Published online: 2021-10-07

Frontal Sinus Fractures

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Semin Plast Surg 2021;35:274–283.

Abstract

Management of frontal sinus fractures is controversial with no universally accepted treatment protocol. Goals of management are to correct aesthetic deformity, preserve sinus function when it is deemed salvageable, prevent sequela related to the injury, and minimize complications associated with intervention. Studies suggest that frontal sinus injuries, including disruption of the nasofrontal outflow tract (NFOT), can be managed nonoperatively in many cases. Advances in the utilization of endoscopic techniques have led to an evolution in management that reduces the need for open procedures, which have increased morbidity compared with endoscopic approaches. We employ a minimally disruptive protocol that treats the majority of fractures nonoperatively with serial clinical and radiographic examinations to assess for sinus aeration. Surgical intervention is reserved for the most severely displaced and comminuted posterior table fractures and unsalvageable NFOTs utilizing endoscopic approaches whenever possible.

Keywords
- frontal sinus fractures
- endoscopic
- transorbital
- navigation
- cerebrospinal fluid

Fracture of the frontal sinus occurs in 5 to 15% of all craniomaxillofacial trauma.[1] Blunt force trauma is the most common mechanism and includes motor vehicle collisions, assaults, falls, and sports-related injuries.[2–4] A significant force of between 800 and 2,200 pounds[5] is required to fracture the anterior table of the frontal sinus and as a result concomitant serious injuries are common.[2] The optimal management of frontal sinus injuries is controversial[6] and numerous treatment algorithms[1,4,7–10] have been described, none of which are universally adopted. However, the goals of treatment are well established and involve correction of aesthetic deformity, reestablishment of a functional sinus, and prevention of early and late sequela such as sinus and/or intracranial infection.[7] Severe complications of frontal sinus fractures can occur, which include meningitis, encephalitis, brain abscess, mucocele, and mucopyocele.[11] Over the last few decades, management of frontal sinus fractures has evolved to a more conservative approach due to improved imaging modalities, growing evidence to support indications when operative intervention is necessary, and increasing utilization of endoscopic techniques to reduce morbidity.[3] The following review describes the indications and most common techniques used in the management of frontal sinus fractures followed by a description of a minimally disruptive pathway that is employed at our center.

Anatomy and Development of the Frontal Sinus

The frontal sinus develops after birth at approximately 2 years of age, reaching adult size after puberty[12] with direct visualization radiographically possible after 5 to 7 years of age.[13] The frontal sinus can be divided into three sections and includes (1) a thick anterior table, (2) a thin posterior table, and (3) a nasofrontal outflow tract (NFOT) that drains the sinus into the middle meatus of the nose (►**Fig. 1**). The frontal sinus has two sides (left and right) that develop independently and are separated by an intersinus septum. The NFOT can be found in the posterior, medial, and inferior location of the frontal sinus and is closely associated with the ethmoid air cells.[14] Unilateral and bilateral frontal sinus aplasia is present in 15 and 5% of the population, respectively.[12] Mechanically, the frontal sinus acts as a cushion to protect the brain from injury.

Issue Theme The Harborview Approach to Craniofacial Trauma; Guest Editor: Craig Birgfeld, MD, FACS

Thieme Medical Publishers, Inc., 333 Seventh Avenue, 18th Floor, New York, NY 10001, USA

DOI https://doi.org/10.1055/s-0041-1736325.
ISSN 1535-2188.

As a result, injury to the frontal bone in children, where the frontal sinus is either absent or poorly developed, results in differing fracture patterns to adults that are dependent on age and the developing sinus.[15]

Assessment and Diagnosis

History and Physical Examination

Careful assessment and diagnosis is necessary for appropriate management. Assessment should begin with a primary and secondary survey as outlined in the Advanced Trauma Life Support protocols. Significant force is required to fracture the frontal sinus and thus serious injuries to the cervical spine, brain, and other areas of the body are frequent and should be surveyed with appropriate referral and concomitant management. A history of presenting illness including the mechanism of injury and past medical history including previous facial injuries should be obtained. If the patient is conscious and alert, they should be questioned regarding clear nasal discharge or salty taste in their mouth that may be a sign of cerebrospinal fluid (CSF) rhinorrhea. The patient should be questioned regarding any vision changes, associated facial anesthesia, and changes in occlusion that may indicate other facial injuries.

A focused craniofacial examination should be performed and includes an inspection of any associated lacerations overlying the frontal sinus that may be used during operative management. The frontal area should be palpated for any contour irregularities that may indicate a depressed anterior table fracture. Any rhinorrhea should be presumed to be CSF, which can be sent for β-transferrin testing. The facial skeleton should be examined for any signs of associated naso-orbital-ethmoid, zygoma, midface, and/or mandible fractures. Patients with posterior table fractures with associated dural injury are at a high risk for meningitis and patients who present late should be assessed for signs and symptoms of infection.[9]

Imaging

Frontal sinus fractures were historically diagnosed using plain radiographs. However, the accessibility and superiority of computed tomography (CT) scanning has made it the imaging modality of choice for assessing injury to the frontal sinus.[1,10] While three-dimensional reconstructions are helpful, the sagittal, coronal, and axial cuts are each useful at assessing different anatomical areas of the frontal sinus. Axial and sagittal cuts allow assessment of anterior and posterior table fracture and displacement. Sagittal and coronal cuts can be useful for assessing involvement of the NFOT (►**Fig. 1**). CSF leaks can be assessed and confirmed using a CT myelogram.[16] The sinus should be visualized for opacity and the adjacent intracranial region assessed for pneumocephalus which can be a sign of dural injury.[17] The remaining craniofacial regions should be surveyed for concomitant fractures.

