# Frontobasal Injuries: The Point of View of the Maxilo-facial Surgeon

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## Introduction

The treatment and management of craniofacial trauma has undergone an important and radical change in the past twenty years. Since Paul Tessier in the sixties operated on monstrous congenital deformities, such as craniofacial-stenosis or hypertelorism[1,2], the new craniofacial surgical techniques have been modified and improved. We can summarize the operative procedures in Craniofacial surgery:

- ❑ We can remove large bone segments and place them in a new position.
- ❑ By Coronal incision we can approach orbital frames and displace them in all directions of the space (Fig.1).
- ❑ We can remove the facial skeleton, so that it loses contact with the cranium and advance it in a single or bipartitioned piece: widening or narrowing the face.
- ❑ We can advance in a monoblock fronto-orbital-maxilar-skeleton.
- ❑ We can remove the facial skeleton to achieve a wide transfacial approach to the Cranial Base region. The facial bone segment, which has been removed free or pediculated provides an excellent visualization of the entire anterior cranial fossa, cribiform and nasoethmoidal regions.

These craniofacial techniques with the refinements achieved today, provide us with a more effective management of frontobasal injuries (F.B.I.)[3]. Obviously, the complex nature of these injuries dictates cooperation among the craniofacial surgeon, neurosurgeon and ophthalmologist.

*Fig.1:* By coronal incision, we can approach orbital frames, osteotomize and displace them in all directions of the space. The craniofacial techniques provide us with a more effective management of frontobasal injuries.

## Classification and Pathology of Frontobasal Injuries

### ORBITAL DISORDERS

1. *Blindness* associated with F.B.I. occurs by trauma to the optic nerve in the region of the optic canal or by the rupture of the globe. Blindness secondary to retrobulbar haematoma has been quoted in some cases.[4,5,]

2. *Static Globe Disorders.* The orbital fragments displacement can cause changes in the position of the ocular globe.[6]

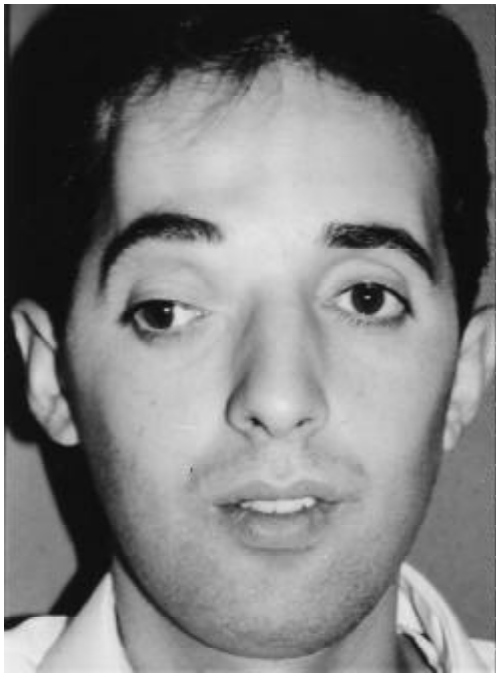

*Fig.2:* The orbitofrontal fragments displacement cause changes in the position of the ocular globe: Exopthalmus and downward displacement.

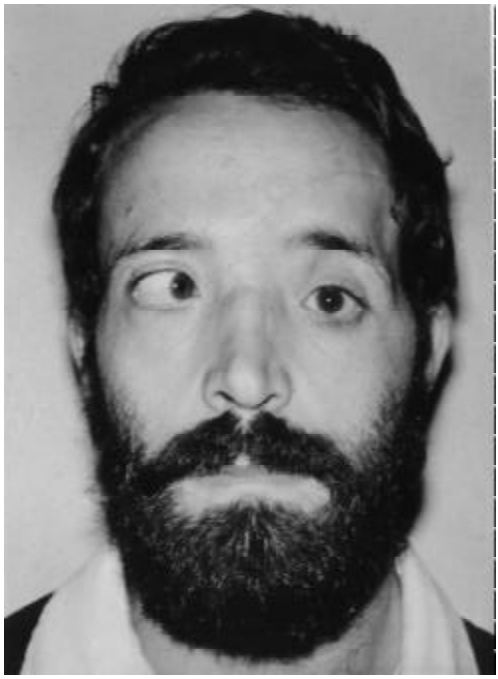

*Fig.3:* A frontonasoethmoidal fracture causes restriction of the movements in the left globe by incarceration of the muscles, and diplopia results.

-Forward: Exopthalmus due to decreased volume of the orbital cavity.
-Backward: Enopthalmus due to exit of the orbital fat following the rupture of the periorbita or enlargement in the size of the orbital cavity (increased volume) by displacement of the orbital walls.
-Vertical displacement is mainly downward (Fig.2).

