

## Surgery of frontal sinus fractures. Epidemiologic study and evaluation of techniques

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### Summary

The frontal sinus trauma is not rare and it is 8% of the facial fractures. It can affect the anterior and/or posterior plates, with or without hitting the nasofrontal duct. It has a large potential of complications and its management still being a controversy. **Objective:** To present the casuistic of fractures frontal sinus, the epidemiology and clinical and surgical management of frontal sinus fractures. **Materials and Methods:** Not randomized retrospective study of 24 patients with frontal sinus fractures Hospital of Clinics, School of Medicine Botucatu, São Paulo, Brazil. **Results:** From the 24 patients, we had 16 (66,6%) fractures of the extern plate and 8 (33,4%) of both. In 2 patients the nasofrontal duct was involved. Others facial fractures were associated in 20 (83,4%) cases and major lesions of the cerebral segment were found in 13 (54,2%). Subpalpebral incision was performed in the majority with satisfactory aesthetic results. The basis of the surgical treatment was reduction and fixation with different materials (steel wire, mononylon, titanium miniplates) and if necessary we used alogen implants or parietal bone to reconstruct the anterior plate. **Conclusion:** The principal cause of frontal sinus fractures is crashed car. The management depends of the complexity, because commonly there are cranioencephalic lesions associated. The surgical thecniques used are the incisions, bicoronal flap or brow-glabella, infra-orbital rim ("butterfly"), associated a endoscopy sinus surgery in cases of infection, cerebrospinal fluid leak and orbital complications.

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## INTRODUCTION

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The frontal sinuses derive from the frontal recess, part of the middle meatus and the air cells of the ethmoidal infundibulum. Their aeration and development are radiologically evident at the ages of 5 or 6 years, and their full development will happen at the ages of 10 to 12 years. About 4% of the population does not have frontal sinuses and other 4 to 5% have only small upper air cells. A complete septum separates the right from the left frontal sinus, and these can be further divided in subcompartments or recesses by complete or incomplete bone septums<sup>2</sup>.

When developed, the frontal sinuses are located between the internal and external plates of the frontal bone, and both walls may be very thin. The anterior bone wall may be less resistant to impact forces, but it is somehow protected by the more prominent supraorbital contour, made up of high resistant bone<sup>3</sup>. The frontal sinuses are closely associated to the orbital roof, ethmoidal cells, nose and anterior cerebral fossa<sup>3-6</sup>.

Differently from what many physicians think, frontal sinus injuries are not rare and correspond to 8% of all facial fractures<sup>7</sup>. Its etiology may vary according to the population studied, gender, age range and a person's social, economical and cultural level.

Most frontal sinuses injuries are related to automobile accidents, physical aggressions, fire arm wounds and civil construction accidents. In 1987, Luce<sup>7</sup> published a series of 78 cases, of which 61 had high speed automobile accidents as cause.

As to fracture type, the most common is the frontal sinus anterior plate, although the most severe cases also involve the posterior plate and/or the sinus floor, and the naso-frontal duct may be involved<sup>8-10</sup>. In less severe injuries, the anterior plate protects the posterior, and the former is usually affected alone. The great impact injuries affect both the plates and the floor with bone fragmentation and derrangement<sup>11-13</sup>.

By studying craniofacial trauma, Nahum<sup>14</sup> showed that the impact force necessary to cause a frontal sinus fracture is of 360 to 990 Kg (800 to 2,200lb), what is enough to cause other head injuries. Depending on trauma intensity, there may be injuries on the anterior and posterior plates, and the latter is frequently associated to central nervous system, orbits and ethmoidal cell lesions<sup>15</sup>. Calvert (1942)<sup>16</sup> described a series of 1,751 head trauma cases, of which 103 (15%) involved the frontal and ethmoid sinuses. 70% were compound fractures, of which 35% of the patients reported anosmia. Whigt et al. (1992)<sup>2</sup> reported that 76% of their patients with anterior and posterior plate injuries had conscience alterations and 93% had multiple facial and cranial fractures.

A controversial aspect in these fractures is nasofrontal duct handling and the possibility of complications

when it is damaged, such as sinusitis and frontal sinus mucocele. For some authors, the most common cause of frontal mucocele are frontal sinus and nasofrontal duct injuries<sup>17,18</sup>. Others believe the nasofrontal duct obstruction in frontal sinus injuries is less frequent that what has been described in previous papers, thus changing so far established concepts as to the need for mucosal cauterization, curettage and even frontal sinus obliteration<sup>17,19,20</sup>.

Even with this concept review and its potential, frontal sinus complications still represent a dilemma for facial trauma surgeons, specially because they are rarely approached by multidisciplinary teams, and this brings about a great variation in handling and repair surgical techniques for these injuries<sup>6,15,19,21</sup>. We must also bear in mind that many of the severe complications such as CSF fistulas and ocular damage may be present regardless of correct handling these injuries<sup>11,17,19-22</sup>.

Our goal with this paper is to show our experience in caring for patients with frontal sinus fractures, discuss literature data and compare them to the approaches used in our facilities.

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## MATERIALS AND METHODS

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We carried out a non-randomized retrospective study with 24 patients diagnosed with frontal fracture, admitted to the Botucatu Medical School University Hospital - Department of Otolaryngology - Head and Neck Surgery, between January 1995 and December, 2004. The data was obtained through the analysis of their charts and the specialized care protocol of facial trauma. Failures in post-operative follow up or patient chart records were considered sample exclusion criteria.

We analyzed populational variables (gender, age, and color), injury etiology, use of alcoholic beverages, fracture site, associated craniofacial injuries, surgical technique employed, handling of the nasofrontal duct and post-operative complications. The definitive diagnosis was based on tomographic findings and post-operative complications. Lesions were classified according to involved site: posterior and anterior plate, comminuting and associated fractures.

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## RESULTS

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Of the 24 patients selected, 23 (95.8%) were males and 1 (4.2%) was female. There were 17 (70.8%) white, 5 (20.8%) brown and 2 (8.4%) black patients. As far as age is concerned, 5 (20.9%) were between 20 and 29 years, 11 (45.8%) between 30 and 39 years, 6 (25%) between 40 and 49 years and 2 (8.4%) between 50 and 59 years.

The most frequent etiology was that of automobile accidents, which occurred in 14 (58.3%) patients. In 16.7% the causes were fights, in 4 the cause was injury by objects and in 2 (8.4%) accidents with animals (falls and being

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