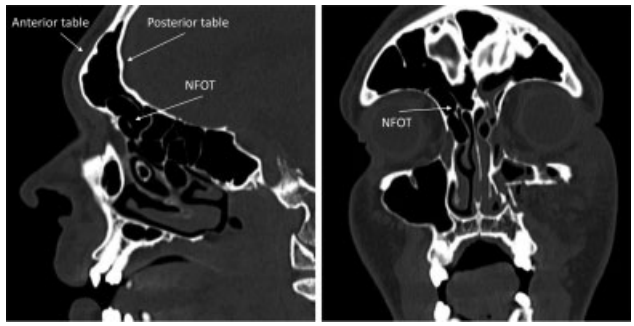

Fig. 1 Anatomy of the frontal sinus. Left: sagittal view illustrating the anterior and posterior tables as well as the nasofrontal outflow tract (NFOT). Right: coronal view illustrating the left and right NFOT.

Overview of Management

Numerous algorithms have been developed for treating frontal sinus fractures based on the amount of involvement of the anterior and/or posterior table, NFOT, and the presence of persistent CSF leak.[18] The goals of treatment are to correct aesthetic deformity due to anterior table disruption, address dural tears as a result of posterior table injury, and prevent sequela from NFOT obstruction. The development and increasing experience with endoscopic techniques have shifted the treatment paradigm to involve more minimally invasive approaches compared with traditional open techniques, particularly given the ability to address the NFOT endoscopically should obstructive complications occur.

The management of frontal sinus injuries can be divided into treatments that preserve the sinus versus those that do not (►**Table 1**). Sinus preservation options include

Table 1 Management options for frontal sinus preservation and nonpreservation

Sinus preservation management options	Nonsinus preservation management options[10]
• Observation • Open reduction and internal fixation • Endoscopic reduction and internal fixation – Transnasal – Transorbital – Brow • Reconstruction with outflow tract and mucosal preservation	• Obliteration: complete removal of the sinus mucosa, filling the sinus with either autologous or alloplastic material and filling the NFOT • Ablation (historical): removal of the anterior table, supraorbital rims, and mucosa with skin resting on posterior table • Cranialization: removal of the posterior table, filling the NFOT, and removal of all sinus mucosa • Osteoneogenesis: removal of the sinus mucosa and filling the NFOT, preserving the sinus which will fill automatically with scar or bone

Abbreviation: NFOT, nasofrontal outflow tract.

observation, open or endoscopic reduction, and repair of the NFOT. Nonpreservation techniques include sinus obliteration, ablation, cranialization, and osteoneogenesis.[7] Traditional open techniques result in increased morbidity, longer recovery time, and lifelong risk of complications, while the same functional goals can be achieved with endoscopic techniques.[7] Endoscopic transnasal approaches can repair the NFOT and both transnasal or transorbital approaches allow reduction of displaced sinus walls and repair of the dura, which reduces the need for open cranialization and obliteration.[7]

Timing of Intervention

The risk of serious infection such as meningitis, encephalitis, brain abscess, frontal sinus abscess, and osteomyelitis with frontal sinus fractures places more urgency to ensure timely management of these injuries compared with other facial fractures. Recent data suggest that when surgical intervention is indicated, delay in management beyond 48 hours results in an increased risk of these serious infections. However, treatment is often delayed in these patients given the presence of other more serious injuries.[18] We believe that immediate repair is warranted with displaced fractures involving the NFOT, severe comminution, or displacement of the posterior table as these fracture patterns are unlikely to result in autoventilation of the sinus. Those patients who do not require immediate repair are followed clinically with repeated imaging to ensure ventilation of the sinus.[7]

Anterior Table Fractures

Indications for Treatment

The indication for treating anterior table fractures is to correct contour defects as a result of comminution and displacement of the fractured segments (►**Fig. 2**). The need to correct a significant contour deformity needs to be weighed against the risks associated with the approaches necessary to access the anterior table. Anterior table fractures can be classified as mild (<4 mm), moderate (4–6 mm), or severe (>6 mm) based on the amount of displacement.[9] Nondisplaced and mild fractures can be managed with observation. Moderately displaced fractures may or may not result in any noticeable contour defect and nonoperative management may be warranted. Once initial swelling has subsided (7–10 days), any residual contour defects are better addressed using cosmetic filler[19] or autologous fat grafting,[20] if desired by the patient. Patients with deep rhytids, lacerations directly over the fracture, and inferior fractures that can be easily accessed through a well-hidden blepharoplasty incision are better candidates for open reduction.[9] Severely displaced fractures may require acute repair or the use of camouflage grafts such as porous polyethylene and/or titanium mesh[19] (please see ►**Figs. 2–4**, which demonstrate open repair of a depressed anterior table fracture). Interestingly, there is evidence that the anterior table may undergo autoreduction with spontaneous correction of the contour defect, suggesting that some patients with contour defects can be managed nonoperatively.[7]

Fig. 2 Contour defect as a result of a depressed fracture of the left anterior table.

