Frontal sinus fractures: a review of 132 cases

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Abstract. – Background: Frontal sinus fractures peculiarity is that a wrong treatment not only could it encompass functional or aesthetic problems but also more dangerous complications: the proximity of the frontal bone to the brain, on a side, and to the nasolacrimal duct, on the other side, and therefore to the nasal cavity, lead the traumatisms occurring within this region to be at high risk of infections.

Materials and Methods: We report our experience on 132 cases of frontal sinus fracture treated from 1989 to 2005 and to present the surgical techniques performed as well as to compare the complications they reported over time to the International Literature data. 101 patients (76.5%) were treated in order to reduce and contain the isolated fractures involving the frontal sinus anterior wall, the patients presenting associated fractures of the frontal sinus anterior and posterior wall were 28 (21.2%), while the cases reporting isolated fractures of the nasolacrimal duct were 3.

Results: Our patients underwent follow-ups from 1 to 16 years long. We subdivided the complications found in our group into infectious and functional so that the incidence of the complications related to the sites and the treatment performed according to the specific case could be better assessed.

In conclusion, the infectious and functional complications found were treated with a multidisciplinary study considering the approach to the craniofacial traumatized person is subordinated to the co-existence of general and neurological conditions requiring for their resolution different approaches and times.

Key Words: Frontal bone, Head trauma, Skull fractures.

Introduction

Frontal sinus fractures have a relative low incidence if compared to the remaining types of fracture involving the cranio-maxillofacial district as the frontal bone is more protected from the traumatic events by both the prominence of the nasal pyramid which protects the naso-orbital region and the frontal bone higher resistance to mechanical impacts.

These fractures peculiarity is that a wrong treatment not only could it encompass functional or aesthetic problems but also more dangerous complications: the proximity of the frontal bone to the brain, on a side, and to the nasolacrimal duct, on the other side, and therefore to the nasal cavity, lead the traumatisms occurring within this region to be at high risk of infections such as meningitis, mucopyocele, encephalitis and cerebral abscess.

Hence the necessity to recognize precociously and rightly the type of fracture and the intervening involvement of the adjacent structures in order to perform a proper surgical treatment according to the specific case, thus reducing the risk of infectious-related complications and either functional or aesthetical alterations at minimum.

The objective of this work is to report our case-load on 132 cases of frontal sinus fracture and to present the surgical techniques performed as well as to compare the complications they reported over time to the International Literature data.

Materials and Methods

Between January 1989 and January 2005, 132 patients who reported frontal sinus isolated fractures underwent surgical treatment at the Maxillofacial Surgery Department of the University of Rome “La Sapienza” and at the Maxillofacial Surgery Unit of the “Belcolle” Hospital of Viterbo (Italy). The co-presence of problems pertaining to Nerosurgery such as liquorrea and persistent cerebral edema or severe general conditions,
represent the reasons why some patients were treated some days after the trauma. As for this, it is wise to highlight that all the patients of our study were treated surgically not later than 20 days after the trauma and the majority of them (97%) were treated not later than 8 days. There were 93 males and 39 females being aged between 13 and 82 (an average age of 30.6). All patients underwent an accurate CT scan of the cranio-facial district. We classified the patients having frontal sinus fractures in: (1) patients reporting fractures of the frontal sinus anterior wall; (2) patients with fractures of the frontal sinus posterior and anterior wall; (3) patients with fractures involving the nasolacrimal duct; (4) patients with fractures of the frontal sinus posterior wall).

101 patients (76.5%) were treated in order to reduce and contain the isolated fractures involving the frontal sinus anterior wall. The surgical access was performed through cutaneous bicoronal incision or by means of skin wounds, if any, in the frontal region.

Once the fractured centre was exposed, the reduction was performed by means of a curved spatula inserted into the fracture rima and, in order not to damage the mucosa, the frontal bone proper projection was restored carefully. Alternatively, were some fragments got trapped among the fracture rimae, these very fragments were repositioned by exerting an outwards traction by means of an osteosynthesis wire or microscrew inserted into the same fragment and successively removed (Figure 1). The synthesis was performed by means of a metal wire or rigid internal fixation (R.I.F.) (Figure 2). In the cases reporting a degree of bone loss or fragmentation that the bone could not be reduced, the frontal bone proper projection was restored by grafting calvaria bone2,10.

The patients presenting associated fractures of the frontal sinus anterior and posterior wall were 28 (21.2%). In the majority of cases the surgical treatment was performed in cooperation with a neurosurgeon due to frequent lacerations of the dura mater. In these cases, a transcranial approach was performed following bicoronal incision. Once the region was exposed the bone fragments of the frontal sinus posterior wall were removed and the mucosa of the very sinus was resected so that no residual element could be left. Afterwards, the frontal sinus was cranialized and the nasolacrimal duct was isolated through Tissucol and a galea-pericranial flap previously prepared. The fractures reported within the anterior region of the sinus were reduced through antero-posterior via and thus fixed by means of osteosynthesis or R.I.F. A cranioplastictreatment was performed, when necessary, through the technique described for the fractures of the frontal sinus anterior wall (Figures 3 and 4).

