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Samii M (ed): Skull Base Surgery. First Int Skull Base Congr, Hannover 1992.
Basel, Karger, 1994, pp 572–576

# Management of Fronto-Naso-Orbital Fractures: Diagnostic Evaluation and Treatment Principles

*K.W. Grätz, P.E. Haers, H.F. Sailer*

Department of Maxillofacial Surgery (Director: Prof. *H.F. Sailer*), University Hospital, Zurich, Switzerland

Fractures of the frontal bone may involve the nasoethmoidal and the zygomatico-orbital complex and can be accompanied by intracranial lesions. Although these fractures might be isolated, any severe midface trauma must be considered highly conspicious for a fracture of the nasoethmoidal complex or the frontal bone. Impaired by soft tissue swelling, clinical examination does not allow for a precise diagnosis and a correct estimation of the extent of the lesions in the frontal area. Therefore, CT scan and 3-D imaging techniques are obligatory diagnostic tools which cannot be bypassed in a correct preoperative diagnostic process (fig. 1a). In emergency cases, at least CT scans including the neurocranium and the midface should always be available [1, 2]. Treatment should not be delayed and should aim for both neurosurgical and primary craniofacial repair, the latter being based upon open reduction and internal osteosynthesis of all fractures thus restoring the facial contour in all 3 dimensions with special attention for a correct primary repair of all periorbital structures (fig. 1b) [3]. The application of these treatment principles and the results obtained in 21 patients are presented.

## Surgical Technique

In the Department of Maxillofacial Surgery in Zurich, the bicoronal incision is used as the standard surgical approach for all fractures involving the upper third of the face. The incision is limited to the galea without damaging the pericranium and is continued by dissection along the loose vascular layer between the galea and the pericranium allowing for the flap design indicated. The pericranium is only incised and reflected at the cranial border of the fracture site. Depending upon the extent of the lesions, different treatment modalities are applied (table 1). Fractures of the anterior wall of the frontal sinus, which are displaced over a distance equal to or greater than the skull bone thickness, demand for exploration of the frontal sinus. The frontal bone fragments are removed and the sinus mucosa is carefully eliminated. Further treatment of the frontal sinus is carried out according to the treatment concept described by Sailer and Grätz [3]. Following inspection of the posterior sinus wall, the



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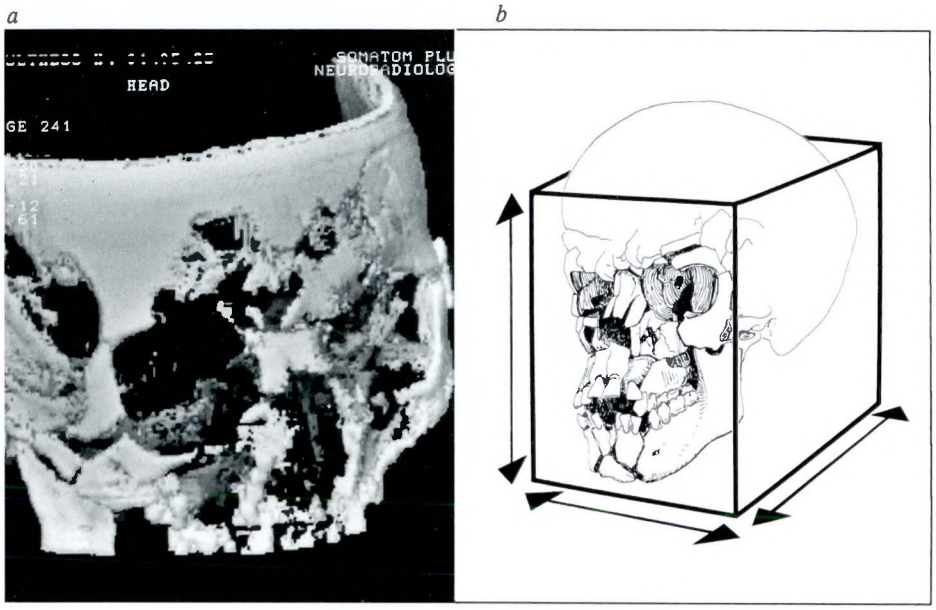



*Fig. 1. a* 3-D imaging illustrating the extend of the bony lesions and the traumatic enlargement of the face. *b* The facial contour should be restored in all 3 dimensions.