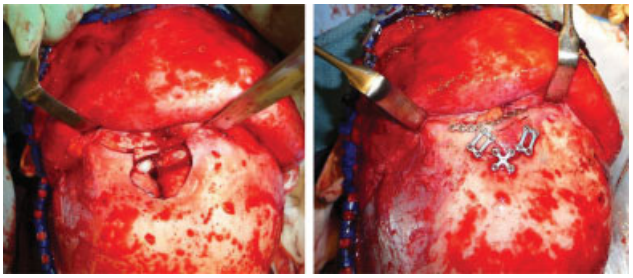

Fig. 3 Intraoperative photos of the same patient in ►**Fig. 2** demonstrating reduction of the fracture through an open bicoronal approach using titanium plate fixation.

Surgical Techniques

Open Techniques

Techniques to access the anterior table of the frontal sinus can be through open or endoscopic approaches. Open approaches include using existing lacerations directly overlying the frontal sinus, as well as direct forehead/suprabrow, upper blepharoplasty, or bicoronal incisions (►**Fig. 3**). Each open approach has its advantages and disadvantages as described in ►**Table 2**. Open techniques are indicated for severely displaced and comminuted fractures and provide optimal visualization and access at the expense of larger scars and their respective morbidity (►**Table 2**). Reduction of the bony fragments and fixation using plates and screws can be easily achieved using these techniques.

Endoscopic Techniques

A transnasal or transorbital endoscopic approach to the frontal sinus can be performed in conjunction with intraoperative navigation to reduce anterior table fractures. The transnasal approach involves insertion of the endoscope through the nose to perform a frontal sinusotomy (Draf IIa, IIb, or III).[21] The procedure requires an endoscopic ethmoidectomy with identification of the ethmoid sinus and lamina papyracea. The agger nasi cell is removed opening the tract and allowing access to the frontal sinus.[9]

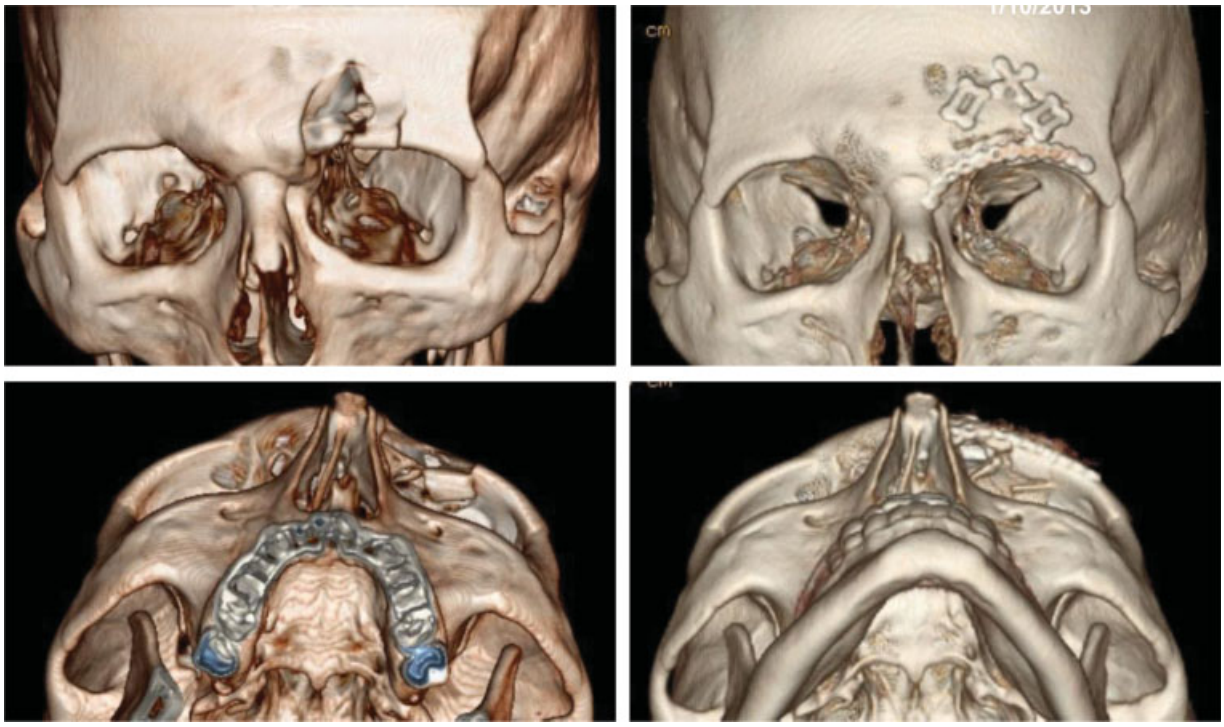

Fig. 4 Comparison of preoperative and postoperative three-dimensional computed tomography scans demonstrating correction of the depressed frontal sinus fracture for the same patient described in ►**Fig. 2** and ►**Fig. 3.** Reconstruction demonstrates excellent correction of the contour defect.

