Facial Fracture Management Handbook - Frontal sinus fractures

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Facial Fracture Management Handbook

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Frontal Sinus Fractures

Anatomy and Mechanism of Injury

We have already considered frontal sinus anatomy and physiology relevant to facial fractures in the introduction and anatomy sections. Impact forces directed at the forehead may fracture the anterior table of the frontal sinus or both the anterior and posterior tables. Patients most frequently present with a history of frontal trauma as the result of assault with a hard object or impact of the forehead onto a hard surface. Soft tissue disruption of the overlying skin is usually present but may be minimal.

Physical Exam

Head and neck trauma exam with special attention to:

1. Careful inspection and palpation of the soft tissues and bone of the forehead area.
2. Carefully explore deep lacerations of the forehead with gentle palpation for underlying fractures.
3. Examine the wound and nasal secretions for evidence of CSF leak as with nasoethmoid fractures.
4. Cranial nerve V1 sensation.

Emergency Management

In most cases of severe frontal sinus injury the primary concern acutely is to exclude the possibility of associated intracranial injury or to establish that it is present and get a neurosurgeon involved in the case. All but the most minor frontal sinus fracture cases warrant a radiographic evaluation of the brain, either MRI or CT. If the patient has an obviously severe craniofacial injury with massive CSF leak or brain tissue in the wound, arrangements should be made for an emergency CT scan on the way to the operating room. Rapid sequence scanning with delayed formatting will enable the CT to be completed in a matter of minutes and a hard copy available by the time the patient is ready for surgery in the operating room. All patients with posterior table fractures should be on prophylactic antibiotics to cover sinus organisms prior to surgery.

Radiographic Work Up

Patients with trauma sufficient to result in a frontal sinus fracture should in most all cases have a brain CT or MRI to rule out intracranial injury. Imaging of the frontal sinus is best done with axial fine cuts of the frontal sinus and midface using bone windows. Be sure to instruct the radiologist to scan high enough to encompass any fracture extension above the frontal sinus. If large supraorbital frontal sinus recesses are present coronal scans to demonstrate their extent and involvement in the fractures is helpful. Pay particular attention to the presence of pneumocephalus. There are several findings on CT scan indicating a high likelihood of injury to the nasofrontal ducts. Anterior table fractures associated with nasoethmoid fractures or superior orbital rim fractures medial to the supraorbital notch have an increased likelihood of trauma to the nasofrontal ducts. Fractures severe enough to involve the anterior and posterior table with comminution are associated with a high probability of irreversible injury to the nasofrontal drainage areas (41).

If surgery on the frontal sinus is anticipated the patient should have a 6 ft. Caldwell plain film with
attention to the frontal sinus done at the time of the CT. This film is used at surgery as a template to guide the initial bone cuts into the sinus.

Definitive Management

Frontal sinus fractures demand exact characterization because the nature of the fracture will dictate the definitive management. In general there are five main methods of managing frontal sinus fractures: 1) observation and radiographic follow up to ensure that the sinus is draining adequately, 2) elevation and fixation of depressed anterior table fragments without intrasinus inspection, 3) elevation and fixation of anterior table fragments with inspection of the posterior table and nasofrontal ducts, 4) bony frontal sinus reconstruction with obliteration and 5) cranialization of the frontal sinus. All patients with frontal sinus fractures should be warned of the lifelong risk of mucocele formation, even after treatment, and cautioned that if they develop frontal headaches evaluation by an otolaryngologist should be scheduled as soon as possible.

Linear nondisplaced transverse fractures of the frontal sinus well away from the sinus floor can be safely observed. A follow up Caldwell view of the frontal sinus to ensure adequate drainage should be obtained 2 - 3 weeks after the initial injury and again at 6 months to one year. There is some controversy regarding the need to obliterate any sinus with evidence of a posterior table fracture, even if the fracture is nondisplaced. Donald takes an aggressive stance toward obliterating all frontal sinus fractures involving the posterior table and supports this position with the suggestion that damaged frontal sinus mucosa has a propensity to develop cysts and therefore mucoceles (3,16). Stanley has reported a large series of frontal sinus injuries and takes a more conservative approach to patients with nondisplaced posterior table fractures not involving the frontal sinus floor (42). He suggests that fibrous tissue spans the fracture before mucosa has an opportunity to enter the fracture line and feels that observing these injuries is reasonable.

Minimally comminuted isolated anterior table fractures with no posterior table component, associated nasoethmoid fracture or supraorbital rim fracture can be elevated either through an overlying laceration or via a coronal approach and fixated using wire or miniplates and screws. The interior of the sinus does not need to be inspected. If there is a question of a posterior table fracture or floor fracture based on the CT scan, the posterior table and nasofrontal duct areas should be inspected. If the anterior fragments are large enough to afford a view of these areas when removed during the reduction and fixation, that is adequate, if not a small osteoplastic flap of anterior table should be raised. If the posterior table is in tact and the nasofrontal ducts are clear the anterior table is simply reconstructed. If injury to the nasofrontal duct area or posterior table is evident the sinus should be obliterated with fat and fascia.

If The CT strongly suggests displaced posterior table or nasofrontal duct area fractures, the safest way to deal with the sinus is obliteration. We prefer to use fat and fascia. The sinus is approached through a coronal incision and a large osteoplastic flap is raised. If the anterior table fragments are severely comminuted they are removed and the mucosa meticulously removed from them with cutting and then diamond burns. If the anterior table can largely be maintained in tact it is left attached to the overlying periosteum inferiorly and reflected anteriorly with the coronal flap. The mucosa of the entire frontal sinus is removed with an elevator, following this posterior table fragments and lateral fragments are repositioned and the entire inner surface of the frontal sinus is burred smooth first with a cutting and then diamond burr. If posterior table fragments are free floating they can usually be replaced into anatomic position without fixation. If fixation is necessary 28 ga. wire should be used. The nasofrontal ducts are tightly packed with two rolled up pieces of fascia lata or temporalis fascia after inverting the mucosa of the nasofrontal ducts down into the ethmoids. The posterior table and floor of the frontal sinus is then covered with a large piece of fascia. Fascia lata is preferred because it is somewhat more robust than temporalis fascia. In some patients a lateral leg scar is objectionable; in these cases the temporalis fascia is will usually be satisfactory. The remaining space in the sinus is then filled with atraumatically (no bovie) harvested fat. This is easily harvested from the leg at the time the fascia lata is harvested or from a periumbilical incision if temporalis fascia is being used. The anterior table fragments are replaced and fixated using miniplates and screws.

In cases of severe craniofacial trauma the frontal sinus may be beyond repair. In these cases reconstruction of the posterior table is not done. The sinus is cranialized by removing all posterior table fragments and all mucosa from the interior surface of the remaining anterior table fragments. The nasofrontal ducts are plugged as above and covered with a larger piece of fascia. The anterior table and external forehead contour is reconstructed using available bone fragments and pericranial bone grafts if needed. If a frontal craniotomy has been done bone grafts from the inner cortex of the elevated frontal bone flap can be harvested while the neurosurgeons are working. A pericranial flap may also be useful in reconstructing the anterior cranial fossa floor; this must be planned for prior to making the coronal flap incision.