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CASE REPORT

Grossly Depressed Frontal Bone Fracture in a Paediatric Patient: A Case Report

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Abstract This study highlights the management of a grossly depressed frontal bone fracture with obvious deformity in a paediatric patient as facial fracture management is frequently intricate and challenging, particularly within the paediatric population as compared to adult. Paediatric fractures have a greater capacity to remodel, but the paediatric brain and craniofacial skeleton are still developing which puts the children at risk for unique complications, such as growing skull fractures.

Keywords Depressed frontal bone fracture · Paediatric population · Titanium mesh

Introduction

Head injury and facial trauma are proportional depending upon the extent of the impact of injury. Although various factors play an important role like mechanism of injury which varies from regions, socioeconomic status, and literacy, it is a common cause for deformities and left untreated can cause morbidity and mortality in the paediatric population. The differences between adult and paediatric group is well documented like frontal sinus transforms to adult architecture at the age of 20 years, before that children usually possess large forehead with potential fat pads, elasticity of bone and higher ability to remodel, but the paediatric brain and craniofacial skeleton are in a developing stage that will jeopardize children. Even though paediatric head trauma has been discursively studied, the literature concerning skull fractures, the time of operative management, and outcomes following surgical intervention in this population is very scanty [1].

The ratio between cranial and facial volume at birth is around 8:1. But, as the child grows to the time adulthood, this ratio becomes 2.5:1. The retrusiveness of the face in relation to the skull promotes a lesser occurrence of midface and mandibular fractures and an increased occurrence of cranial injuries in children who are aged below 5 years, especially the frontal bone with its bony prominence [2].

The incidence of depressed skull fractures is seen in 7–10% of children who are admitted to hospital with a head injury. The extent of the head injury may be associated with dural tears, penetration of brain parenchyma with a foreign object or bone fragment, and the presence of primary brain injury or intracranial haematoma. The most imperative complications are post-traumatic epilepsy and infection [3].

Case Report

Six-year-old male child was referred to Craniofacial unit with history from the parents that their child has a depression forehead following an episode of injury since 4 days. History revealed that child sustained the injury following a fall as a pillion on a motor vehicle following which accidently forehead came in contact with the road surface. There was no history of loss of consciousness,

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cerebrospinal fluid rhinorrhoea, vomiting, seizures, ear or nasal bleed present. No other associated symptoms were noted. Patient was admitted under paediatric surgeon care who advised against the intervention for reasons best known and was discharged. Patient later got information about the Craniofacial centre where such intervention is being carried out and reported.

On clinical examination, a clearly evident gross depression was noted on the centre of the child's forehead (Figs. 1, 2). Mild tenderness and crepitus were present on palpation on the frontal bone region with a step deformity in the centre. There was no signs of any other facial bone fracture or neurological with the extent of impact. Provisional diagnosis of depressed frontal bone fracture was made. Computed tomography of axial, coronal slices of 1 mm and three-dimensional reconstruction was asked which showed a depressed skull fracture in the frontal bone region involving both the outer and the inner table with multiple depressed bone fragments involving frontal sinus (Figs. 3, 4). Neurosurgeon and ophthalmic evaluation was sought prior to planned intervention, and the child was put on phenytoin sodium 25 mg tablets prophylactically for 3 months. The patient's parents were explained about the same and noted their expectation of that they cannot send the child to school with the existing deformity. Planned surgery under general anaesthesia was also explained to the child's parents and consented for possible complications especially dural tear, cerebrospinal fluid leak and infection.