Table 2 Advantages of open and endoscopic approaches to the frontal sinus

	Advantages	Disadvantages
Open techniques		
Existing laceration	• Direct approach • Use of existing laceration	• Laceration location may not be ideal necessitating lengthening the incision
Direct forehead/suprabrow	• Direct approach • Well-hidden scar in older patients with deep rhytids	• Visible scar • Risk of paresthesia
Upper blepharoplasty	• Well-hidden scar	• More limited access
Bicoronal	• Well-hidden scar in hairline • Widest exposure • Access to adjacent calvarial bone graft	• Extensive scar • Risk of alopecia • Risk of anesthesia • Risk of injury to the facial nerve • Temporal hollowing
Endoscopic techniques		
Transnasal	• No external scar • Can be used to treat NFOT obstruction reducing the need for obliteration or cranialization • Can maintain a safe sinus	• Requires expertise in endoscopic techniques • Difficult to reduce bony fragments
Transorbital	• Minimal access incision • Can be used to reduce displaced bony fragments and repair the dura • Can maintain a safe sinus	• Requires expertise in endoscopic techniques • Best for more limited anterior table injuries
Endoscopic brow	• Minimal access incisions	• Requires expertise in endoscopic techniques • Used for anterior table reduction only • Technically challenging • Best for camouflage as opposed to fracture reduction techniques

Abbreviation: NFOT, nasofrontal outflow tract.

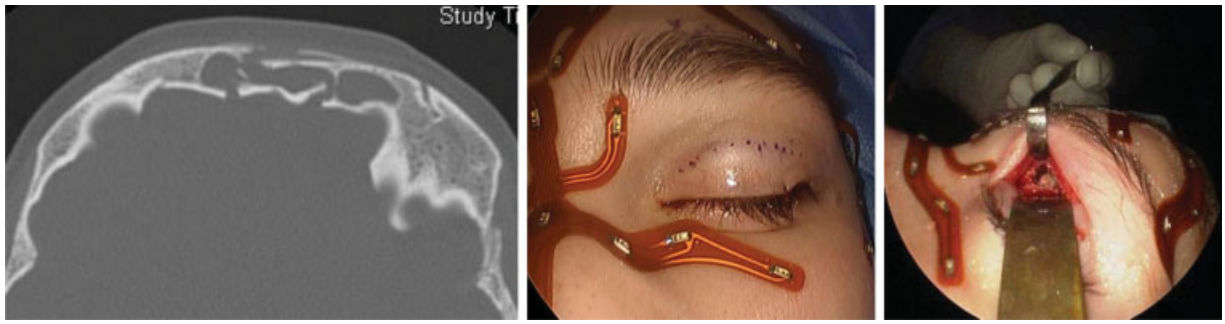

Fig. 5 Left: comminuted anterior and posterior table fractures of the frontal sinus with CSF leak. Middle: blepharoplasty incision marking for planned transorbital endoscopic approach to the frontal sinus utilizing navigation. Right: superior transorbital approach to the frontal sinus. Note the posterior wall fracture with protruding brain tissue. CSF, cerebrospinal fluid.

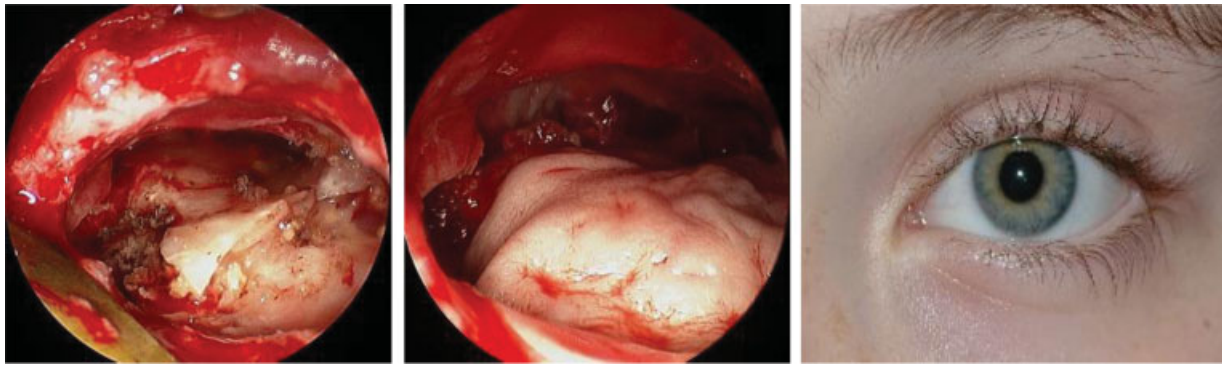

Fig. 6 Left: endoscopic transorbital visualization of the fractured frontal sinus, mucosa removed and dura exposed. Middle: view following coverage of defect with allogenic dermis before sealing with fibrin glue. Right: healed blepharoplasty incision demonstrating the well-healed and positioned scar. Same patient as described in ►**Fig. 5**.

For the transorbital approach (►**Figs. 5** and **6**), the frontal sinus is accessed inferiorly through a blepharoplasty incision. The sinus is then entered through the fracture or through the floor of the sinus by drilling a segment of bone adequate for entry. The injury is explored and the displaced segments reduced using an elevator. Alternatively, if there is dural injury, the bone can be removed and the dura repaired with allogenic dermis or a suitable alternative.[22] ►**Fig. 7** demonstrates a pre- and postoperative imaging results of an anterior table fracture reduced using a transorbital endoscopic approach. ►**Fig. 8** demonstrates the endoscopic view of reduction of an anterior table fracture through a transorbital approach. Navigation can be used to confirm the position of the fractured segments (►**Fig. 9**) and the reduction can be maintained using an absorbable sponge.[7]

The endoscopic brow approach to the anterior table is performed through two incisions. A larger 3 to 5 cm working incision and smaller 1 to 2 cm endoscope incision posterior to the hairline are utilized. Subperiosteal dissection for both incisions is required and an elevator is used through the working incision with endoscopic visualization to perform the reduction.[9]

