complications associated with cranialization or obliteration including mucocele formation and frontocutaneous fistula. (*Plast Reconstr Surg Glob Open* 2015;3:e300; doi: 10.1097/GOX.0000000000000271; Published online 2 February 2015.)

K.H.K. is a 29-year-old car mechanic who sustained a contaminated 3 cm × 4 cm open wound over the left medial canthus and nose when a car suspension spring sprang out and hit his face. There were no neurological deficits or visual disturbances and no cerebrospinal fluid (CSF) leak on nasoendoscopy.

A computed tomography (CT) scan with 3-dimensional reconstruction of the face revealed (1) displaced comminuted fractures of the anterior and posterior left frontal sinus walls extending to the floor of the left anterior cranial fossa and cribriform plate, with pneumocranium; (2) fractures of bilateral orbital roofs; and (3) nasal bone fractures involving the bony canals of bilateral nasolacrimal ducts (Fig. 1).

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Serial CT scans of the brain did not show any acute intracranial hemorrhage or midline shift. He was started on intravenous ceftriaxone 2 g once a day and dexamethasone 6 mg q8H.

SURGICAL MANAGEMENT

K.H.K. underwent open reduction and internal fixation (ORIF) of his facial fractures and left frontal sinusotomy under general anesthesia within 24 hours of admission. A bicoronal, combined with endoscopic, approach was used to access the facial fractures and the left frontal sinus.

Intraoperative findings confirmed CT findings. Of significance, a 1-cm dural tear with CSF leak was noted at the left posterior table fracture site, which resolved with multilayer repair of the dural defect. A 1.5 cm × 1.5 cm sheet of DuraGen was used as an underlay graft. A 2 cm × 2 cm pedicled (right supraorbital artery) pericranial flap was used as an onlay graft. Repair was reinforced with Tisseel glue (Fig. 2).

Left uncinectomy, medial maxillary antrostomy, anterior ethmoidectomy, and a standard Draf 2A

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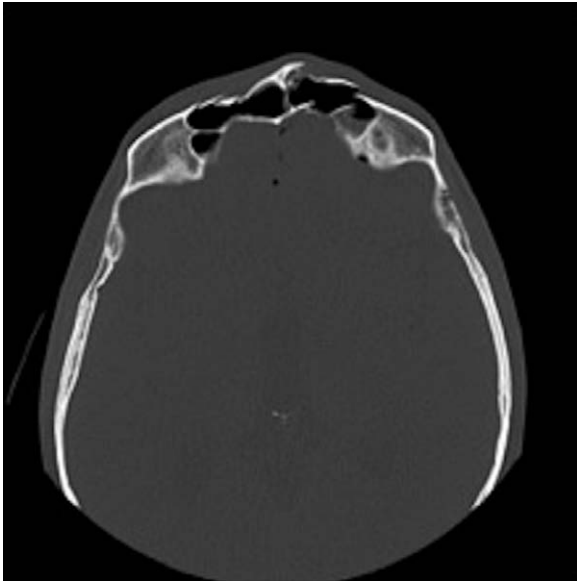


Fig. 1. Preoperative axial computed tomography scan of the frontal sinuses.

A 0.5-mm Silastic stent was inserted into the left frontal recess endoscopically. Merocel packs were then inserted into each nostril.

POSTOPERATIVE MANAGEMENT

Postoperatively he was monitored in a high dependency unit, placed on hourly conscious level charting, intravenous antibiotics, and steroids, and nursed in a 30° head-up position. Laxatives were added to prevent straining at the stools. X-ray of face confirmed correct placement of implants (Fig. 3). The Merocel packs were removed on POD1. No CSF leak was seen. He started oral feeds on POD2, and subgaleal drains were removed. He was subsequently transferred to general ward. Nasoendoscopy revealed no middle meatal adhesions or obvious CSF leak. The left frontal recess stent remained patent. Ambulatory physiotherapy commenced on POD6. He was started on sinus irrigation and discharged well after completing 1 week of intravenous acetazolamide and antibiotics. The antibiotics were oralized for another week.

He was reviewed at 3 weeks' postoperatively and then monthly after. At 3 weeks, some hemerosous mucus in the left middle meatus was seen. In subsequent appointments, the left frontal-ethmoidal recess remained patent (stent was removed after 1 month) and dry with no CSF leak (Fig. 4).