Fig. 1 Preoperative frontal view showing depressed frontal bone defect

Fig. 2 Lateral profile showing the extent of deformity

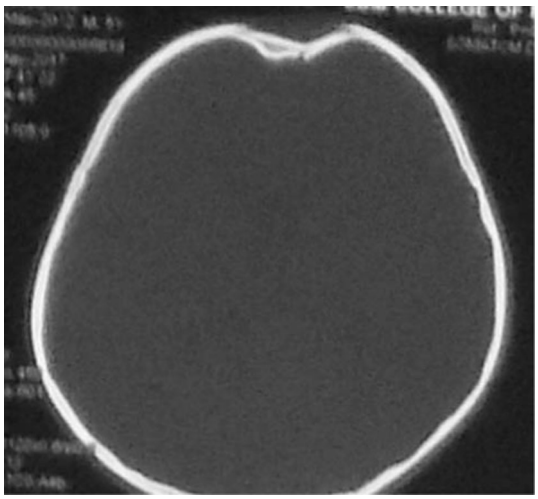

Fig. 3 CT axial section showing fractured frontal bone

After adequate patient preparation with routine blood investigations, the depressed fracture was elevated and contoured titanium mesh and miniplate fixation was done by coronal approach under general anaesthesia (Fig. 5). The coronal incision was marked and placed extending preauricular region just below the tragus bilaterally (Fig. 6). After the blunt dissection, the pericranial layer was raised with a broad base to preserve the blood supply and nasal bridge was reached. After exploration of the fractured site and careful elevation of the multiple depressed fracture fragments, a small dural tear was noted and repaired (Fig. 7) There was no evidence of

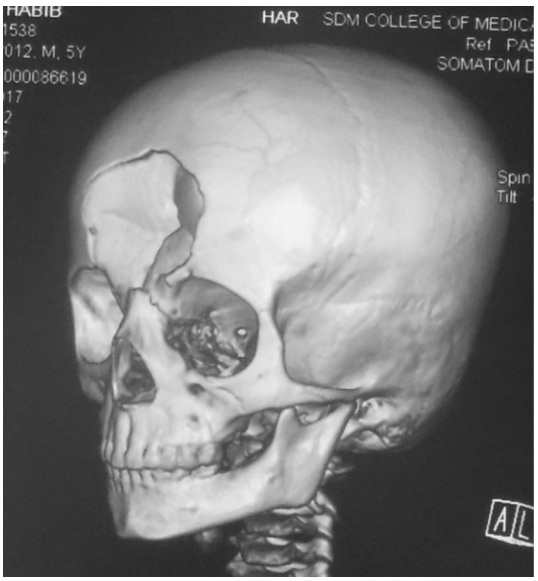

Fig. 4 Three-dimensional reconstruction of computed tomography reveals the depressed fracture of the frontal bone

Fig. 5 Coronal approach

cerebrospinal fluid (CSF) leak. Thorough cleansing of the frontal sinus was done with normal saline. The displaced posterior table was repositioned with bone wax. There was no evidence of obstruction nasofrontal outflow tract which was checked with diluted methylene blue. The anterior table fracture fragments were then placed back in the desired position, and miniplate fixation was done using two 1.5 mm (4 hole with gap) and two 1.5 mm (2 hole with gap) titanium miniplates and screws, and a titanium mesh was positioned and adapted in the centre connecting all the

Fig. 6 Surgical exposure of depressed frontal bone fracture with pericranial flap

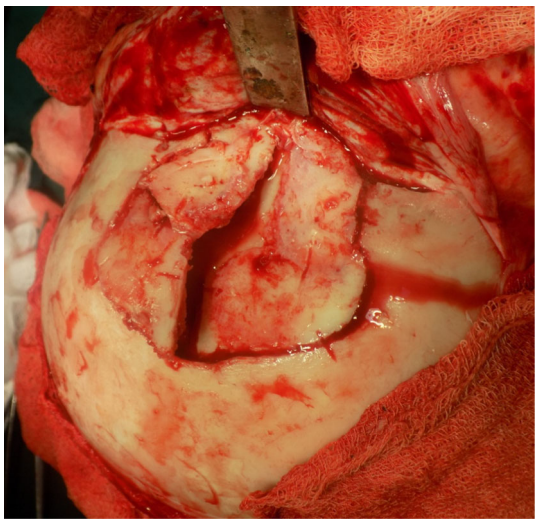

Fig. 7 Mobilizing the fractured fragments

fracture fragments and secured using 4 (2 × 6 mm) screws (Figs. 7, 8). The surgical site was cleaned with saline solution once haemostasis was achieved and was closed in layers with minivac drains. The post-operative check radiograph was done, and the healing process was uneventful with a significant improvement in the facial profile at the time of discharge (Fig. 9). Patient was followed up for 2 years without any specific complaint (Fig. 10).