Posterior Table Fractures

Indications for Treatment

Isolated posterior table fractures are rare[1,7] and they are almost always associated with anterior table fractures. Posterior table fractures can be associated with CSF leak and intracranial injury. One of the goals of treating posterior table fractures is to prevent intracranial infection as a result of communication between the sinus and intracranial space. Extensive comminution and/or displacement of the posterior table and the presence of pneumocephalus may suggest that dural injury has occurred. Significant displacement,

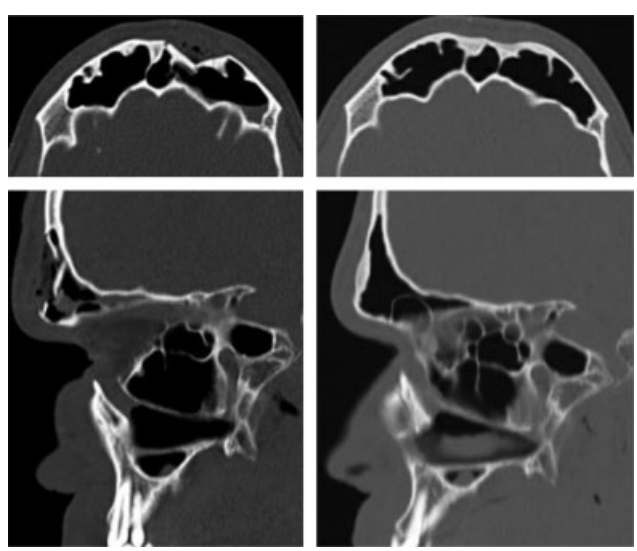

Fig. 7 Left: preoperative axial and sagittal CT cuts of an anterior table fracture of the frontal sinus. Right: 2-year postoperative axial and sagittal CT cuts following transorbital endoscopic reduction. CT, computed tomography.

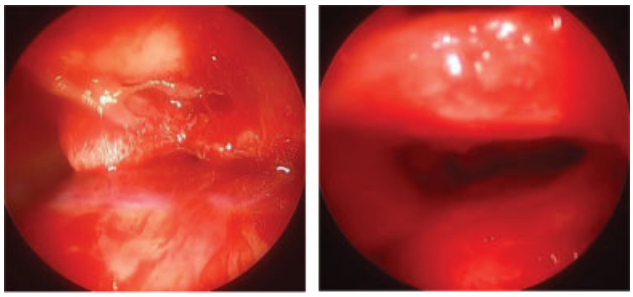

Fig. 8 Transorbital endoscopic view of a (left) prereduction and (right) postreduction anterior table fracture of the frontal sinus.

comminution, and the presence of persistent CSF leak in posterior table fractures are traditionally used as indications for cranialization.[23] However, a study by Choi et al demonstrated that the majority of patients with these severe features can be managed conservatively.[23] We believe that nondisplaced posterior table fractures can be managed with observation. Severely displaced and/or comminuted posterior table fractures do require operative intervention and this should be performed using an endoscopic approach whenever possible. Open sinus obliteration or cranialization are described below as these techniques may be required for the most severe injuries or when the patient is taken to the operating room for a frontal craniotomy for neurosurgical indications. In these cases, the steps described for sinus obliteration are also required to perform a successful cranialization.

Surgical Techniques

Sinus Obliteration and Cranialization

Traditional techniques for sinus obliteration or cranialization usually involve access through a coronal incision unless a

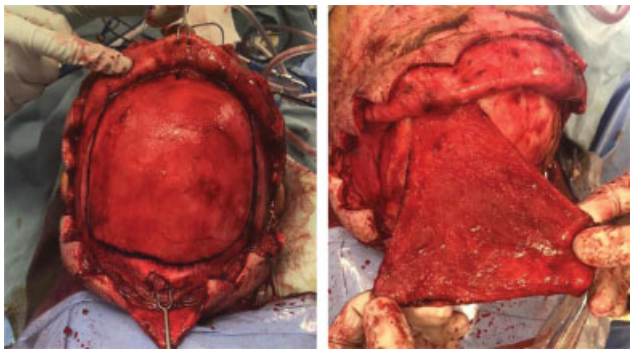

Fig. 10 Left: bicoronal approach using subgaleal plane with pericranium exposed and outlined for an anterior-based pericranial flap. Right: harvest of an anteriorly based pericranial flap that can be used for both sinus obliteration and cranialization.

laceration of sufficient size is present. Obliteration involves complete removal of all sinus mucosa and sealing the NFOT using autologous tissue (e.g., fat, bone, pericranium, muscle fascia). Pericranium provides well-vascularized soft tissue that is easily accessible through an open coronal approach (►**Fig. 10**). This requires complete removal of the anterior table to visualize the entire sinus. Identification of the sinus extent can be accomplished using several methods including intraoperative navigation, transillumination using an endoscope, or palpation using the tines of an instrument. The outline of the sinus is marked and the area is plated for later reduction after removal. The anterior table is removed using a saw, burr, or multiple drill holes along the marked sinus periphery. The sinus mucosa is removed and the sinus walls burred to ensure any remaining mucosal elements are obliterated. The mucosa within the NFOT is inverted and sealed with autologous tissue (please see ►**Fig. 11**, which demonstrates an open bicoronal approach to obliterate the

