

Treatment of Fractures of the Anterior Floor Base of the Skull in Maxillo-Facial Surgery

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Received: November 22, 2019; **Published:** December 23, 2019

Abstract

The traumatism of the anterior floor of the base of the skull represent 15 to 20% of the cranial traumatism in general. These traumas threaten the overlying neuroencephalic structures and are very often responsible for osteomeningeal breccia exposing to a major infectious risk, with morphological deformations.

This work is a descriptive retrospective study of 14 patients operated for fracture of the anterior floor of the base of the skull, at the department of stomatology and maxillofacial surgery of the hospital August 20, 1953 for a period of 3 years from January 2015 to December 2017.

We found a male predominance of 78.5%, the causes are dominated by road accidents (50%), the diagnosis was suspected before the evocative signs (rhinorrhea, morphological deformations and periorbital bruising) and was confirmed in all patients by CT. Fractures of the anterior stage of the skull base were classified according to a classification that relates to the biomechanics of trauma; 28.6% of the patients had a medio-basiscranial fracture, 71.4% had a latero-basiscranial fracture.

The ideal treatment is the surgical closure of the breccia to avoid the risk of meningitis, in combination with medical means, the ideal time of repair is beyond the 72nd hour after the decrease of cerebral edema in case of absence an intracranial lesion requiring emergency intervention.

The management of these fractures is often multidisciplinary because of the diversity of the clinical picture and the observed lesions.

Keywords: Fractures; Anterior Floor Base; Skull; Maxillo-Facial Surgery

Introduction

The traumatism of the anterior floor of the base of the skull represent 15 to 20% of the cranial traumatism. They threaten the overlying neuroencephalic structures, and they can be responsible for osteomeningeal breccia exposing to the infectious risk. The causes of this trauma are dominated by road accidents.

The diagnosis of fractures and osteomeningeal breccia of the anterior stage can be obvious in front of a typical picture, however in certain cases it is delicate, and escapes the standard radiological investigations.

The CT has solved some of this problem; however some dural breccias may go unnoticed by the CT, hence the interest of MRI.

In the vast majority of cases, it is the intracranial lesions that condition the vital prognosis, the other lesions of the face can tolerate more commonly a slightly delayed management.

The treatment should ideally be fast and complete to avoid the risk of meningitis.

The management of these fractures is often multidisciplinary because of the diversity of the clinical picture and the observed lesions.

Materials and Methods

Our work is descriptive retrospective study of 14 patients operated for fracture of the anterior stage of the base of the skull, at the department of stomatology and maxillofacial surgery of the hospital August 20, 1953, during a period of 3 years from January 2015 to December 2017.

The analysis of the files focused on the epidemiological, clinical, neuroradiological explorations, therapeutic and evolutionary aspects.

Results

Our work is descriptive retrospective study of 14 patients operated for fracture of the anterior stage of the base of the skull, at the department of stomatology and maxillofacial surgery of the hospital August 20, 1953, during a period of 3 years from January 2015 to December 2017. A male predominance of 78.5% was found. The average age was 27.8, with extremes of 18 years and 43 years. The young population aged between 15 and 30 years was the most concerned and represented 87.5%. Road accidents (AVP) account for 50% of cases, assaults take second place 35.7% of cases, against for falls 14.3% of cases.

In our study eight patients had an initial loss of consciousness (PCI), 7 of whom received a stay in intensive care for a period ranging from 2 days to 7 days.

The rhinorrhea was present preoperatively in 5 patients 35.7% (3 unilateral/2 bilateral), and 1 patient (7.14%) who presented a persistence of postoperative rhinorrhea requiring surgery. 35.7% of patients had epistaxis on admission, and 14.3% had otorrhagia. 1 patient had facial paralysis due to a fracture of the tympanal bone, 3 patients had a frontal wound.

85% of patients (12 cases) had periorbital bruising at admission (Figure 1); 4 of them had unilateral bruising and 8 others had bilateral bruises.



Figure 1: Bilateral periorbital bruise .

85.7% of patients had a morphological deformation; 71% had a frontal depression, 14% a step of the supra-orbital rim, 14.3% a depression of the nasal pyramid. 1 patient had vertical diplopia, and 1 had right eye blindness. 1 patient had a cubital fracture, and another had a tendon injury of the forearm.

Craniofacial CT was performed in all our patients, it made it possible to objectify the bone and extra-bone lesions, as well as the classification of these fractures.

