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Clinical Paper
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Closed reduction of the isolated anterior frontal sinus fracture via percutaneous screw placement

G. Spinelli[a,b], D. Lazzeri[c], F. Arcuri[a,b], T. Agostini[a,b]
[a]CTO-AOUC, "Careggi Hospital", Florence, Italy; [b]Unit of Cranio-Maxillo-Facial Surgery, "Meyer Children's Hospital", Florence, Italy; [c]Plastic Reconstructive and Aesthetic Surgery Unit, Villa Salaria Clinic, Rome, Italy

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Abstract. Fractures of the frontal sinus are a common maxillofacial trauma and constitute 5–15% of all maxillofacial fractures. Conventional surgical approaches include the coronal flap, direct cutaneous incision, and endoscopic techniques. Minimally invasive techniques have recently been described for the reduction of the isolated anterior frontal sinus fracture via a closed approach. The medical records and radiological findings of all patients who underwent surgical treatment for anterior frontal sinus fractures from January 2009 to December 2013 at the study hospital in Florence, Italy, were reviewed. The final study sample consisted of 15 patients (13 males and two females) with isolated anterior frontal sinus fractures who were treated with closed reduction using percutaneous screws. The mean age was 32.1 years. The skin incisions healed without any visible scarring, and no depressions of the frontal sinuses were evident in the postoperative period. Computed tomography scans performed at 6 months postoperatively showed adequate reduction of the displaced fragments. This closed technique is a good option for displaced isolated fractures of the anterior frontal sinus. However, the technique is not adequate for complex fractures of the frontal sinus.

Keywords: closed reduction; frontal sinus fracture; percutaneous screw placement.

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Introduction

Fractures of the frontal sinus are a common maxillofacial trauma and constitute 5–15% of all maxillofacial fractures. One-third of frontal sinus fractures involve only the anterior wall, and two-thirds affect the anterior wall or the posterior wall and/or the frontonasal duct. The signs of such fractures are depression of the supraorbital area, anaesthesia/paraesthesia of the supraorbital nerves, orbital ecchymosis, and cerebrospinal fluid rhinorrhoea. Undisplaced or minimally displaced anterior table fractures are commonly managed by observation. More extensively displaced anterior table fractures are managed using several techniques, which are progressing towards adequate reductions with fewer complications.[1,2]

Various surgical techniques have been used to manage isolated anterior frontal sinus fractures. Conventional surgical approaches include the coronal flap, direct cutaneous incision, and endoscopic techniques. The standard coronal approach allows for adequate visualization of the fracture site and adequate plating of the fractured fragments. This technique is associated with risks of complications such as nerve injuries, scarring, alopecia, and paraesthesia.[3,4] Direct cutaneous incision allows for adequate access to the fracture site, which enables reconstruction and osteosynthesis. However, this technique is rarely utilized due to the risk of facial

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scarring. Endoscopic approaches have been advocated because they avoid external incisions, either by utilizing a small incision in the hairline or a transnasal approach. However, the endoscopic approach is associated with a steep learning curve and is limited by narrow fields of view. Further difficulties are related to the navigation of the complex and variable frontal sinus and nasofrontal duct; moreover surgical access can be troublesome due to the convexity of the frontal bone.[5]

Minimally invasive techniques have recently been described for the reduction of the isolated anterior frontal sinus fracture via a closed approach. Hwang and Song[6] reported the use of a stab incision at the end of the eyebrow to allow for the insertion of a periosteal elevator. This transcutaneous transfrontal approach through an eyebrow incision was also later used by Kim et al.[7]

The aim of this study was to report our experience in the management of isolated anterior frontal sinus fractures using a minimally invasive closed approach with the placement of percutaneous screws.

Materials and methods

The medical records and radiological findings of all patients who underwent surgical treatment for anterior frontal sinus fractures from January 2009 to December 2013 at the maxillofacial surgery unit of the study hospital in Florence, Italy, were reviewed. The following demographic and surgical data were recorded: age, gender, time of surgery, mechanism of injury, length of hospital stay, preoperative and postoperative computed tomography (CT) findings, and complications.

The inclusion criteria were isolated anterior frontal sinus fracture and treatment via closed reduction using percutaneous screws. The exclusion criteria were concomitant posterior wall and nasofrontal duct fractures, treatment with conventional surgical approaches, and insufficient preoperative or postoperative data.

