Transcutaneous Approach to Treat a Fracture of the Anterior Wall of the Frontal Bone With Low Level of Comminution: A Case Report Closed Reduction of a Midfacial Bone Fracture

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Abstract
Study design: case report.
Objective: present a transcutaneous approach to treat a fracture of the anterior wall of the frontal bone with low level of comminution.
Methods: the fracture was studied in detail with computed tomography (CT) and the patient was treated with a closed reduction of a midfacial bone fracture with the use of transcutaneous screws.
Results: Optimal aesthetic result was achieved without any adverse event up. CT at 6-month follow-up demonstrated good bone alignment of the anterior wall of the fractured frontal sinus.
Conclusion: Closed approaches, when well indicated, can be an interesting treatment option for isolated fractures of the anterior wall of the frontal sinus with low levels of comminution.

Keywords
frontal bone, frontal sinus, bone fractures, minimally invasive surgical procedures

Introduction
Frontal bone fractures have a prevalence ranging from 5% to 15% of facial fractures,¹-³ with motor vehicle accidents and sports injuries being the most common causes of these fractures.⁴,⁵ Young male adults are the most affected group.¹,⁶,⁷ A third of frontal sinus fractures affect the anterior wall, while two thirds affect the anterior or posterior wall and/or nasofrontal duct.⁴ The most common clinical sign of this fracture is depression of the frontal sinus region, sometimes with exposure of bone fragments through lacerations, anesthesia or paresthesia of the supra-orbital nerves and rhinorrhea of cerebrospinal fluid (CSF).⁸,⁹

Frontal sinus fractures without displacement, or with minor displacement, and that do not affect esthetic

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Frontal sinus fractures, where there is aesthetic involvement, can be treated using several techniques. Conventional surgical approaches include coronal access, direct cutaneous incisions with internal fixation, endoscopic techniques, and minimally invasive approaches using percutaneous screws. Many of these fractures are still treated through open reduction and internal fixation. The surgical access of choice is usually bitemporal approach, as it provides wide exposure of the fractured site and prevents facial scars. However, it can still lead to visible scars, as well as alopecia and damage to sensitive motor nerves of the face.

The objective of this article is to present a case of a transcutaneous reduction of a frontal sinus bone fracture with the use of transcutaneous screws, and without the application of any kind of fixation to immobilize the fractured bone segments.

**Case Report**

This is a 41-year-old male with no previous comorbidities. During a soccer match suffered a head injury caused by a direct contact with another player (head-to-head). Soon after it, he presented an evident depression of the left frontal bone, without associated skin lacerations. Within 1 hour after the injury, the patient was seen in an emergency service. On periorbital examination there was no presence of hypophagamia, cerebrospinal fluid or emphysema. The patient reported no changes in the skin sensitivity around the affected region. Computed tomography (CT) obtained two hours after the accident showed the presence of multi-fragmented fracture of the anterior wall of the frontal sinus (Figure 1).

After physical examination and tomographic study, the surgical planning included bloodless fracture reduction with percutaneous screws, as the bone fragments were robust. It was also decided to apply the traction force vector to reduce depressed fragments. The surgery was performed under
general anesthesia, due to the possibility of failing to achieve stability in the reduction of the fractured bone segments. Two titanium screws of the system, 2.0 x 16 mm in length, were applied to the fractured bone segments via two small skin incisions, and with a heavy needle holder attached to the head of the screws, controlled traction force was applied to the screws in the direction of the planned preoperative vector and bone stability was verified. The reduced segments were considered stable once there was no bone displacement, when the traction force was ceased and upon light palpation of the region, therefore no fixation was indicated. The skin punctures performed for the insertion of the percutaneous screws were sutured with nylon 5.0 after intraoperative removal of the screws (Figure 2). The surgical treatment was carried out in 20 minutes. Patient was discharged after 1 day and referred low levels of pain both during hospital stay. There was any neurological damage or infection.

The depression on the frontal sinus disappeared immediately after the surgery. The skin punctures performed to insert the percutaneous screws healed without any visible scars. The patient did not present bone displacement or infection during the 6-month follow-up. CT of the patient in the sixth postoperative month showed good bone alignment of the anterior wall of the fractured frontal sinus (Figure 3).

Discussion
The aim of facial trauma treatment is to restore form and function, with less morbidity and mortality. The efficacy of minimally invasive surgical techniques has been demonstrated in several areas of maxillofacial surgery. Endoscopic approaches have been defended because they do not require broad external incisions; only a small incision on the hairline, or a transnasal approach, is necessary. However, the endoscopic approach provides a limited field of view and has a long learning curve, and navigation is difficult due to anatomical complexity. On the other hand, reports of simpler minimally invasive surgical techniques have been published, such as the use of percutaneous screws, with excellent esthetic, functional results and low post-surgical morbidity.

Spinelli et al conducted a retrospective study with a sample of 15 patients with isolated fracture of the anterior wall of the frontal sinus treated with bloodless reduction through percutaneous screws. The skin incisions healed without any visible scar, and no depression of the frontal sinuses was evident in the postoperative period. CT performed 6 months after the procedure showed adequate reduction of displaced fragments.

However, three patients required intraoperative conversion to an open approach, due to unstable reduction and failure to achieve anatomical reconstruction using the minimally invasive technique. These cases were treated by open reduction and internal fixation via coronal access.

Jin et al carried out a retrospective analysis of 20 cases of isolated fractures of the anterior wall of the frontal sinus. In 11 patients, the reduction was performed via the endonasal route, while in 9 patients, a small trepanation was performed at the medial end of the eyebrow. The fractures were successfully reduced in all cases. The mean follow-up was 21.2 months and no postoperative complications were observed.

Yoo et al evaluated the results of transcutaneous reduction of fracture of the anterior wall of the frontal sinus with a Tapper device in 13 patients. The changes in shape...
and contour were restored in all patients. One complication reported by the authors was a case of pneumocephaly due to a lesion of the posterior wall that occurred during the application of the Tapper device, from which the patient recovered completely after 1 week of antibiotics. According to the authors, this approach presents better esthetic results, shorter surgical time and minimum hospital stay. Despite having a minimal risk of posterior wall injury, this method has clear advantages over the others.

Surgical navigation is an excellent tool for treating complex facial fractures. However, its use in all facial fractures seems restricted due to the increased operative time, high cost, and radiation exposure. In the future, with the decrease in operational costs related to intraoperative navigation and associated with imaging exams with low radiation exposure, we believe its application will be greater in facial trauma.

The technique used by the authors, with transcutaneous screws, requires careful perforation of the external cortical bone of the anterior wall of the frontal sinus. The initial plan was reduction with a single screw fixed to the larger bone segment; if instability occurred, a second screw would be inserted for traction in the previously planned vector.

The main limitation found with the transcutaneous screw technique are the blind manipulation of the fragments; this can be overcome with surgical experience; and the potential instability of the bone segments after the reduction, requiring immediate conversion to open reduction and internal fixation.

**Conclusion**

The technique of transcutaneous reduction through miniscrews was efficient, and is a reliable method for the treatment of isolated fractures with low comminution of the anterior wall of the frontal sinus.

**Declaration of Conflicting Interests**

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IRB Statement
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Patient Consent
The patient signed the written consent form.

Level of Evidence
V

General public’s take away
Bloodless treatment of forehead fracture may apply

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