In our study, the various fractures of the anterior stage of the base of the skull were classified according to a classification which relates to the biomechanics of the traumatism (Figure 2): 28.6% of patients (4 cases) had a medio-basiscranial fracture; of which 2 cases had a frontal sinus fracture, and the other 2 cases had a fracture type CNEMFO (naso-ethmoido-maxillo-fronto-orbital complex) (Figure 3). 71.4% of patients had a laterobasiscranial fracture (10cas); of which 5 cases had a lateral fronto-orbital fracture, 3 other cases had an irradiated fracture of the basal arch, and 2 cases had a fronto-sphenotemporal fracture (Figure 4). In some patients, facial fractures were also diagnosed: 35.7% had a zygomatic fracture, 21.4% had a maxillary fracture, and 28.6% had a nasal bones fracture.

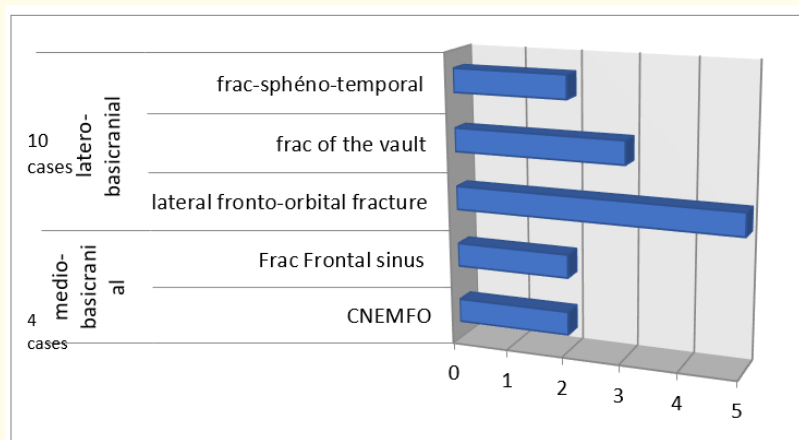


Figure 2: Classification of fractures.

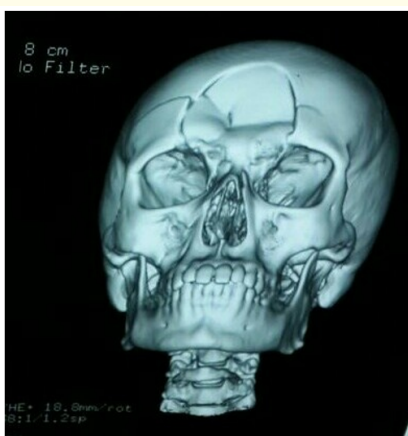


Figure 3: 3D reconstruction of a medio-basiscranial fracture .

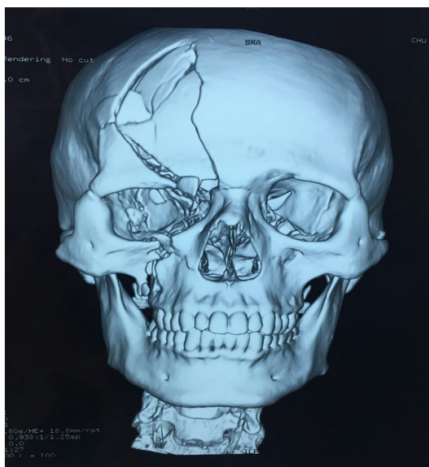


Figure 4: 3D reconstruction of a latero-basiscranial fracture.

For extra bone lesions, 64% of patients had pneumocephaly, 21.4% had extradural hematoma and 14% had cerebral edema.

In our study, only one patient received cerebral MRI as part of the preoperative assessment to locate the osteomeningeal breccias.

Therapeutic management has always started with intensive care, Preventive antibiotic therapy has been used by all our patients.

In our series all the patients have benefited from a surgical treatment for different reasons; 14.28% had osteomeningeal breccia alone, 57% had morphological damage only, and 21.42% had the association (osteomeningeal breccia, and morphological deformity).

The intervention delay varies between 10 days to 1 month. The surgical approach, bicoronal in 10 patients (71.42%), a hemi-coronal approach in 3 patients (28,58). The osteomeningeal breccia was found in 5 patients (35.71%), they benefited from a suture of the breccia by separate single points, and dural suspension points, and to ensure the tightness a lining was made by placement of an anterior cranial flap in 2 patients, and a transplant of a galia specimen reinforced with a biological glue in 2 patients (Figure 5). The cranialization of the frontal sinus was performed at the same time in 8 patients (57.14%) because the bony because of the depressed skull fracture or smashing extended downwards towards the base with opening of the posterior wall of the frontal sinus. Three patients (21.42%) have benefited of an exclusion of the frontal sinus by filling of the sinus cavity and the nasofrontal canal, by corticocancellous grafts.