*Table 1.* Treatment modalities

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|---|
| Bicoronal approach |
| Systematic preparation of pericranium flap |
| Rigid osteosynthesis of the frontal bone, preferably using microplates |
| Obliteration of the frontal sinus using a pericranium flap and lyophilized cartilage chips, embedded in fibrin glue |
| Transsinusoidal repair of dural tears |
| Further neurosurgical interventions |

nasofrontal duct is obliterated using a rotated pericranium flap. The whole sinus is packed with lyocartilage chips and fibrin glue (fig. 2a). The frontal bone fragments are carefully repositioned and fixated. Osteosynthesis in this area is preferentially performed with microplates (fig. 2b), while in case of associated midface fractures osteosynthesis of the facial pillars demands stronger osteosynthesis material. If the fractured frontal bone segments are not suitable for repositioning or if there is a frontal bone defect, sheets of lyophilized cartilage as well as split thickness calvarial bone are used for the reconstruction of the forehead contour. If the posterior wall is fractured too, dural tears are systematically investigated via a transsinusoidal approach, as long as a craniotomy has not been indicated by the neurosurgeons. The fractured posterior sinus wall is removed under severe protection of the underlying frontal lobes. The dura is sutured microscopically and covered with a free pericranium patch, which is fixated to the dura with fibrin glue. The defect of the posterior sinus wall is covered using the pericranium flap obliterating the nasofrontal duct, which is folded to cover the posterior bony defect. Consequently, fractures of the nasoethmoidal complex, the medial orbital wall, orbital roof, lateral orbital wall and comminuted fractures of the zygomatic arches are treated via the same approach.

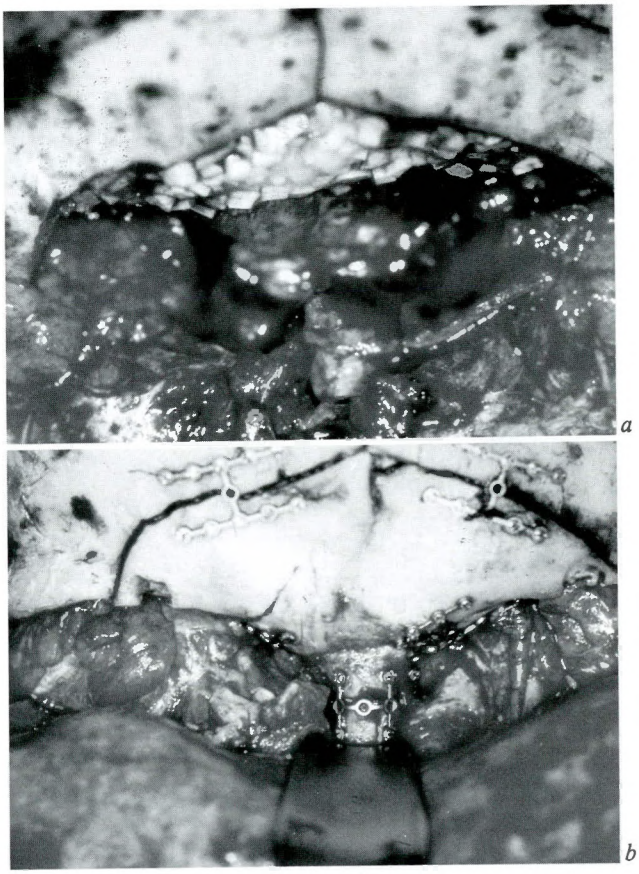


*Fig. 2. a* Following removal of the frontal sinus mucosa and inspection of the posterior wall, the nasofrontal duct is obliterated with a rotated pericranium flap and the sinus is completely filled with lyophilized cartilage chips imbedded in fibrin glue. *b* Microplates are preferably used in this area. Because of their appropriate dimension they are easy to bend and hardly palpable postoperatively.

## Patients

From January 1990 to December 1991, 19 male and 2 female patients have been treated according to this protocol. The average age was 36 years with a minimum of 20 and a maximum of 66 years. Etiologically, the fractures were due to traffic road accidents in 14 cases (67%), work accidents in 3 cases (14%), 3 gunshot wounds (14%) and 1 sport accident (5%). In all cases, CT scans were available. There was only one case of isolated frontal bone fracture without associated midface fractures. According to the lesions, transsinusoidal dural repair was performed four times, craniotomy in 6 patients, obliteration of the frontal sinus in 13, reconstruction of a frontal bone defect using lyophilized cartilage slices in 5 and using calvarial bone in 3 patients. In one gunshot case where the frontal sinus was directly involved, bony reconstruction was delayed. In 4 cases, simple repositioning and osteosynthesis of minimally dislocated frontal bone fractures was done. In all cases, associated fractures of the zygomatic arches, lateral orbital wall, roof and medial orbital wall as well as the nasoglabellar junction were treated via the same approach. Medial canthopexy was performed in 5 cases. Associated orbital floor defects, midface and mandibular fractures with ensuing occlusal disturbance were treated in the same session.

## Results

Permanent palsy of the frontal branch of the facial nerve was not observed. Six months postoperatively, transient paresthesia and hypesthesia of the V1 had recovered in all cases. No infection or any recurrence of rhinoliquorrhea occurred, nor was any revision or secondary correction indicated until now. In all cases, a normal appearance of the forehead contour could be obtained. Late complications such as frontal mucoceles were not observed yet. A good restoration of the intercantal distance was obtained, except in one gunshot wound case.