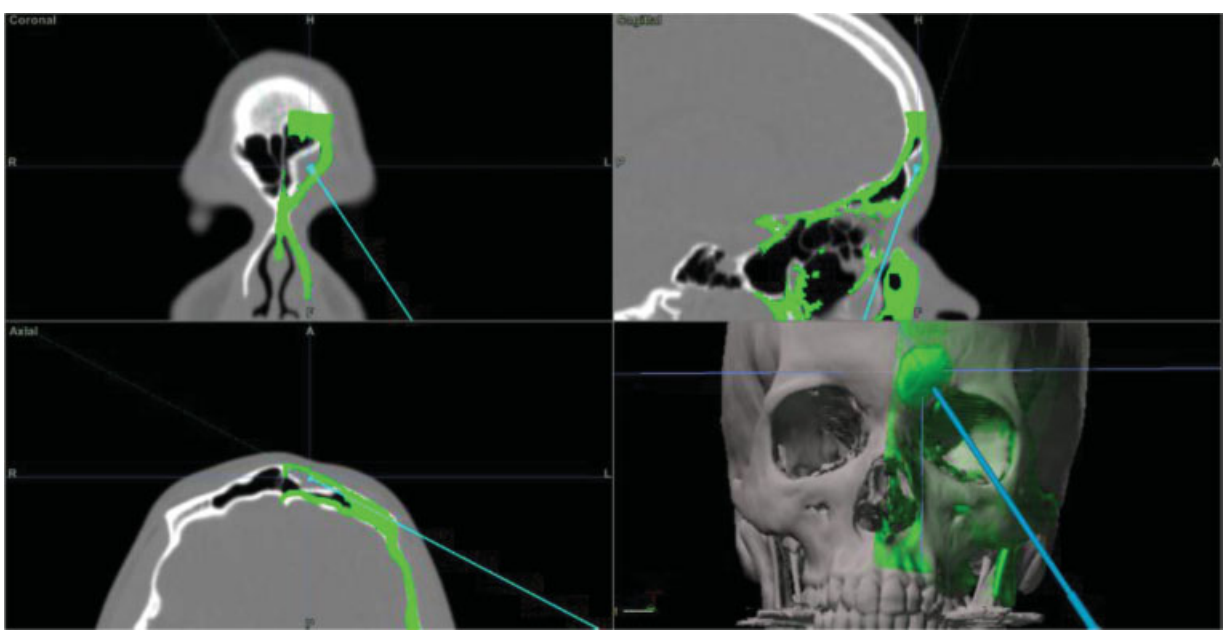

Fig. 9 Multiview navigation windows demonstrating utilization of the normal unaffected side of the frontal sinus mirrored and overlaid on the affected side for intraoperative navigation to verify reduction of the fracture.

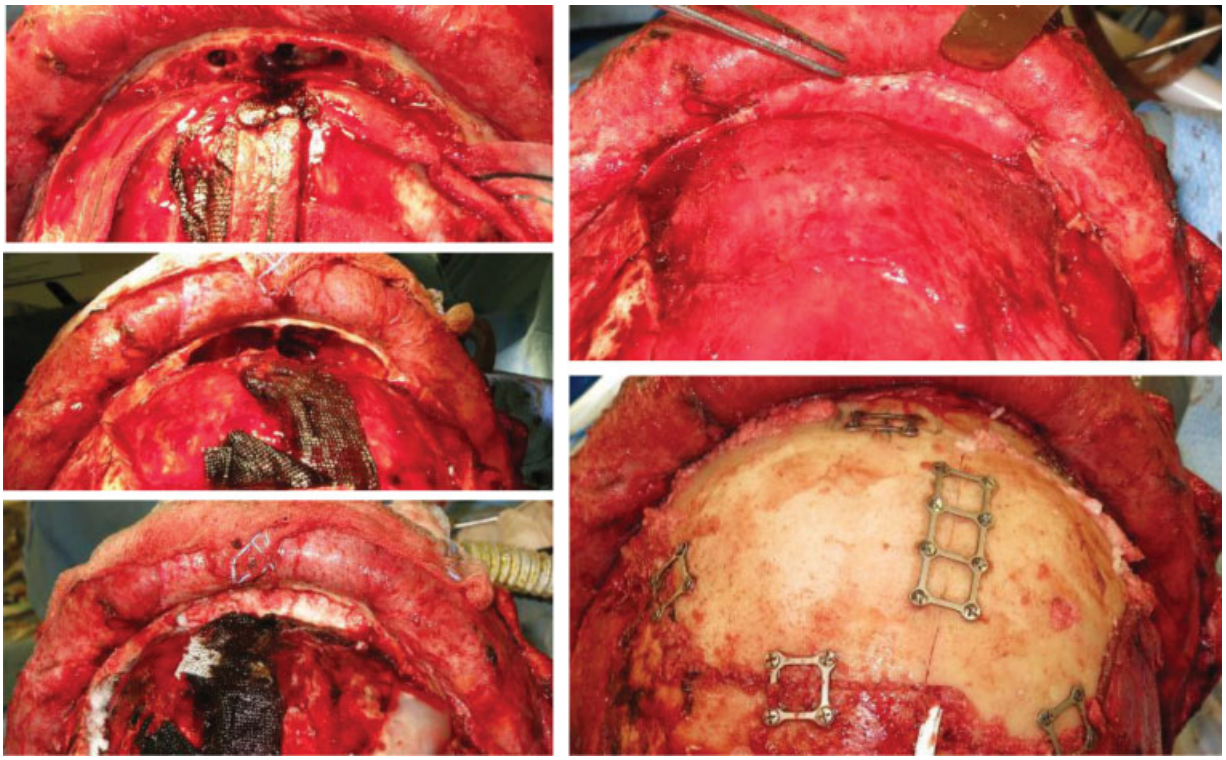

Fig. 11 Top left: comminuted and displaced fracture of the nasofrontal outflow tract (NFOT) and nondisplaced fracture of the posterior table requiring frontal sinus obliteration. Middle left: frontal sinus mucosa obliterated. Bottom left: frontal sinus packed with bone graft. Top right: anteriorly based pericranial flap lining the bone graft and obliterated frontal sinus. Bottom right: repair of the frontal craniotomy using plates.