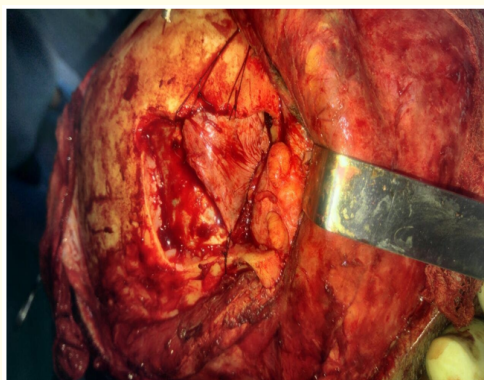


Figure 5: Intraoperative view showing closure of the gap by single points and dural suspension points with the anterior pericranial flap.

All patients benefited from a reduction of displaced fractures with osteosynthesis fixation by screwed miniaturized plates, or by a multi-perforated titanium grid adaptable to the cranial curve (cranioplasty) (Figure 6).

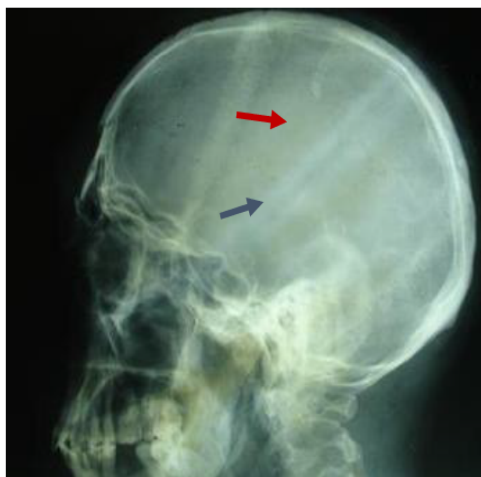


Figure 6: Standard radiograph of the skull in profile incidence showing a frontal fracture (→) and a fracture of the anterior wall of the frontal sinus (→)

The evolution was considered favorable in 86% of the operated patients. No cases of perioperative mortality were noted in our series, only 1 case of persistence of rhinorrhea which benefited from a surgical revision after 2 weeks of surveillance with good progress, and 1 case of meningitis treated with antimicrobial therapy. days with good evolution.

Sequelae dominated by hyposmia in 2 patients presenting a median breach with bilateral frontal approach, 14.28% of patients, with anosmia in only 1 patient who was operated twice for the breach, and 1 patient who presented with headache persistent trapped by medical treatment.

| Characteristics | Number and percentage (%) |
|----------------------|---------------------------|
| Sex | |
| Man | 11 (78,5%) |
| Woman | 3 (21,5%) |
| Age : | |
| Middle age | 27,8 |
| Extremities | 18 - 43 |
| Etiologies | |
| Public road accident | 7 (50%) |
| Assault | 5 (35,7%) |
| Fall | 2 (14,3%) |

Table 1: Demographic and etiological characteristics.

| Clinical signs | Number and percentage (%) |
|-----------------------------------|---------------------------|
| Initial loss of consciousness | 8 (57,14%) |
| Rhinorrhea | 5 (35,7%) |
| Unilateral | 3 (21,42%) |
| bilaterale | 2 (14,28%) |
| Epistaxis | 5 (35,7%) |
| Otorragie | 2 (14,3%) |
| Facial paralysis | 1 (7,14%) |
| Wound | 3 (21,42%) |
| Periorbital bruise | 12 (85,71%) |
| Unilateral | 4 (28,57%) |
| Bilateral | 8 (75,14%) |
| Morphological deformations | 12 (85,71%) |
| Frontal depression | 10 (71,2%) |
| Marche d'escalier | 2 (14,3%) |
| Depression of the nasal pyramid | 2 (14,3%) |
| Diplopia | 1 (7,14%) |
| Blindness | 1 (7,14%) |
| Others | |
| Cubital fracture | 1 (7,14%) |
| Painful tendon of the forearm | 1 (7,14%) |

Table 2: Results of the clinical examination.

