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CASE SERIES

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Management of frontal bone fractures in a resource challenge setting: A report of 2 cases and literature review

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ABSTRACT

Traumatic injuries to the frontal bone and sinus, can lead to severe life-threatening complications due to their closeness to critical intracranial and orbital structures. These injuries can significantly impact both function and appearance. When depressed fractures of the frontal bone occur, especially in high-velocity maxillofacial trauma, it results in obvious facial deformity if not properly addressed. Treatment options are diverse, ranging from conservative measures to open reduction and internal fixation utilizing plates and screws, use of mesh, acrylic, and tailored to the injury nature, context, available resources and operators expertise. We present two compelling cases of depressed frontal bone fractures (FBFs) involving the anterior table. In these instances, fractures were effectively reduced and stabilized using titanium mesh and mini plates. Both cases resulted in excellent surgical outcomes, with smooth postoperative recovery and no complications. This study highlights the successful management of FBFs in a resource-limited setting and also offers a concise review of pertinent literature. Open reduction and internal fixation with titanium mesh or miniplates stand out as robust options for managing FBFs, effectively restoring the natural contour of the forehead and minimizing long-term complications.

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Introduction

Effective and timely management of frontal bone fractures (FBFs) is both crucial and challenging [1]. With evolving management protocols and treatment approaches, satisfactory outcomes are increasingly achievable [1]. Historically, FBF were managed aggressively using open techniques which often results in obliteration or cranialization. While the aggressive methods remain essential for significant injuries, the treatment of FBF has evolved over the past 50 years with recent studies showing, favorable outcomes with conservative management. Additionally, minimally invasive endoscopic techniques are becoming more prevalent [2].

Rodriguez et al. [3] developed a treatment algorithm based on the fracture patterns while considering nasofrontal outflow tract injuries. In cases of nondisplaced FBF with patent nasofrontal duct, only clinical observation, head elevation, and sinus precaution is necessary. Conversely with FBF with nasofrontal duct outflow obstruction, either sinus obliteration or cranialization is recommended depending on whether the posterior wall is involved. In displaced FBF with no obstruction without nasofrontal duct obstruction, reconstruction of the anterior wall is indicated [3].

Inadequate or improper treatment of these fractures can result in a disfigured forehead for the patient. Therefore, it is important to consider the fracture type, degree of comminution, condition of posterior table fracture, any nasofrontal duct injuries, cerebrospinal fluid (CSF) leaks, and other associated maxillofacial or other head injuries when managing FBF. Surgical techniques such as

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open reduction and internal fixation using titanium plates, titanium mesh, or a combination of both can lead to optimal surgical outcomes. Other techniques include the use of methylmethacylate and the use of resorbable materials.

FBF are not uncommon, as they occurs in 5%–15% of all maxillofacial fractures and 32% of pan-facial and maxillary injuries. These fractures are often linked to a high-velocity maxillofacial and systemic injuries, which can increase its mortality and morbidity, approximately, one-third of FBFs affect the anterior wall, while the remaining two-thirds involve the posterior wall and the nasofrontal duct [1]. The posterior wall table is thinner and less resistant to fractures [4]. Although, isolated fractures of the posterior wall are rare when they do occur, they are typically associated with fractures of the anterior skull base, nasoethmoidal regions, orbital roofs, and may also impact the intracranial contents, such as the dura or brain tissue [1].

The mismanagement of FBF can lead to life-threatening complications that demand immediate attention. Failure to identify and treated these issues promptly, can have severe neurological consequences [4]. Among the most critical complications associated with inadequate treatment are meningitis, encephalitis, and brain abscesses. Additionally, patient may suffer from persistent cerebrospinal leakage, mucocele, mucopyoceles, frontal bone osteomyelitis, aesthetic deformities, and neurologic symptoms like forehead paraesthesia or anesthesia. Chronic sinusitis, temporal nerve paresis, irregularities of frontal bone, meningoencephalocele, non-union of the frontal bone further underlines the necessity for effective management [3]. Timely and comprehensive treatment is essential to prevent these serious outcomes.

The management of FBFs is a critical topic that warrants attention, as diverse algorithms, procedures, and protocols have emerged in this field. While cranialization and obliteration techniques have gained traction in numerous centres, it is essential to recognize the shared objectives of treatment: achieving excellent aesthetic outcomes, restoring vital function, and preventing complications [5]. This study aimed to present the management of two cases of FBFs in a challenge setting.

Case Reports

Case 1

A 35-year-old Nigerian farmer was brought to the accident and emergency unit of The Federal Teaching Hospital, Birnin Kebbi, Kebbi State, Nigeria, following a road traffic collision and transient loss of consciousness that lasted for 12 hours. He sustained injuries to the maxillofacial region as well as the upper limbs. Initially, he was managed at a peripheral hospital before being referred for further care. Upon arrival, he was evaluated by the neurosurgical, orthopedic, ophthalmology, and maxillofacial teams.