3. *Dynamic Globe Disorders.* These are caused by injuries directly on the oculo motor nerves or by incarceration of the muscles. The movements of the globe are restricted and diplopia results. (Fig.3).

4. The disturbance of the nasolacrimal apparatus due to direct injury of the sack or obstruction of the nasolacrimal duct is frequently associated with F.B.I., and must be repaired by the opthalmologist.[7,8]

## FRONTAL SINUS DISORDERS

Anterior wall fractures cause aesthetic disorders if there is fragment displacement.
Posterior wall fractures may cause neumatocele, infections or cerebrospinal fluid leak if damage of the dura is present.

## ETHMOID SINUS DISORDERS

The injuries in this region may cause communication of the nasal fossas with cranial fossa and cerebrospinal fluid leak is possible (Cerebrospinal Rhinorrhoea).

## ANTERIOR CRANIAL FOSSA DISORDERS

1. Brain parenchymal injury.

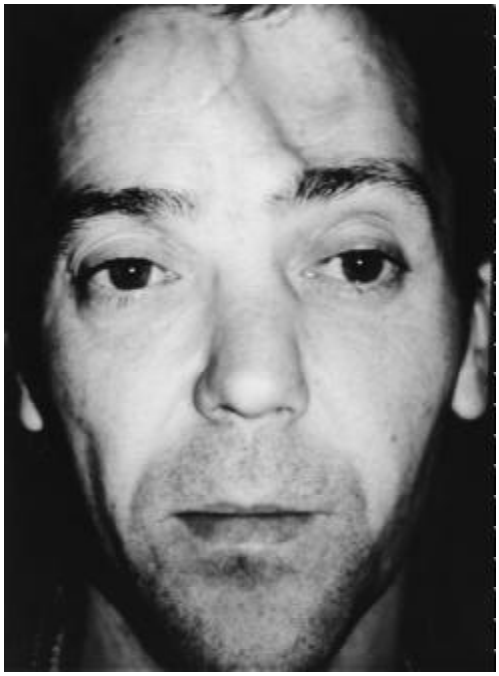

*Fig.4:* Important aesthetic disorders are the outcome of displacement of the frontal bone fragments.

2. Damage to the dura.

3. Important aesthetic disorders are the outcome of bone fragments displacement (Fig.4).

## CLASSIFICATION
(ACCORDING TO THE AREA INVOLVED)[9]

- *Central:* Involves upper nasoethmoidal complex, central frontal bone with sinus and medial third of the superior orbital rim and supero-internal orbital walls.
- *Lateral:* Involves the entire supraorbital rim, the upper-lateral orbital wall and lateral frontal bone with ipsilateral sinus.
- *Central-Lateral* (Left or Right)
- *Central-Bilateral*

## Treatment

Based on CT Scan findings, the treatment by simultaneous neurosurgical and craniofacial reconstruction must be carried out as soon as possible. A previous thorough examination by an ophthalmologist is mandatory.
The objective of a one-stage surgical procedure is to restore craniofacial anatomy and so achieve a normal natural function[9,10,11]. In cases of F.B.I. in which displacement of the fragments is not present, the management is observative.

## ACCESS

External incisions must be avoided as much as possible. The development of surgical approaches to the facial skeleton using incisions made behind the hairline or internal incisions provide greater exposure than the previously used external incisions.

1. *Coronal* incision is the most important access in F.B.I. Coronal Flaps are today standard approach to the upper third of the facial skeleton providing and excellent exposure of the frontal vault, fronto-naso-ethmoidal region, medial canti, lacrimal fossa, medial, lateral and supraorbital rims, lateral wall and roof of the orbit and the zygomatic arches.[12]

2. *Transconjunctival and sublabial* (upper bucal sulcus incision) approaches provide a wide exposure of the rest of the facial skeleton frequently affected in these traumatic injuries.
In some elective cases we can approach through the *external wounds* at the fracture site.

## CRANIOTOMY

When the fracture fragments are displaced, frontal osteotomies are used for access achieving a wide exposure of the anterior cranial fossa, frontal and paranasal sinuses and orbital contents.

Raveh prefers the subcranial approach because, in his opinion, the neurosurgical-transfrontal route presents a higher rate of morbidity.[10,11] From our experience, craniotomy has no significant operative morbidity, no infections nor late cerebrospinal leak. The craniotomy must be done by the neurosurgical team. *Complete frontal* craniotomy in cases of central fractures extended in cases of central-lateral fractures. *Unilateral frontal* craniotomy in cases of lateral fractures.

*Supraorbital osteotomies* may be made elective to provide higher exposure if the case requires it.[9] These naso-orbital osteotomies must be done just above the medial canthal attachments.

## SURGICAL STAGES

1. *Dura* must be repaired by a neurosurgical team, directly closing or using pericraneal flaps anteriorly or laterally pediculated,[13] duraplasty with fascia lata and fibring glue, or galea if necessary.