DISCUSSION

Frontal sinus fractures form a significant portion (5–12%) of all craniofacial fractures. Due to their anatomical position and the high kinetic energy required to cause the fractures, they are associated with other possible complications (Table 1).

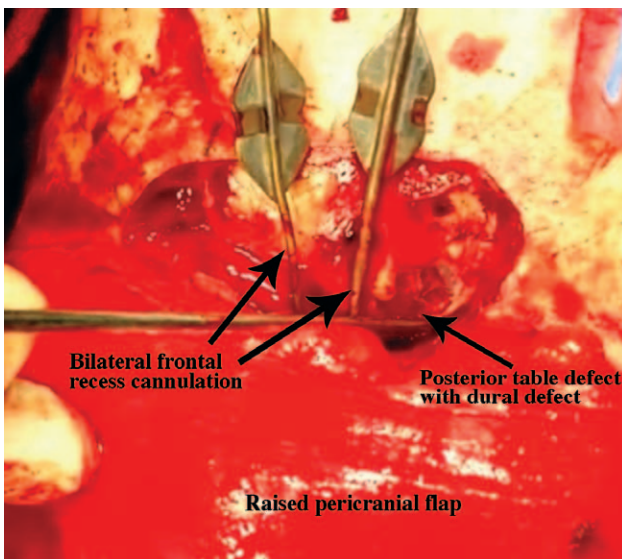


Fig. 2. Frontal sinus fracture with dural defect.

frontal sinusotomy¹ were performed to adequately expose the frontal recess boundaries. (Frontal recess boundaries are lamina papyracea laterally, middle turbinate medially, anterior wall of bulla ethmoidalis posteriorly, and posterior wall of the agger nasi cell anteriorly.)

The frontal sinus bone fragments were repositioned and fixed with plates. The bilateral supra-orbital rims and frontal buttress were plated with orbital mesh plate and 4mm × 4mm screws. Pericranial flap was placed in left orbital roof defect to support dural repair. Drains were placed in subgaleal plane before the galea and skin were closed.

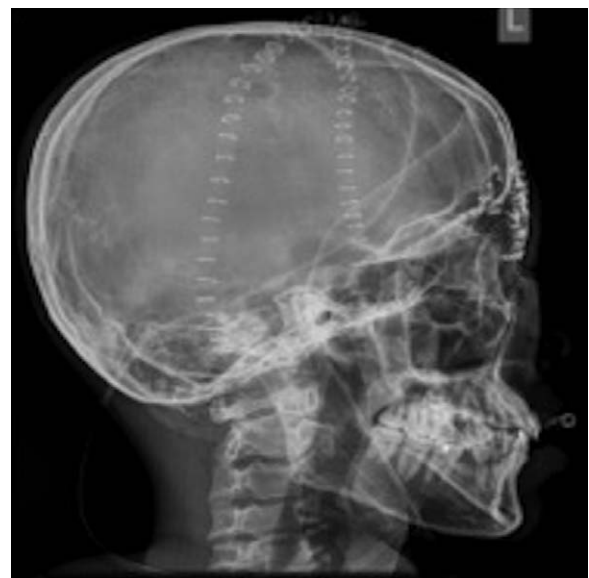


Fig. 3. Postoperative x-ray of the repaired fractures.

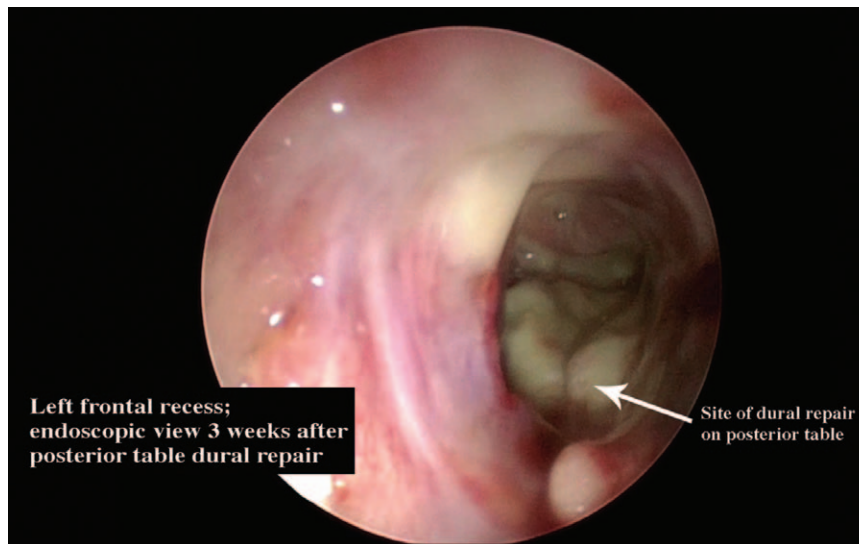


Fig. 4. Endoscopic view of the left frontal recess 3 weeks after repair.