Clinical examination revealed a moderately head-injured patient with a comminuted FBF but without any skin laceration. The patient also had a mandibular symphyseal fracture and bilateral periorbital oedema. A complete ophthalmological examination including a visual acuity test was performed. There was no signs decreased visual acuity or limitations of eye movements. The patient's vital signs were stable, with a pulse rate of 88 beats per minute, and a blood pressure of 110/80 mmHg. Heart sounds were normal, with S1 and S2. Laboratory results showed a packed cell volume of 30%, urea 6.0 mmol/l, Na^+ 138 mmol/l, K^+ 4.2 mmol/l, CL^- 100 mmol/l, $BC0_3^-$ 22 mmol/l, and random serum glucose was 5.6 mmol/l.

The frontal bone was exposed through the coronal incision (Fig. 1). The supraorbital neurovascular bundles were released from their foramina to allow for a more inferior displacement of the coronal flap. This enabled meticulous exenteration and curettage of the entire mucosa within the frontal sinus. The contour of the frontal bone was reconstructed using

Figure 1. Coronal flap to expose the fracture site.

Figure 2. Adaptation of 1.5 mm titanium mesh.

1.5 mm titanium mesh and screws (Fig. 2). Other fractures were treated accordingly. The patient experienced uneventful healing and no complications were recorded after a follow up period of 1 year. Figures 3 and 4 present 2 weeks of postoperative radiographs and photographs of the patient taken 2 weeks after surgery, as the patient could not afford a computed tomography (CT) scan.

Surgical intervention was chosen to restore the cosmetic appearance and contour of the forehead, as well as to prevent any short or long-term complications.

Case 2

A 30-year-old student was brought to the accident and emergency unit of the Federal Teaching Hospital, Birnin Kebbi, Kebbi State, following a road traffic accident with transient loss of consciousness that lasted for 10 hours. He bled from

Figure 3. Postoperative radiograph of the patient.

the frontonasal region, the nose, and the oral cavity. Initially he was evaluated by the neurosurgery team, and then co-managed with the maxillofacial team.

A clinical assessment indicated that the patient had sustained a moderate head injury along with panfacial fractures, including fractures of the frontal bone, nasal complex, orbit, zygomatic, and maxilla. These injuries were confirmed by the CT scan (Fig. 5). Specifically, there was a FBF at the lower part of the anterior table of frontal bone and the patient's paraclinical data were within normal limits.

The frontal bone was exposed through the sutured laceration and irrigated with normal saline. The FBF was then reduced and immobilized using 2.0 mm miniplates and 2 × 4 mm miniscrews (Fig. 6). Haemostasis was achieved, and suturing was performed using 3-0 Vicryl for the subcuticular layer 3-0 nylon for the skin. Other fractures were treated appropriately. The post-operative healing was uneventful with the patient being monitored closely, and no complications were recorded after a follow up period of 18 months. The surgery aimed to correct the facial deformity and prevent potential complications.

Figure 4. Postoperative photograph of the patient.

