MANAGEMENT OF FRONTAL SINUS TRAUMA ASSOCIATED WITH ORBITAL ROOF AND NASAL BONE FRACTURE - CASE REPORT AND REVIEW OF THE LITERATURE

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Abstract: *The majority of frontal sinus fractures are common in young male adults, which sustain accidents, involving significant amount of force. Treatment of such cases is still a matter of research in neurosurgical and craniofacial surgery. A rational approach to the management of frontal sinus fractures is based on understanding the anatomic relationship of the frontal sinus with the brain and periorbital region and preventing early and late complications. The main goal of a multidisciplinary team is to isolate the intracranial contents and restore function and aesthetics of the frontal bone and orbital area. Although diagnosis and prognosis have progressed due to advances in computer tomography, patients have to be aware of life long problems and risks, even with appropriate management. In this article we present a case of a 32-year old male patient, who sustained such an injury and required specialized diagnosis and treatment.*

INTRODUCTION

Frontal sinus fractures are common in high energy trauma and require a proper management due to the anatomic relationship with the brain and periorbital region.(1) They occur with a frequency of 6-12% of all craniofacial fractures and are often associated with neurological and orbital injuries, but also with other facial fractures: nasal, orbital, ethmoidal, zygomatic and maxillary.(1,2)

Motor vehicle accidents (decreasing in the last 3 decades from 71%-52%) and personal violence (increasing from 9% to 21 %) are most responsible for the majority of the frontal sinus fractures, but etiology may include industry and recreational accidents as well.(3)

Proper management relies on early, accurate diagnosis and treatment.(4) Initial evaluation requires airway control and hemodynamic stability.(5) Head and neck evaluation must focus on injuries to brain, spine, orbits and facial skeleton.(4) This requires a team approach and neurosurgeon, maxillofacial surgeon, ophthalmologist and ENT-surgeon must work together in developing a surgical plan, after careful clinical and CT examinations.(4,6)

The goal of an algorithmic approach must be a safe sinus, by decreasing early and late complications, preserved function and reestablishment of aesthetics of the forehead and orbital area.(2,7) Missed diagnosis, delayed treatment and incorrect surgical care can cause life threatening complications.(4)

CASE REPORT

A 32-year old patient was brought to our emergency department 24 hours after sustaining a head injury following assault.

At presentation, the patient reported loss of consciousness and his main complaints were double vision, drowsiness and nose bleeding. Vital signs were stable and the patient was well oriented to time, place and person.

He was admitted to neurosurgery ward with a Glasgow coma score of 13 on arrival. Further physical and neurological examinations showed forehead laceration, sutured elsewhere, bilateral periorbital ecchymosis and edema, swelling of the nasal and left frontal area. Vision assessment showed inferior displacement of the left eye, limitation of movements, diplopia with pupils moderately dilated and reacting to light. No foreign bodies were palpable around the sutured wounds and no other motor or sensory deficit was detected.

Radiological findings

CT scans with 3D reconstruction revealed comminuted fracture of anterior frontal sinus wall and nasal bone, depression of left frontal area, displaced fracture of left orbital roof and ethmoidal, frontal, left paranasal sinus bleeding. No fractures of the posterior sinus wall or nasofrontal duct injuries were visible.

Figure no. 1.a. CT on admission

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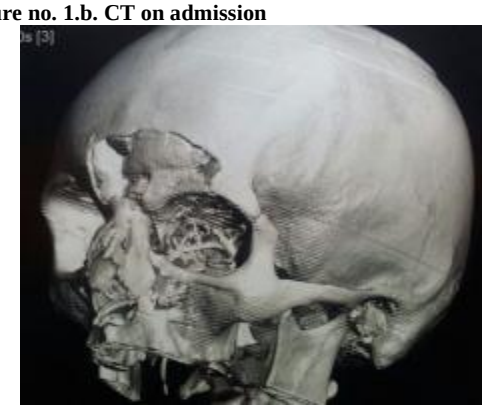
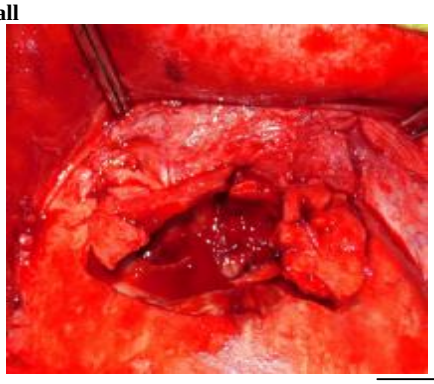
Figure no. 1.b. CT on admission