Table 1. Complications Associated with Frontal Sinus Fractures (Metzinger 2009 et al¹⁴)

Complications of Frontal Sinus Fractures			
Skull Base	Intracranial	Ophthalmological	Maxillofacial
CSF leak	Intraparenchymal hemorrhage	Orbital apex syndrome	Orbital, naso-orbital-ethmoidal, nasal and midface fractures
Mucocele formation	Infections (brain abscess, meningitis, encephalitis)	Decreased visual acuity and blindness	Chronic sinusitis
Meningoencephalocele	Pneumocephalus	Orbital volume change (enophthalmos, exophthalmos)	Frontocutaneous fistula
Acute and chronic osteomyelitis	Intracerebral pneumatocele	Ophthalmoplegia	Scalp necrosis
Subperiosteal abscess	Cerebral contusion	Intraocular lesions (macular hole, retinal detachment, lens displacement, orbital mucopyocele, orbital abscess)	Facial nerve injury
Pott's puffy tumor	Raised intracranial pressure Chronic headaches		Decreased forehead sensation

The management of frontal sinus fractures is complex and can be controversial at times. Treatment options range from just observation to ORIF of fractures and obliteration or cranialization of the frontal sinus.²

Preservation of the frontal sinus anatomy is not a new concept. Anterior table fractures³ involving the frontal outflow tract have been successfully repaired with preservation of the frontal sinus and its outflow tract. In the series by Smith et al⁴ of 7 anterior table fractures repairs, 5 had patent outflow tracts postoperatively. Two had outflow obstruction requiring subsequent sinusotomy procedures.

The management of posterior table fractures is more controversial. Current guidelines recommend cranialization or obliteration of displaced posterior table fractures with CSF leaks⁵⁻⁷ to avoid complications of brain infections. However, there are complications of cranialization and obliteration, including postoper-

ative CSF leak, frontocutaneous fistula,⁸ and mucocele (mucoceles are encapsulated collections of mucus that cause bony erosion and remodeling as they enlarge, causing orbital or intracranial erosions) formation.⁹

Sinus preservation is possible in a select group of frontal sinus fractures. Chen et al¹⁰ advocate that, in the absence of fracture comminution or displacement, CSF leaks can be managed conservatively. Shi et al¹¹ described transnasal endoscopic repair in 15 patients with traumatic frontal sinus CSF leaks, preserving frontal sinus anatomy and outflow tract. However, it was not reported whether the fractures were displaced or comminuted enough that cranialization or obliteration of the frontal sinus would have otherwise been required.

Restoring frontal sinus anatomy and outflow patency is ideal in frontal sinus fracture management. If the frontal sinus outlet tract is subsequently ste-

nosed, a later frontal sinus rescue procedure¹² can be performed. If this also fails, cranialization or obliteration can still be performed.

In our case report, the severity of K.H.K.'s frontal sinus trauma would normally have necessitated cranialization or obliteration. He underwent successful ORIF of the frontal sinus fractures and dural defect closure with preservation of the frontal sinus anatomy and its outflow tract, which remained patent with no CSF leak 6 months postoperatively.

Our team proposes that frontal sinus and its outflow tract preservation are viable options in select patients with posterior table fractures and dural defects. This approach should only be performed if:

1. CSF leak can be stopped. A review¹³ of 875 frontal sinus fractures suggests that patients with comminuted and displaced posterior table fractures with CSF leaks could possibly be managed nonoperatively. Three of 7 such patients were managed nonoperatively, with no intracranial complications of CSF leaks. The decisions behind the conservative management and long-term complications were not documented.
2. Other causes of raised intracranial pressure such as empty sella syndrome/benign intracranial hypertension/intracerebral hemorrhage in trauma are excluded.

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