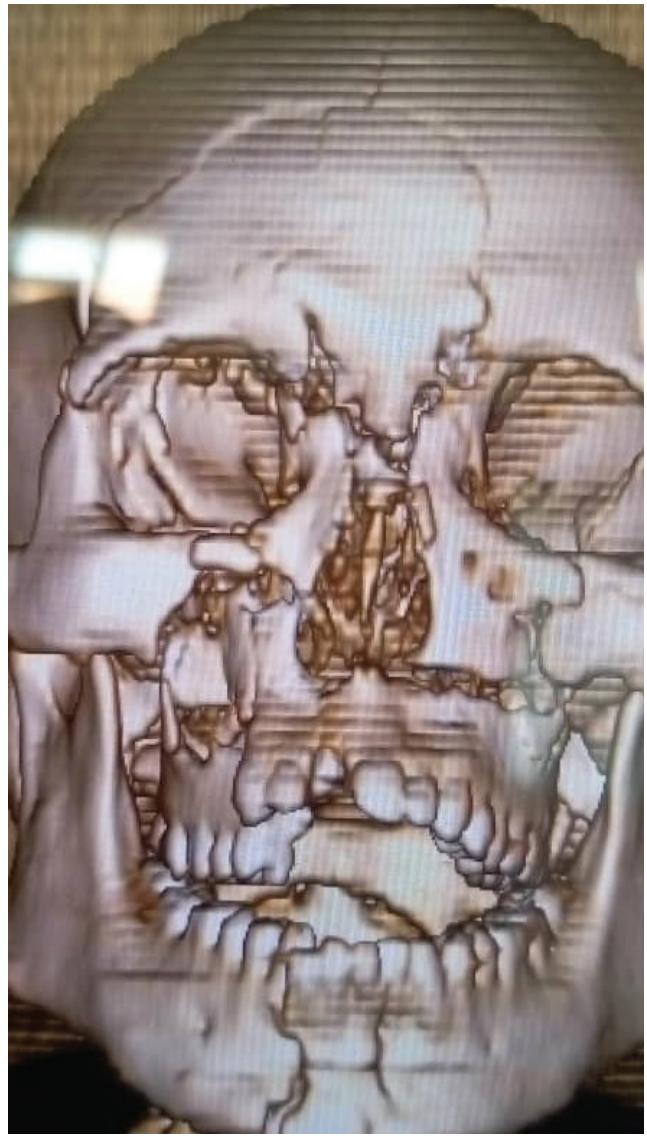

Figure 5. Panfacial fracture showing a frontal and frontonasal complex fracture.

Discussion

FBFs, often called frontal sinus fractures may be uncommon, but they demand careful attention due to their potential complications. Depending on the force of impact, they can affect not only the anterior table and posterior tables of the bone but also adjacent structures of the skull. Effective treatment is essential focusing not only on cosmetic outcomes. Our approach also aims to prevent late complications and protect critical intracranial structures, despite the fortunate absence of CSF leaks in our cases [6]. Our primary aim was to correct forehead deformities and safe guard against future complications.

The frontal bone is home to the frontal sinus, which connects directly to the orbit and the anterior cranial fossa. Crucially, frontal sinuses develop gradually; they are absent at birth, still forming around age two, and typically become radiologically visible by age six, growing until about twenty. This development means young children are naturally protected, having a harder head structure [7,8]. Interestingly, approximately 15% of individuals have a single sinus, while 5% lack frontal sinuses entirely. In our series, we observed fully developed frontal sinuses in patients over the age of twenty, consistent with expectation [9].

Statistics indicate that males are significantly more prone to FBFs due to their greater involvement in high risk activities such as car crashes, drug abuse, interpersonal violence, and alcoholism [10]. Our cohort consisted of young, active males reflecting the trends noted in existing literature.

High-energy blunt force to the upper third of the face, most commonly from the motor vehicle accidents are the leading cause of these fractures [11]. The force required to fracture the frontal bone ranges between 800 and 1,600 pounds, twice the force needed for the mandible and five times that of

Figure 6. The fixation of the frontal and nasofrontal complex using 2mm miniplates and 2 × 4 mm miniscrews.

the maxilla [12]. This significant force often leads concurrently to intracranial, ophthalmological and, maxillary injuries [6].

The impact of FBF creates defects that noticeably alter the contour of the face. Effective repair methods include both autogenous bone grafts and alloplastic materials. While autogenous bone grafting is widely regarded as the gold standard technique for reconstructing frontal bony defects, its use is limited by the potential for donor site complications and unpredictable resorption [13]. For these reasons, we chose to refrain from utilizing autogenous bone grafts in this series.

Various alloplastic materials, including bone cement, have been effectively used in the reconstruction of depressed FBFs [14]. Methylmetacrylate stands out as a commonly selected alloplastic material due to its desirable properties. However it is essential to acknowledge that it carries a higher risk of infection compared to autogenous bone, along with several limitations such as low tensile displacement profile, accelerated crack propagation, and inadequate retention. To address this concerns innovative solutions like titanium mesh, miniplates and wires have been developed, offering stable options to managing FBF [4].

For depressed comminuted FBFs, the standard practice involves elevating the bone and, if necessary, stabilizing it with titanium mesh or other alloplastic materials that can restore the natural contour [4]. In Case 1,we effectively employed titanium mesh and screws were used to restore the frontal bone's contour, while Case 2 involved elevating the depressed fracture and immobilizing it with miniplates and screws, resulting in satisfactory outcomes.

Surgical approaches in treating FBF are diverse, including the coronal approach, gullwing incision, open sky approach, sub brow approach (either unilateral or bilateral), and open access through an existing laceration [15,16]. This report favored the coronal incision in Case 1, giving its versatility and extensive exposure benefits. Conversely, Case 2 utilized an existing sutured laceration for efficient access to the frontal bone. The coronal incision also serves as a valuable neurosurgical pathway and can facilitate other maxillofacial procedures. Additionally it allows for harvesting of split calvarial bone, paricranium, muscles, and fascia. Ultimately, the choice of the surgical approach should be tailored to each patient's unique circumstances and available tools.