Discussion

The epidemiological data of our series correspond to those of the literature with a clear male predominance with a percentage of 78.5%; this is explained by the predominance of men in the labor force, which makes them more exposed to public road accident and aggression. An average age of about 30 and a high prevalence of road accidents as a factor Etiological (50% of cases), assaults are in second place with a frequency of 35.7%, most authors share the same findings; Scholsem [9] public road accident account for 58% of cases, and assault accounts for 30% of cases.

In our series, the majority of patients were aware of admission to the emergency department (85.71%), thus facilitating the search for signs in favor of an osteomeningeal breccia, very similar to the Benbihi series (81%) [12].

The post-traumatic osteomeningeal breccia corresponds to an osteomeningeal continuity solution that allows the cerebrospinal fluid (CSF) to flow into an air cavity in the base of the skull. They preferentially occur in areas of meningeal weakness that are localized to the strongest grip points (Apophysis Crista Galli, clinoid processes, posterior border of the small wings of the sphenoid) [6,12]. In our study rhinorrhea was present in 35.7% of patients, this incidence is comparable with data from the literature 30% [7]. It is difficult to highlight the rhinorrhea in an intubated patient, we must think of looking for the morning in the form of a clear spot on the pillow.

In its typical form, easy to diagnose, it is described as a flow through the nose of clear, intermittent liquid, often favored by the head position bent forward. The search for glucose in this strip flow is definitely obsolete, because of the presence of it in the nasal secretions. When the collection of flow is possible, it is the determination of b2-transferrin, a highly specific CSF protein, absent from other body

fluids, which confirms rhinorrhea [4]. This rhinorrhea is complicated by meningitis in 7 to 30% [6], therefore none of our patients showed signs of meningitis.

Herbella [11] studied the relationship between the "raccoon eyes sign" bilateral bruise and fractures of the base of the skull in a study of 50 cadavers, he found that this sign was associated with fractures of the base of the skull in 48% of cases, even if this sign is not formally pathognomonic of such an injury. In our series, 85% of patients had periorbital bruising (Figure 1). The percentage of our study is greater compared to that found in the Herbella study, could be explained by the fact that his study was made on corpses victims of severe head injury only, while in our study all categories of cranial trauma were included.

X-rays of the skull are no longer relevant in the assessment of trauma of the anterior stage of the base of the skull, when they are made, they can objectify a fracture of the vault, the frontal sinus or pneumocephaly (Figure 6).

The high-resolution 3D reconstruction scan is the key examination in the fracture assessment of fractures of the skull base, it is the most effective examination in the exploration of the skeletal structures of the base of the skull. Images of good spatial resolution and at the same time allows the study of the soft parts adjacent to the bone elements [13]. In our study, all of our patients benefited from a craniocerebral CT, which made it possible to establish the diagnosis of fracture of the anterior floor of the base of the skull, and also makes it possible to classify the lesion and to pose the operative indication. Some authors [10] have proposed a computerized automatic classification method that would be more objective and save considerable time.

MRI is not urgent because the high resolution scanner allows a good analysis of the lesions, however it is very useful to locate the breccia in the presence of rhinorrhea while the scanner shows no breccia [7].

The aim of therapeutic management is to protect the brain from mechanical and infectious levels, to reconstitute the initial anatomy and its aesthetic corollary with, in particular in this region; the return to the projection, the vertical dimension and the transverse dimension as they were before the trauma, to dry up the flow and to promote the spontaneous healing of a possible osteomeningeal breccia, and to intervene to surgically close an osteo-meningeal [3].

The conditioning of the patient begins at the place of the trauma especially in case of coma with the maintenance of the vital functions, oro-tracheal intubation [never of naso-tracheal intubation nor of nasogastric tube in case of suspected fracture of the anterior floor] [3,12].

Medical treatment is still in place and aims to preserve the vital functions of the traumatized, fight against cerebral edema, mitigate the risk of infection and prevent seizures.

The surgical treatment of fractures of the anterior floor of the base of the skull appeals to the skills of a multidisciplinary team (maxillofacial surgeons, neurosurgeons). It aims to repair the various bone damage posing aesthetic problems and to surgically close the osteomeningeal breccia. In our series all the patients benefited from a surgical treatment; 57% for aesthetic damage only, 14.28% for osteomeningeal branch alone, and 21.42% for association (osteomeningeal breccia, and morphological deformity). The ideal operating period is between the 8th and the 15th post-traumatic day, after reduction of the edematous phenomena and before the enamel of the fractures foci [6,12] in our series the time of intervention varies between 10 days to 1 month.