In the cases reporting clear fractures of the nasocral duct (the isolated fractures reported were 3) after an accurate exploration of the posterior wall, in order to rule out continuous solution involving this region, a silicate drainage was positioned in order to keep all the frontal nasal duct unobstructed. The drainage was left in this site about 40 days and then removed.

In our sample there were no patients reporting isolated fractures of the frontal sinus posterior wall.

Figure 1. Microscrew inserted in the bone fragment to reduce it.

Figure 2. The reduced fragments fixed with the screws.
Results

Our patients underwent follow-ups from 1 to 16 years long. We subdivided the complications found in our group into infectious and functional so that the incidence of the complications related to the sites and the treatment performed according to the specific case could be better assessed (Figure 2). Among the functional and infectious-related local complications, 4 cases with meningitis, 2 cases with mucopyocele, 6 cases with sinusitis and 1 case with post-traumatic mucocoele out of the 132 patients treated were reported 3 cases with meningitis were reported in patients with fractures of the frontal sinus anterior and posterior wall, with laceration of the dura mater and of the cerebrospinal fluid leakage through the nasal cavities. The onset of this pathology occurred in the immediate post-operative period and was solved with a precise antibiotic-based therapy. In 1 case, the meningitis out broke 17 months after the trauma in presence of fractures of the sinus anterior wall only and lead the patient to death. The 2 cases of mucopyocele, being treated surgically without positioning the drainage, resulted from fractures of the frontal anterior wall only, without apparent involvement of the nasofrontal duct. Also 5 cases with post-traumatic sinusitis and 1 case with mucocoele fall into this group (Table I).

Table 1. Infectious and functional complications on 132 frontal bone fractures.

<table>
<thead>
<tr>
<th>132 cases</th>
<th>Anterior wall</th>
<th>Anterior-posterior wall</th>
<th>Nasofrontal duct</th>
<th>Posterior wall</th>
<th>N°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meningitis</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Mucopyocele</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Sinusitis</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Mucocoele</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td><strong>10</strong></td>
<td><strong>4</strong></td>
<td><strong>0</strong></td>
<td><strong>0</strong></td>
<td><strong>14</strong></td>
</tr>
</tbody>
</table>

Figure 3. Pre-treatment CT scan.

Figure 4. Post-treatment CT scan.
Discussion

Cases with isolated fractures of the frontal bone involving both the anterior and posterior wall of it, presented a higher risk of infectious complications. As for this, the International Literature agrees on the type of attitude to take on: the obstruction of the nasofrontal duct due to several materials and the cranialization of the frontal sinus following the removal of the sinus posterior wall as well as the removal of all the lining mucosa. The patients of our study who reported fractures of the frontal sinus anterior and posterior wall, underwent surgical treatment, following fracture reduction, carried out with the preparation of a pericranial flap than turned over in order to separate the cranial nasal cavities and by projecting, at the same time, the nasofrontal duct together with some Tissucol. Three out of 4 cases of meningitis reported were not connected to the perviousness of this barrier created against the bacterial migration, but to the probable contamination before the surgical treatment. In fact, it is important to note the short lapse of time rolled by between the onset of meningitis and the traumatic event, characterized by the regression of infection during the targeted antibiotic-based treatment, and the absence of further infectious episodes development over the follow-up period. The remaining cases of meningitis out broke 17 months after the trauma and could lead to presume the presence of a certain connection, although minimal, between nasal and cranial cavities. Although nearly all Authors, in case of posterior wall fractures agree on the cranialization-based treatment of the sinus and on the closure of the nasofrontal duct, in the International Literature, the opportunity to position the drainage along the nasofrontal duct when its posterior wall is integral and when the involvement of the nasofrontal duct of the fractured rimae is controversial. Following clinical and radiological examination of our patients, no complications due to mucous down flow block, such as mucoccele, mucopyocele and post traumatic events ordinarily affecting sinuses were reported. However, it is important to note that the drainage-based technique was introduced in 1994 and that the number of patients reporting mucopyocele, mucocelle and sinusitis before that year is little if compared to that of the patients we treated. Ioannides et al report the indication about the positioning of this type of drainage in all patients presenting isolated anterior frontal fractures, because of the possibility that the duct may be fractured, although not manifest, or because of the possibility that the cicatrisation may determine the obstruction of the duct in the post-operative period. We agree with Luce: we position the drainage only in cases in which the involvement of the duct is clear and patients with drainage did not report any complications. The complications aforementioned due to obstruction were reported in the patients treated before 1994. As far as the aesthetical problem due to an intervening loss of frontal bone projection is concerned, we agree with Ioannides et al when we consider the calvaria bone graft the best material to use in cranioplastic. Rib graft is subject to resorption and, therefore, to deformation and the different alloplastic materials encompass different complications if used in a primitive cranioplastic. As far as maxillofacial related problems are concerned, the more rapidly they are treated the better the functional and aesthetical result will be. However, the approach to the craniofacial traumatized person is subordinate to the co-presence of general and neurological conditions requiring for their resolution different approaches and times. Only a multidisciplinary study and participation involving several specialists may lead to treat properly every single case.

References

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