The literature presents various techniques for reconstructing frontal bone defects. Regardless of the chosen technique, it is crucial that the cranioplasty material used is impact- resistance, stable, durable, biologically inert, moldable, nonreactive, noncorrosive, non-resorbable, and non-antigenic [16–18]. In our department, we frequently opt for titanium based systems due to their malleability, adaptability, availability, and ease of application. This choice diverges from the perspective of Yavuzer et al. [13], who advocates for absorbable internal fixation systems. His approach avoids the need for subsequent removal of titanium devices enhancing patient comfort.

Many authors have observed that the subcutaneous tissue overlying the frontal bone tends to be insufficiently thick, potentially leading to the palpation of the internal fixation system. Nevertheless, our study found this to be a non-issue since we utilized screws less than 5 mm [13]. While the literature reports high complication rates from treating FBFs, our series experienced none, showcasing the effectiveness of our methods.

Conclusion

Managing FBFs is inherently challenging. Nevertheless, the proven effectiveness of our titanium mesh and mini plates presents a reliable and

successful alternative, culminating in outstanding patient outcomes.

References

1. Becelli R, Palmieri M, Facchini V, Armocida D, Pesce A, Kapitonov A, et al. Management of frontal sinus fractures: a comprehensive review and treatment algorithm from Sapienza University of Rome. Interdiscipl Neurosurg 2021; 1(1):101318.
2. Arnold MA, Tatum SA. Frontal sinus fractures: evolving clinical considerations and surgical approaches. Craniomaxillofac Trauma Reconstr 2019; 12(2):85–94.
3. Rodriguez ED, Stanwix MG, Nam AJ, St. Hilaire H, Simmons OP, Christy MR, et al. Twenty-six-year experience treating frontal sinus fractures: a novel algorithm based on anatomical fracture pattern and failure of conventional techniques. Plast Reconstr Surg 2008; 12(206):1850–66.
4. El Khatib K, Danino A, Malka G. The frontal sinus: a culprit or a victim? A review of 40 cases. J Craniomaxillofac Surg 2004; 32:314–7.
5. Bell RB, Dierks EJ, Brar P, Potter JK, Potter BE. A protocol for the management of frontal sinus fractures emphasizing sinus preservation. J Oral Maxillofac Surg 2007; 65(05):825–39.
6. Kanu OO James O, Bankole OO, Adeyemo WL. Management of frontal sinus fractures: a review of the literature. Niger J Exp Clin Biosci 2013; 1(2):3–9.
7. Obiadazie AC Adeola DS, Idehen K, Agbara R, Ononiwu CN, et al. Frontal sinus fractures: report of one case and review of the literature. Int J Med Health Dev 2011; 16:60–66.
8. Schultz JJ, Chen J, Sabharwal S, Halsey JN, Hoppe IC, Lee ES, et al. Management of frontal bone fractures. J Craniofacial Surg 2019; 30(7):2026–9.
9. Lopez J PK, Pradeep T, Khavanin N, Kachniarz B, Faateh M, et al. Pediatric frontal bone and sinus fractures: cause, characteristics, and a treatment algorithm. Plastic reconstructive Surg 2020; 145(4):1012–1023.
10. Zavattero E, Boffano P, Bianchi FA, Bosco GF, Berrone S. The use of titanium mesh for the reconstruction of defects of the anterior wall of the frontal sinus. J Craniofac Surg 2013; 24:690–1.
11. Jeyaraj P. Frontal bone fractures and frontal sinus injuries: treatment paradigms. Ann maxillofacial Surg 2019; 9(2):261.
12. Meyyappan A JE, Jeevitha JY. Bone cement in depressed frontal bone fractures. Ann Maxillofacial Surg 2019; 9(2):407.
13. Yavuzer R SA, Kelly CP, Tuncer S, Latifoglu O, Celebi MC et al. Management of frontal sinus fractures. Plastic Reconstr Surg 2005; 115(6):79e–93e.
14. Dayashankara Rao JK, Malhotra V, Batra RS, Kukreja A. Esthetic correction of depressed frontal bone fracture. Natl J Maxillofac Surg 2011; 2:69–72.
15. Seok H, Im SB, Hwang SC. Reconstruction of anterior skull base fracture using autologous fractured fragments: a simple stitching-up technique. Korean J Neurotrauma 2021; 17:25–33.
16. Vrinceanu D, Banica B, Cirstoiu C, F, Papacocea R, Papacocea T. 3D anatomically shaped titanium implant for the reconstruction of an orbital floor fracture with a large posterior defect: a case report. Rom J Mater 2018; 48:407–11.
17. Pereira RA, Barbosa O, Basílio AP, Santana AS, De Paula D, Marangon Jr H. Surgical decompression of the orbit due to frontal bone and roof of the orbit fractures—a case report. Ann Maxillofac Surg 2020; 10:495–500.
18. Doonquah L, Brown P, Mullings W. Management of frontal sinus fractures. Oral Maxillofac Surg Clin North Am 2012; 24(02):265–74.