In the absence of urgent neurosurgical lesions, the principle was to treat the facial lesions after medical stabilization of the neurological state with decrease of the frequent cerebral edema. The loss of bone substance was repaired secondary or even tertiary. Currently, most authors recommend early treatment, in a single operation, this technique can treat all lesions, at the same time as neurosurgical exploration, and it allows to reduce the iterative interventions, and the reduction the number of functional and cosmetic sequelae sometimes linked to treatment that is too late and particularly difficult to correct [6].

For the surgical treatment our team uses the classical way which begins with a coronal incision going from one tragus to the other following the sinusoidal line of implantation of the hair.

The detachment of the scalp flap forward is associated with the discovery of the temporal muscles. Care must be taken not to expose these muscles too low so as not to injure the frontal branch of the facial nerve. In addition, depending on their location and importance, skin wounds can be used for the exploration or even the treatment of fractures. And to access the lesions of the base, there are three ways in particular according to their extent: the transfrontal way: above the sinuses, a unilateral or bilateral flap, gives access to the base of the skull by limiting the risks of anosmia; the trans-sinus way: it creates a flap flush with the superciliary arches crossing the frontal sinuses. It allows more tangential access to the base of the skull and its lesions, by imposing a smaller gap to the brain to access the jugum, which limits the risk of cerebral edema. Anosmia is almost inevitable if the approach is bilateral; and the transborder or trans-lesion pathway, which often represents an access associated with one of the two previous ones [5,6].

Whatever the approach, a dural exploration time is essential. It can be limited to a detachment of the dura mater, very anterior if the lesions affect the posterior face of the frontal sinus, thus sparing the sense of smell. If these lesions extend behind, the exploration must be able to go up to the sphenoidal jugum thus sacrificing the odora. After the detection of the breccia, we can suture dural lesions, this suture is done by simple stitches or an overlock, using a non-resorbable 4/0 thread. To ensure water tightness, a liner must be provided by free or pedicled flap of epicranium lined with biological glue, or by the fascial fascia lata or temporal muscle fascial flaps [6,12]. In our study osteomeningeal breccia. was found in 5 patients, was sutured with separate single stitches, and had dural suspension points, lined with anterior peri-cranial flap in 2 patients, and a grafted graft of galia in 2 other patient.

A new technique has been described by Jacoob [1], which involves the repair of extensive fractures of the anterior floor of the skull base complicated by CSF leakage by a multilayer technique using combined flaps (peri-cranial, anterior, naso-septal and lateral temporofacial), In case of failure of the anterior peri-cranial flap, a double flap (temporal muscle flap) should be used, and if this double flap fails, the flap can be used. naso-septal flap by endoscopy.

The cranialization of the frontal sinuses is the rule after traumatic or surgical intrusion of their walls, it is necessary to remove the mucosa to avoid the formation of mucocele [6]. In our series 8 patients underwent cranialization.

For indications, for frontal sinus fractures and CSF fistulas, indications include: fracture of the external table with dysaesthetic deformation; a fracture with obvious obstruction of the nasofrontal canal; a fracture of the internal table with displacement greater than the thickness of the vault predicting a dural laceration; a refractory CSF fistula; a cranio-cerebral wound with LCS fistula; pneumocephaly with LCS fistula; the occurrence of meningitis while monitoring rhinorrhea; late onset of rhinorrhea; a defect in the base of the skull with cerebromeningeal hernia through this defect [6,8].

Three patients were excluded from the frontal sinus by filling the sinus cavity and nasofrontal canal with corticocancellous grafts. All patients benefited from a reduction in displaced fractures with osteosynthesis fixation by screwed miniaturized plates, or by an adaptable multi-perforated titanium mesh (Figure 7).

Complications are mostly infectious and may occur early or late. Sequelae result from a misdiagnosis, an incorrect lesion report, poorly adapted or insufficient primary treatment or a complication of the initial treatment and sometimes serious and complex lesions [3,12].

Anosmia is an often definitive sequel or a very partial recovery, it can be related to the initial lesions when they reach the fronto-ethmoidal complex or the explorations of a rhinorrhea [3]. In our study Sequelae scored dominated by hyposmia in 2 patients with a medial breccia first frontal bilateral or 14.28% of patients, with anosmia in 1 single patient who is operated twice for the breccia.

Conclusion

Fractures of the anterior floor of the skull base often require aggressive, multidisciplinary treatment. The new recommendations prefer an early treatment in a single operation to achieve long-term good aesthetic and functional results. New breccia closure techniques can also be used, using the endoscopic approach combined with flaps, minimizing complications.

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Volume 3 Issue 1 January 2020

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