## Discussion

Frontal sinus fractures are relatively uncommon and are estimated to occur in 5–8% of all facial fractures [4]. Early surgical treatment of naso-orbito-frontal fractures is indicated, because delayed and incomplete treatment causes deformities which are difficult to correct in secondary procedures [5]. For the same reason primary bony reconstruction is mandatory, except in gunshot wounds [6]. The bicoronal incision is the ideal approach to expose fractures of the upper third of the face [6]. This incision is also the best method of widely exposing the nasoethmoidal complex [1]. Exposure of the scar by a receding hairline is prevented by positioning the incision at the vertex. Reconstruction of the orbital floor is performed via a transconjunctival approach, so that there is no need for incision in the face itself. Microplates are the preferential osteosynthesis material used in this area. They allow by a stable and rigid fixation of the frontal bone fragments and are hardly palpable because of their appropriate dimensions [7–9]. They are very useful for fixation of fractures of the nasoglabellar junction with special regard to the transversal repositioning of the bony fragments.

Lyophilized cartilage is used both in the frontal sinus obliteration technique described by Sailer and to restore the frontal contour [3, 10]. Lyophilized bank cartilage has been used in our clinic for facial contour corrections, reconstruction of the orbital floor and by augmentation procedures in both upper and lower jaws. Experimental foundations, preparation of the material and clinical indications have been reported extensively by Sailer [11]. Lyocartilage is a material with a reduced antigencity and ossifies rather quickly in a bony environment. It is also resistant to infections because of its avascular structure and its rehydratation in an antibiotic solution prior to its use. Whenever a fracture line is seen in the posterior wall of the frontal sinus, the underlying dura is explored systematically. Dural repair is done via a transsinusoidal or transcranial approach depending upon the importance of the lesion, the specific anatomy and further neurosurgical indications [12]. It is preferentially carried out under microscopic magnification [13]. Whatever approach is used, it is essential to reposition impacted Le Fort III and other severely dislocated midface fractures before dural repair is undertaken, because this traumatic maneuver itself can disrupt the dura. Regarding the incidence of late complications, a definitive evaluation is only possible when long-term postoperative information is available. Although a controversy concerning cranialisation and obliteration techniques is still going on [14–16], it is our conviction that this technique allows for a total ossification of the former frontal sinus and gives more guarantees in this perspective than the cranialisation techniques, where remaining empty spaces cannot be excluded.

## References


1 Leipziger LS, Manson PN: Nasoethmoidal orbital fractures. Clin Plast Surg 1992;19:167–193.
2 Manson PN, Markowitz B, Mirvis S, et al: Toward CT-based facial fracture treatment. Plast Reconstr Surg 1990;85:202–212.
3 Sailer HF, Grätz KW: Das Konzept der Behandlung schwerer Mittelgesichtsfrakturen beim Bezahnten und Unbezahnten. Fortschr Kiefer-Gesichtschir 1991;36:52–54.
4 Helmy ES, Koh ML, Bays RA: Management of frontal sinus fractures. Oral Surg Oral Med Oral Pathol 1990;69:137–148.
5 Heine RD, Catone GA, Bavitz JB, et al: Naso-orbital-ethmoid injury: Report of a case and review of the literature. Oral Surg Oral Med Oral Pathol 1990;69:542–549.
6 Key JM, Tami T, Donald P: Gunshot wound to the frontal sinus. Head Neck 1990;12:357–361.
7 Eppley BL, Sadove MA: Application of microfixation techniques in reconstructive maxillofacial surgery. J Oral Maxillofac Surg 1991;49:683–688.
8 Luhr HG: A microsystem for cranio-maxillofacial skeletal fixation. J Cranio-Maxillofac Surg 1988;16:312–314.
9 Luhr HG: Indications for use of a microsystem for internal fixation in craniofacial surgery. J Craniofac Surg 1990;1:35–52.
10 Sailer HF: Experiences with the use of lyophilized bank cartilage for facial contour correction. J Maxillofac Surg 1976;4:149–157.
11 Sailer HF: Transplantation of Lyophilized Cartilage in Maxillofacial Surgery. Experimental Foundations and Clinical Success. Basel, Karger, 1983.
12 Beziat JL, Pierluca P, Freidel M: The transsinusal and translesional approaches to traumatic lesions of the craniofacial borders. Ann Chir Plast Esthét 1985;30:236–240.
13 Klaiber RD, Grätz KW: Microsurgery applied to neurotraumatology in frontobasal injuries, in Vécsei V (ed): Fractures of the Frontobasis. Proc Ist Viennese Workshop Int Coll Surg 1982, pp 33–37.
14 Gruss JS, Bubak PJ, Egbert MA: Craniofacial fractures. An algorithm to optimize results. Clin Plast Surg 1992; 19:195–206.
15 Rohrich RJ, Hollier LH: Management of frontal sinus fractures. Changing concepts. Clin Plast Surg 1992;19:219–232.
16 Romain P, Legros M, Hannion X, et al: Traumatismes des sinus frontaux. Rev Stomatol Chir Maxillofac 1990; 91:14–22.



Dr. Dr. med. K.W. Grätz, Abteilung für Kieferchirurgie, Universitätsspital Zürich,
Frauenklinikstrasse 10, CH–8091 Zürich (Switzerland)