2. *Frontal and ethmoidal sinus*: When the sinus is involved, two behaviors may be practiced, conservative or radical. When it is possible to maintain the cavity isolated from the cranial fossa and the duct permeable, we prefer conservative behavior. Otherwise, the cavity must be removed. This radical treatment includes the removal of all mucosa, inversion of the nasofrontal duct mucosa into the nasal cavity, contoured bone grafts to plug the nasofrontal ducts (not muscle grafts) and cavity if it is a small, one filling with cancellous bone grafts harvested from the iliac crest *(OBLITERATION)*. If it is large, or the fracture of the posterior wall is comminuted, we must resect the posterior sinus wall *(CRANIALIZATION)*[9,14].

When large defects are present in the nasoethmoidal complex, the isolation of cranial fossa from the facial cavities is necessary. In these cases, split calvarian bone grafts are used for immediate repair.[3,9,15] In our opinion and based on our experience in the field of craniofacial surgery, it is not necessary to repair completely the orbital roof, particularly, if the periorbital is undamaged and the escape of fat is not possible.

*Fig.5:* Blindness caused by direct injury to the optic nerve in the region of the optic canal.

3. *Optic Canal Decompresion*. In F.B.I., examination by an ophthalmologist is mandatory. The causes of blindness may be: ruptured globe, direct optic nerve injury, (Fig.5) or ischemic opticneuropathy secondary to retrobulbar haematoma. The timing of visual loss is essential for prognosis; when the loss has been delayed and progressive after the impact, the prognosis for the recovery of vision is better and in these cases, optic nerve decompression may be indicated even in the absence of radiological abnormalities in a mandatory high-resolution CT Scan.[4,5,9,16]

Megadose of steroids might be useful for the optic nerve injury. The transethmoidal route for optic nerve decompression is a proven alternative to the transfrontal approach. In some special cases we have used latero-external transorbital route for decompression.

4. *Orbito-Frontal reconstruction* with the fracture fragments; an anatomic and symmetrical reassemble of the fracture fragments must be carried out; the supraorbital rim, glabella and naso-frontal region, and all the cranial vault, carefully reconstructed, must be accurately

*Fig.6:* All malpositioned fragments must be osteotomized again, repositioned, as well as possible, and rigidly fixed.

fixed as well. Plating systems have proven to be a great advance in F.B.I. The strength of the plate which is necessary in this region is less than in other areas due to the absence of external forces; profiles of 0.8 - 1.2 mm of the plates and screws of 1.8 mm are used. These plates are mainly placed in the load-bearing buttresses (glabella, supralateral orbital rim)[17]. Our policy, now, is to be as sparing as possible with the use of miniplates. In children below the age of six, titanium plates must be avoided. In these cases we use reabsorbable fixation systems if necessary. These "biodegradable" plates and screws are made of polyglycolide (R.G.A.) and of polylactide(P.L.A.).

5. *Repair of Soft Tissues*. Lateral and medial canthopexies are carried out. The scalp is closed with absorbable subcuticular sutures and the skin, with staples.

6. *Postoperative care*. Intravenous antibiotics are administered during the first week and oral antibiotics for a further week. If a repair is correctly performed, no patient will have to undergo subsequent surgery for cerebrospinal fluid leak. Minimal rhinorrhoea in the first post-surgical days is not uncommon, but it ceases spontaneously.

## SECONDARY TREATMENT OF SEQUELAE

Sometimes sequelae are still frequently observed secondary to the lack of adequate initial surgical treatment.

In sequelae with functional and aesthetic disorders, we can find dislocations and/or loss of bone. Dislocation is the displacement caused by the bone fragments; Bone Loss is due to direct loss in the injury or by posterior infection.

The surgical behavior is the same as the primary treatment, and the all malpositioned fragments must be osteotomized again, repositioned as well as possible, and rigidly fixed (Fig.6).

When an extensive bone loss is present, the best graft material is the autogenous bone. We prefer membranous versus endochondral graft, rigidly fixed and therefore, the chance of survival is better and reabsorption is less. Split cranial cortical graft is the most convenient. The methods for harvesting split cranial bone are[15]:

If a craniotomy is not performed, the outer cortex can be separated at the diploe layer.

1. Separating the inner cortex of the craniotomy flap with an oscillating saw.
2. Special craniotomy may be performed to harvest a complete calvarian graft if necessary.
3. In large defects, allografts like titanium Mesh, Methylmethacrylate may be used. In some cases of large volume of bone loss or anatomical-topographic complexity, a

prefabricated prosthesis can be extremely useful. The prosthesis are made from anatomically exact computer-generated models.

In the naso-ethmoidal-orbital region it is frequently necessary to carry out a medial canthoplasty combined with dacryocystorhinostomy[7,8].

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