Discussion

Incidence of head injury reported in the paediatric age group and skull fractures account for 10–30%. As per the 5-year retrospective review conducted by Bonfield et al. [1], there is a male preponderance in maximum reports on

Fig. 8 Repositioned and secured fracture fragments with miniplates

Fig. 9 Pre-op and immediate post-operative frontal and lateral profile

skull fracture and the frequent cause of injury being variable, mainly lists motor vehicle accidents, falls, and assaults as the main mechanisms. A wide series on surgical management of depressed skull fractures in paediatric population concluded that falls and road traffic accidents are the most frequent causes of injury [3].

Even though fractures of the cranial vault are rare in paediatrics, the frequently involved site is the frontal bone which is very prominent. As the frontal sinus, which is that of a cherry-size is yet to reach the orbital roof before the age of 6, the involvement of the frontal sinus is usually not

Fig. 10 2-Year follow-up of patient showing no residual deformity

seen below this age. The occurrence of frontal sinus fractures increases, with pubertal pneumatization of the frontal sinus [2].

Precise and swift diagnosis is of vital importance in the ideal management of paediatric facial fractures. The potential injuries to the facial skeleton should be initially evaluated by close physical examination. It is a challenge to examine the paediatric patients than adults, and if required, sedation can be considered. Present computed tomography (CT) is the benchmark for visualizing craniofacial fractures. Exceptional details of the cranium, midfacial structures, and the mandibular condyle are furnished by the CT images. Along with the sagittal and coronal views, converting the images into a three-dimensional reconstruction delivers an enhanced outlook in complex craniofacial injuries [2].

A recent comprehensive classification is divided into three types based on the fracture pattern and type of dentition [4]. In this case report, it was a type I closed depressed greater than width of skull thickness impacted comminuted fracture of frontal anterior and posterior table without involving nasal bones, naso-orbitoethmoidal/zygomaticomaxillary complex, medial or inferior orbital walls.

In cases of frontal bone injuries in paediatric patients, surgical intervention is usually not mandatory if fractures are not displaced. However, in cases of displaced fractures or fractures involving injury to the nasofrontal duct, exploration and reduction is necessary. A widespread exposure of the orbital rims, zygomatic arches, and nasal root is offered by the coronal approach. In surgical reduction, the fractured fragments are frequently fixed using titanium microplates with a probability of one more procedure for fixation removal later, which was well informed to the patient parents [2]. The role of biodegradable osteosynthesis in maxillofacial trauma is well documented [5]. Although the role of resorbable plates and screws has been extensively used in craniofacial

surgeries and facial bone fractures, there is evidence of secondary infection and cost factor. Although in the beginning it had its own drawbacks, with its newer concepts its shifted the term from resorbable to bioresorbable meaning biodegradation with stimulus for bioactivity [5, 6]. But in our series previously the handling issues and post-operative infection prompted for miniplate fixation which was stable even at 2 years follow-up. The controversy of its use below 3-year child continues with different centres adopting different protocols with no obvious advantages [7].

In the present case report, patient parents were apprehensive about the gross deformity following trauma which was aesthetically not looking good hence sought for consultation immediately. The gross deformity which was indicated for intervention was planned with a coronal approach under general anaesthesia with a south pole tube. The impacted fractured fragments were elevated, and fixation was done with miniplates and titanium mesh.

Because of the superior osteogenic potential, quicker healing rates, and minimal necessity for open reduction and rigid internal fixation, post-operative infection, mal-union or non-union are occasional in children [8]. A usual complication in patients with fractures of the frontal sinus is CSF leaks, approximately around 18–36%. In the truancy of any associated injuries requiring surgical intervention, conservative management of traumatic CSF leaks is considered [9]. The standard protocol of bed rest, head end elevation of bed, and laxatives was found to be efficacious in resolving 70% of CSF leaks in paediatric patients [10].

Contemporary treatment paradigms centres around early, aggressive, and definitive management of frontal bone fractures and frontal sinus injuries, with the goal to protect intracranial structures from further injury, to restore frontal sinus function and to minimize the possibility of development of complications in the future in both the paediatric and adult patients [11]. This is a one more case report of a child to the literature already available with gross deformity of upper third of face which was managed with present concepts without any morbidity.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval The manuscript was reviewed by Institutional review Board for publication. This article does not contain any studies with human participants or animals performed by any of the authors.

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