Management

Patient was put on prophylactic antibiotic, analgesics and oxygen by mask. Surgery was performed 48 hours later via the coronal approach, exposing the fracture of anterior frontal sinus wall, left orbital roof and nasal bones. An open reduction and internal fixation were performed, after the risks of bleeding, infection, paraesthesia, headache, orbital injuries, diplopia, meningitis and late mucocele formation were explained to the patient. A straight incision was made, 6 cm behind the hair line, from one temporal line to the other that passed through the skin and subcutaneous tissues. Skin hooks were used to retract the skin away from the skull and elevation of the flap was made by protecting the underlying pericranium. Electrocoagulation was limited to avoid injuries to the hair follicles and large vessels were tide off individually. For the lateral dissection, initial incision was extended below the temporal line, through the superficial temporal fascia and onto the deep temporal fascia, traversing the temporal artery and vein. The flap was raised anteriorly using blunt finger dissection. Integrity of the temporoparietal fascia, that contains the frontal branch of the facial nerve, was maintained. Central dissection was made medially to the temporal line. A sharp dissection was used towards the zygomatic arch. The scalp was rotated forward with elevation of the glabellar flap. Avoiding injuries to the supraorbital and supratrohlear neurovascular pedicles, the frontal bone was exposed. More extensive dissection was used to expose orbital rims, roof and nasal bones, releasing the supraorbital neurovascular pedicle. After complete exposure, fracture reduction was made by pulling the bone fragments back(5,8) Visualisation of the sinus and frontal recess showed a hematoma that was evacuated, and the mucosa removed in order to avoid later complications. No obliteration of the frontal sinus and nasofrontal duct was performed, due to the integrity of the posterior sinus wall and the nasofrontal recess.

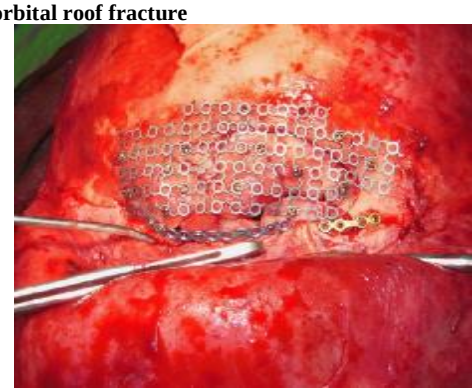
Figure no. 2. Comminuted fracture of the anterior frontal sinus wall



All fractures were reduced and fixed at the same time. Bone fragments of the anterior frontal sinus wall were kept in place by a titanium mesh. Left orbital roof and nasal bone fractures were reduced and fixed, using miniplates and screws.

Bilateral Penrose drains were inserted beneath the scalp. The skin was sutured and a pressure dressing was applied. Penrose drains were removed 48 hours later and pressure dressing 4 days later.

Figure no. 3. Reduction and fixation of the frontal sinus wall and orbital roof fracture



The patient was prescribed intravenous broad-spectrum antimicrobial therapy, postoperatively.

Another 96 hours later, head CT was repeated. Restoration of orbital volume, nasal and frontal contour were accomplished. Complaints about double vision vanished.

Figure no. 4.a. Post surgery CT

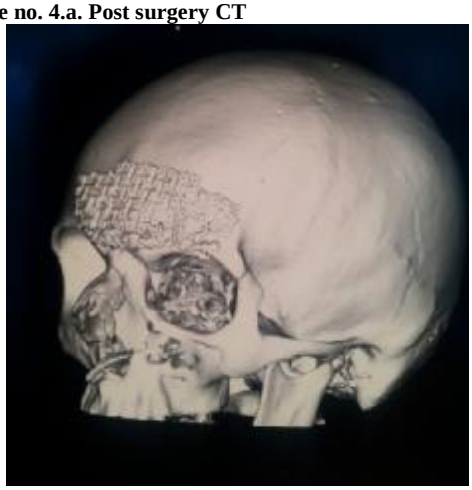
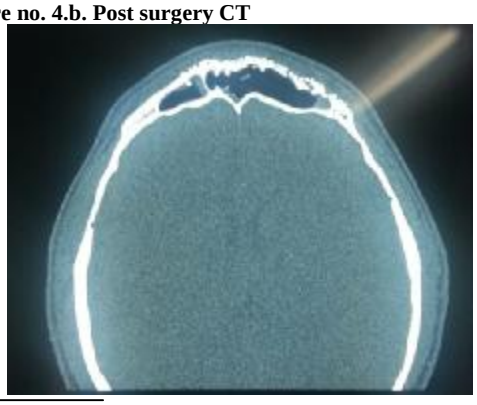


Figure no. 4.b. Post surgery CT



The patient was discharged on the 10th day in a stable neurological condition and with pre-trauma aesthetics fully restored.