Surgery was performed within 1 week of injury for all patients. Clinical follow-ups were performed at 1 week and at 1, 3, 6, and 12 months and then yearly thereafter. The follow-ups included an accurate physical examination and clinical photography. CT scans were performed during the follow-up period to evaluate the anatomical reduction and to detect any postoperative complications. Postoperative reductions of the frontal sinus fractures were assessed on a 4-point Likert scale (1 = poor; 2 = fair; 3 = good; and 4 = excellent) by four clinicians who were blinded to the study conditions (two consultants and two registrars). This research was approved by the local ethics committee.

Surgical technique

Under local anaesthesia and with the patient in the supine position, two percutaneous titanium screws (16 mm in length) are inserted into the fractured and depressed fragments through two separate skin stab incisions. The traction forces necessary to properly reduce the fragments are evaluated in the preoperative phase based on clinical and radiological analyses and intraoperatively by clinical assessment. Steel wires are tied around the heads of the two screws. The reduced fragments are clinically assessed as stable after the removal of the traction. The sinus mucosa and bone periosteum that were attached to the fragments are preserved to maintain the positions. Skin closure is performed with 6–0 non-absorbable sutures. The head is elevated for the first few days after the operation to drain the frontal sinus.

Results

Applying the inclusion criteria, of the 22 patients with anterior frontal sinus fractures who underwent surgical treatment in the department between January 2009 and December 2013, only 15 were included in the investigation. Two patients were excluded due to insufficient preoperative and postoperative data. Five patients were not included due to concomitant posterior wall and nasofrontal duct fractures.

The final study sample consisted of 15 patients (13 males and two females) with isolated anterior frontal sinus fractures who were treated with closed reduction using percutaneous screws. The patients ranged in age from 17 to 62 years; the mean age was 32.1 years. The injuries resulted from physical assaults (seven patients; 47%), falls (three patients; 20%), sporting accidents (three patients; 20%), and car accidents (two patients; 13%). The median hospital stay was 2.2 days (range 1–4 days).

Among the patients included, three (20%) required intraoperative conversion to an open approach due to unstable reduction and a failure to achieve anatomical reconstruction using the minimally invasive technique. In these cases, after manipulation of the fragments with the screws and wires, we were unable to achieve a stable reduction, and the result was evaluated as unacceptable; thus, the intraoperative decision to proceed with open reduction and internal fixation was made. These cases were treated by open reduction and internal fixation via coronal access.

The follow-ups ranged from 6 to 93 weeks, and we observed no major complications such as infection, haemorrhage, nerve damage, or brain injuries during this time. The skin incisions healed without any visible scarring, and no depressions of the frontal sinuses were evident in the postoperative period. The patients exhibited no displacements of the fragments during the follow-up period. Transient forehead numbness occurred in six patients, and all cases had resolved within 1 year after surgery.

Postoperative CT scans were performed on average 6.2 months (standard deviation 2.3 months) after the procedure. The CT scan revealed the absence of complications, such as chronic frontal sinusitis, mucopyocele, or mucocele, in all cases. The postoperative reductions of the displaced fragments were excellent in 12

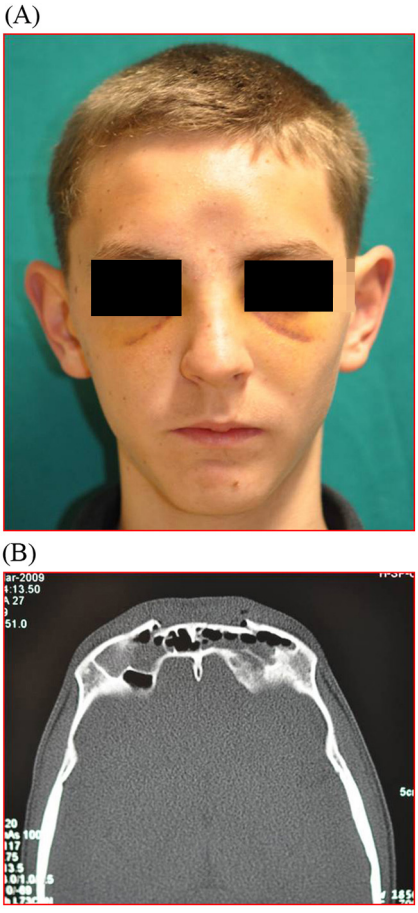

Fig. 1. (A) Preoperative view of the depression area over the forehead. (B) Preoperative CT scan showing an isolated anterior fracture of the frontal sinus.