frontal sinus using bone graft and pericranium). Both autologous and alloplastic[24] materials have been used to seal the NFOT and fill the sinus. However, some advocate using autologous tissue such as pericranium, temporalis muscle, bone,[1] or allowing the sinus to form a new bone or scar (osteoneogenesis).[25] There is a suggestion that complication rates using fat graft to obliterate the sinus are higher due to the avascularity of the surrounding sinus walls.[1] We recommend against the use of foreign materials in frontal sinus surgery due to a permanent increased chance of infection.

Cranialization involves the same steps as obliteration with the addition of posterior table removal and repair of any dural tears. Removal of the posterior table can be performed using an elevator. The table is then rongeured to ensure a smooth and flush anterior frontal bone to accommodate the brain.[9] The anterior cranial base can then be reconstructed using bone graft and pericranium as shown in ►**Fig. 12**.

Endoscopic Techniques

Similar to the approach used for anterior table fractures, an endoscopic transnasal[21] or transorbital (►**Fig. 12**)[7] approach can be used for addressing the posterior table and repairing dural injury. The mucosa is removed from the posterior table fracture segments and the segments are manually reduced or removed with a suction or probe. An overlay graft such as dermal allograft and fibrin glue can be used for an overlay.[7] In severely comminuted fractures where the posterior table segments are removed, an epidural graft or dural substitute can be used to seal dural tears.[21]

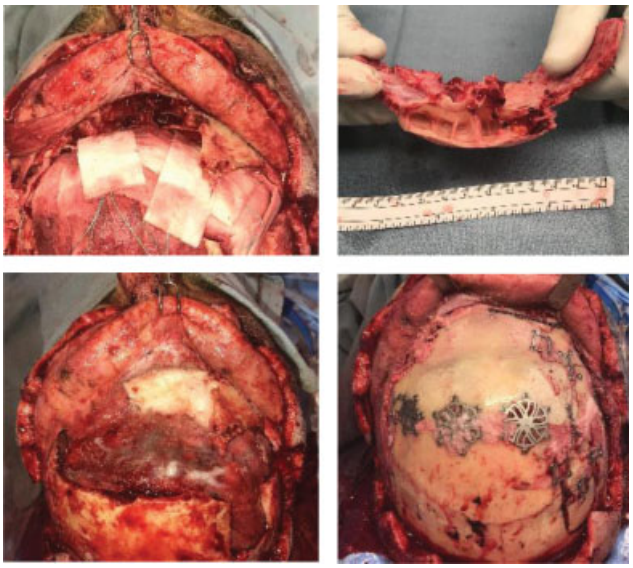

Fig. 12 Top left: comminuted and displaced fracture of the nasofrontal outflow tract (NFOT) and displaced fracture of the posterior table requiring frontal sinus cranialization. Top right: frontal bone with sinus removed as patient also required dural repair demonstrating the anatomy of the frontal sinus and fracture pattern after obliteration of the sinus mucosa. The posterior table was then removed. Bottom left: anterior cranial base defect packed with bone graft harvested from the cranium. Bottom right: repair of the frontal craniotomy using plates.

Nasofrontal Outflow Tract

Indications for Treatment

Rodriguez et al defined NFOT involvement on CT scan as one or more of (1) outflow tract obstruction, (2) frontal sinus floor fracture, or (3) fracture of the medial aspect of the anterior table.[1] This patient review[1] and a recent meta-analysis[10] have demonstrated that involvement of the NFOT is the most important aspect of managing frontal sinus fractures. A determination of NFOT disruption is critical to prevent mucocele or mucopyocele formation. Traditionally, fractures that involve the NFOT are treated with obliteration or cranialization. The decision of whether to cranialize versus obliterate depends on the indications described for addressing posterior wall fractures. The study by Rodriguez et al demonstrates a complication rate of 9% for cranialization and obliteration for fractures with NFOT involvement compared with observation (63%).[1]

Several studies have demonstrated autoventilation of the sinus with NFOT involvement suggesting that surgical repair may not always be warranted with NFOT involvement.[8,26] Therefore, a determination of which fractures are more likely to autoventilate would help dictate nonoperative versus operative management. There are no universally accepted criteria for making this determination. However, Shaye and Strong classified fractures as mild/moderate or severe.[9] Patients with mild/moderate involvement were followed clinically with repeat imaging to assess for autoventilation and progression of opacification may indicate the need for endonasal repair. Severe fractures are better treated with acute endonasal approaches with sinus preservation or sinus obliteration.[9]

Surgical Techniques

Open cranialization or obliteration is performed similar to the techniques previously described for posterior table fractures. Both procedures require meticulous closure and sealing off of the NFOT using autologous tissue to prevent communication between the sinus and the intracranial space.

Techniques to open the NFOT can be used to preserve the frontal sinus preventing the need for cranialization or obliteration with their associated morbidity. The transnasal approach is the most suitable endoscopic technique to open the NFOT as creation of a tact is necessary to gain access to the frontal sinus.