Figure no. 5.a. 10-day post-operative condition

Figure no. 5.b. Condition 10 days after surgery

DISCUSSIONS

The frontal sinus is a mechanical barrier, with an important role in protecting the brain, due to the fact that these air-filled compressible cavities absorb the impact energy in head traumas.(9)

Frontal sinus fractures are not an emergency, unless associated with neurological or ophthalmologic injuries that require immediate treatment.(9) Accurate diagnosis and adequate consecutive treatment are crucial in these cases of facial trauma.(4)

A thin cut axial CT scan with coronal, sagittal and 3D reconstruction is the imaging gold standard for frontal sinus fractures. Axial images provide the best information about anterior and posterior tables; coronal images are used to assess sinus floor and orbital roof. Sagittal reconstruction is ideal in evaluating the patency of the frontal recess and 3D reconstruction can visualize the external contour deformity, seen less clearly with 2D cuts alone.(10)

Surgical treatment must take into consideration the integrity of the anterior table, posterior table, nasofrontal recess, that requires a frontal sinus obliteration, dural tear leak and fracture comminution.(7,11)

Depending on the extent of the frontal sinus fractures to the anterior and posterior wall, a number of complications must be taken into consideration, such as: obstruction of nasofrontal duct, entrapment of the mucosa in the fracture lines, epistaxis, cerebrospinal fluid leakage, intracranial hematoma, sinusitis, meningitis, mucocele, osteomyelitis and intracranial and orbital abscesses.(7,12,13)

Thanks to the accumulation of clinical experience and technological progress, diagnosis and surgical possibilities have changed over time.

For displaced anterior table fracture, technology progressed towards achieving reduction with less invasive methods like: modified transcutaneous or endoscopic approaches.(14,15)

Percutaneous simple reduction is less invasive than coronal approach. It provides an adequate access, avoids large scars and heals with fewer complications. Although the aesthetic outcome is satisfactory, the technique has the drawback of the absence of direct vision, less control of the fracture and low chances of complete reduction.(2)

The endoscopic approach is a minor invasive, challenging procedure that offers the advantage of reduced soft tissue dissection, accurate visualization and few sequelae like paraesthesia and alopecia, compared to the coronal flap. Surgery is performed under local anesthesia with a barely visible incision and small postoperative scar. Instead, it is a time consuming procedure, especially in cases of involvement of supraorbital rim and the fracture reduction can be difficult.(16)

Because of the association with the orbital roof and nasal fractures, we chose the coronal flap approach for maximal visualization and plating over a large area, in spite its many disadvantages of large blood loss and postoperative scar, alopecia and high risk of injury to the frontal branch of the facial nerve.(14,17)

Isolated orbital roof fractures are rarely observed and are most of the time associated with other craniofacial fractures, in high velocity trauma.(18,19) The best approach is the coronal flap and iliac bone grafting is a good solution with little complication. The prognosis depends on the associated lesions and can require a team work, associating maxillofacial surgeon and neurosurgeon.(14)

In treating anterior frontal sinus wall fractures, most authors accept an open exploration and obliteration of the sinus, in presence of displaced or depressed anterior wall or injury to the nasofrontal duct.(20)

We chose the removal of the sinus mucosa, taking into account that anterior table fractures with displacement over 2-6 mm have a high risk of mucocele formation and avoided the obliteration of the sinus, due to the preservation of the integrity of the nasofrontal duct.(20)

CT performed every 3 months for a year showed no complications following our surgical approach.

CONCLUSIONS

The bony skeleton of the face protects multiple organs, therefore minimizing scaring and preventing further injury to adjacent structures is of great importance in facial trauma.(21)

Frontal sinus trauma is often associated with neurological damage and other maxillofacial fractures. Proper clinical and radiological assessment, as well as adequate surgical planning, is necessary in achieving satisfactory functional and aesthetic results.(9,21)

Every single patient must be thoroughly evaluated upon initial presentation, and the type of treatment must be individualized according to each case, based on decisions made by a multidisciplinary team, after thorough evaluation.(21)

Regardless of age, gender and type of fracture,

complications can occur, which may involve brain, eyes and bones. Early detection requires lifelong routine CT scans, endoscopic examination, as well as neurological and ophthalmological evaluations.(11)

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