Overall Approach

The authors utilize a minimally disruptive protocol that has previously been published[7] and is illustrated in ►**Fig. 13**. The majority of fractures are treated nonoperatively. Immediate repair is reserved for patients where the frontal sinus is deemed to be unsalvageable due to a nonfunctional NFOT or severe comminution of the posterior table where autoventilation is unlikely as well as if the patient requires a frontal craniotomy for neurosurgical indications. Delayed repair is performed in patients who have a persistent CSF leak, mucocele or intracranial infection. Patients who are observed undergo repeat CT scan at 3 months to assess sinus aeration. Those with partial aeration are followed with repeat imaging and those who have an opacified sinus are treated surgically.

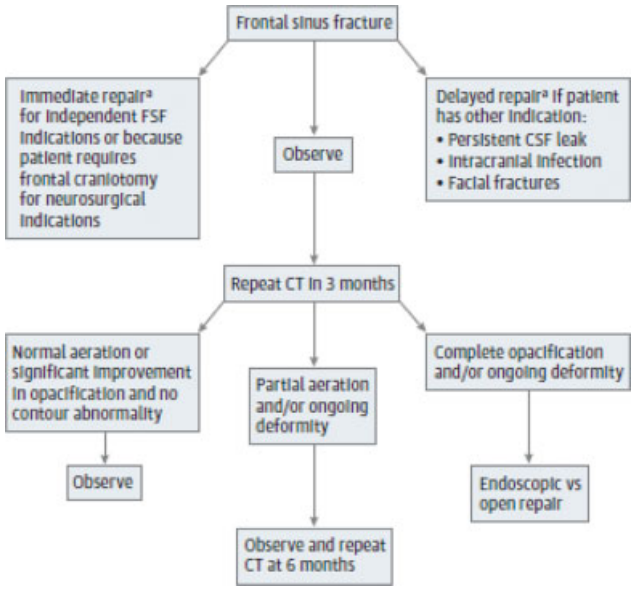

Fig. 13 Minimally disruptive protocol for frontal sinus fractures used at our institution. CSF, cerebrospinal fluid leak. CT, computed tomography. (Reprinted with permission from Patel et al.[7])

Complications

Complications can be classified as early (less than 6 months) or late (greater than 6 months).[19] Early complications include cerebral injury, contour abnormality, paresthesia from injury to the supraorbital and supratrochlear nerves,[27] meningitis, sinusitis, and CSF leak.[19,27] Late complications include contour deformity, mucocele, mucopyocele, brain abscess, meningitis, hypoesthesia, and chronic pain.[19] A retrospective study determined an overall complication rate of 10% for fractures treated surgically with 6% developing meningitis or mucocele.[19] Long-term complications can occur, such as mucocele or mucopyocele and patients should be counseled on signs and symptoms of their presentation, which include frontal pain, headaches, swelling, and visual disturbance.[28]

Cerebrospinal Fluid Leak

The majority of CSF leaks present within 48 hours after injury and most resolve spontaneously. Early management is conservative and involves head of bed elevation, bed rest, blood pressure control, and avoidance of activity that may elevate intracranial pressure.[29] The duration of conservative management should not extend beyond 1 week as the risk of meningitis is substantially higher after this period.

Although not conclusive, most studies recommend against using prophylactic antibiotics. CSF diversion using a lumbar drain can also be used as an adjunct for conservative treatment. Persistent CSF leak requires surgical closure and some suggest sinus cranialization using open techniques. However, recent studies suggest that the majority of these injuries even with persistent CSF leak can be managed conservatively without significant complications. When intervention is pursued, endoscopic techniques that repair the posterior table and dura are effective and negate the need for the morbidity associated with open cranialization.[30] Please refer to the study of Moe et al,[22] which shows the details of the approach and outcomes for our technique.

Mucocele and Mucopyocele

A mucocele is formed due to obstruction of the NFOT with incomplete removal of sinus mucosa during obliteration or unrecognized injury to the NFOT. Mucocele formation can occur many years after frontal sinus fracture and/or intervention. They have been described as occurring up to 35 years after injury[31] and can have serious consequences such as associated infection (mucopyocele) as well as intracranial and/or periorbital invasion.[31] Diagnosis is based on history and physical examination and radiographic confirmation.[28] Treatment involves creation of a patent NFOT to allow drainage of the sinus contents, which can be accomplished through either a transorbital or transnasal endoscopic approach.[32] More significant mucoceles that are too large or have invaded surrounding structures can be treated with either sinus obliteration or cranialization. Associated abscess or infection (mucopyocele) requires drainage, source control, and appropriate antibiotics.

Conclusions

The management of frontal sinus fractures is challenging due to the risk of severe complications associated with the injury and treatment and the proximity of the frontal sinus to critical structures. These complications may present immediately or decades later. Thankfully, there is increasing evidence suggesting that many of these fractures can be managed conservatively. Open sinus obliteration and cranialization are effective treatment options for select patients with severe injuries. However, approaches to the frontal sinus have seen a paradigm shift toward less invasive endoscopic techniques that can be used to repair the NFOT, preserve the sinus, reduce anterior and/or posterior table fractures, and repair dural tears. The future of frontal sinus fracture management will continue to shift toward more conservative and minimally invasive approaches that have reduced morbidity compared with traditional open approaches.

Conflict of Interest
None declared.

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