Case Report

Surgical management of maxillary trauma in pediatric special needs patient using modified cap splint

ABSTRACT

Pediatric maxillofacial trauma is a rare entity, which is primarily the reason for an individual surgeon's inexperience in managing such injuries. More so, maxillary injuries are infrequent. Pediatric maxillofacial injuries are usually a result of blunt force trauma such as falls, motor vehicle accidents, bicycle injuries, sports-related injuries, assault, and child abuse. The atypical pattern of facial injuries in the pediatric population necessitates each surgeon to approach individual cases with a unique and innovative technique of management, while still following the basic principles of surgical management of maxillofacial injuries. Since facial trauma and surgical interventions both have the potential to lead to disturbance in growth and development, management should be as conservative as possible. The foundation of any surgical intervention must be developed keeping in perspective, the future growth, and development of dentofacial structures. Pediatric facial trauma management is in itself a disconcerting situation for a maxillofacial surgeon, but when a special needs child is involved it becomes an even more perplex decision. We present a case of maxillary trauma in a pediatric patient with global developmental delay, the treatment dilemma, and a review of current literature.

Keywords: Global developmental delay, maxillary fractures, modified cap splint, pediatric fractures, pediatric maxillary fractures, surgical management of pediatric maxillary fractures

INTRODUCTION

Evolutionary scientists believe that the structure of the mid-face has developed in a way that enables protection of the maxillary dental arch against the masticatory forces exerted by the mandible and at the same time to protect vital organs like the brain from traumatic injuries due to external forces.[1,2] The framework of the mid-face region provides a "cushioning effect" by acting as a "match box" to prevent injury to the brain and other vital structures by fracturing the relatively weaker bones of the facial skeleton.[3,4] The stress-bearing pillars of the midfacial skeleton absorb considerable amount of forces from below, but can be easily fractured by the comparatively low amount of forces from other directions.[5] Fortunately, pediatric patients with maxillofacial fractures have been reported to have better posttreatment outcomes as compared to adults likely due to a higher osteogenic potential.[6] Children also heal faster and recover more quickly postsurgery. As a result of this, they do not tend to develop postoperative complications like malunion or nonunion, infections, and most of the times do not require open reduction and fixation. It is said to induce malunion in children, it needs "considerable skill" and extremely serious errors in management.[7]

Pediatric craniofacial fractures in children are not the same as in adults. Differences in mechanical properties of bones,

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craniofacial anatomy, healing capacity, and dental morphology have clinical relevance in diagnosis and management. Because of these differences, the diagnosis and management of pediatric facial fractures is a surgical dilemma since the fractures are generally oblique or greenstick in nature. Children are usually under strict parental supervision which is an important variable in reduced incidences of pediatric injuries.[8] Other factors leading to reduction in pediatric maxillofacial fractures include the retruded position of the facial skeleton, bony elasticity, increased adipose tissue content, undeveloped paranasal sinuses, and tooth germs.[9] However as reported in the literature, the overall incidence rates of pediatric trauma range from 0.87% to 1%, with a male predominance.[10,11]

Despite being a rare entity, pediatric facial trauma can range from soft tissue injury to bony injuries and even neurovascular insult.[12] In infants and younger pediatric patients, the skull being larger in size is the chief site of blunt force trauma as compared to the face.[13] In children, <5 years of age the most common mechanism of facial trauma are falls (44%) followed by motor vehicles incidents (25%) and assault or abuse (25%), with obvious variations due to social, cultural, and environmental factors.[14] The maximum number of cases are due to falls in the younger spectrum of the pediatric age group.[15]

Global developmental delay (GDD) is a common presentation in pediatric practice, affecting up to 3% of the pediatric population.[16] GDD is defined as a difficulty in achieving specific developmental milestones compared with chronological peers.[17] Shevell *et al*. defined GDD as evidence of significant delay in two or more of the following developmental domains: gross or fine motor, speech or language, social or personal, cognition, and activities of daily living.[18] Generally, it is assumed that a delay in two domains is associated with delay across all domains being evaluated.

Surgical management of pediatric facial fractures poses a great risk of hindrance to growth and development of the facial skeleton, scarring, iatrogenic injuries, and postoperative facial asymmetry. Due to higher rates of postoperative facial deformities after surgical management of maxillofacial injuries in children, the treatment is preferred to be conservative. However, in cases of severe maxillofacial injuries, it becomes inevitable to avoid the conservative approach and take a more evidence-based surgical approach for treatment. In this case report, we present a case of pediatric maxillary fracture in a patient with GDD which posed as a challenge for the management and treatment.

CASE REPORT

A 7-year-old female previously diagnosed with GDD reported to the of our institution with a history of falls from bike resulting in the bike handle hitting the left side of her face. Clinical examination and orthopantomography revealed a fracture of the left maxillary alveolopalatal segment, leading to palatal segment collapse and malocclusion [Figures 1 and 2]. The patient had multiple carious teeth and mixed dentition with teeth in different stages of eruption pertaining to her age group. Due to the patient's preexisting medical condition, the patient was immediately admitted and empirical antibiotics along with analgesics were started. A battery of blood tests were ordered to rule out any physiological abnormalities. After the patient was deemed fit for surgery under the ASA II category, the patient was kept nil per oral for 6 h and using ketamine for conscious sedation, an alginate impression of the dental arches was made since the buccal plate of the maxilla was intact. A lateral and upward force was used to reduce the fractured segments while recording the impression. The alginate impression was disinfected and a cast was poured using die stone (Kalabhai Labstone©), following which a splint was fabricated using self cure acrylic (DPI R. R Cold Cure©) in which five Erich's arch bar cleats were incorporated to provide anchorage for wire suspension of the fractured segment [Figure 3]. Once the splint was fabricated cold sterilization was done with 2% Cidex© 12 h before the procedure. The patient was kept nil per oral for 8 h and shifted to the operating theatre where under general anesthesia, standard surgical scrubbing and draping were done. 2% lignocaine with 1:200,000 adrenaline diluted with distilled water (1:1) was infiltrated along the maxillary labial vestibule. A curvilinear incision was made in the right and left maxillary vestibule without joining the incisions in the midline. Mucoperiosteal flaps were elevated and 1.7 mm × 6 mm titanium screws (Stryker©) were placed one each in the left zygomatic buttress and piriform region and one in the right piriform region. The splint was placed using an upward and lateral force to achieve reduction and appropriate occlusion of the fractured maxillary segment. Fixation and stabilization were done using 24 gauge stainless steel wires engaging the screws in the maxilla and cleats of the arch bar incorporated in the splint [Figure 4]. Further stabilization was done using self polymerizing acrylic on the wire engaging the cleats in the splint. Suturing was done using 4-0 vicryl suture and the patient was extubated uneventfully. After 3 weeks, the patient was recalled and the hardware along with the splint was removed under ketamine conscious sedation. Postoperative orthopantomogram shows adequate reduction of the maxillary dental arch and adequate stabilization of occlusion postoperatively [Figures 5 and 6].

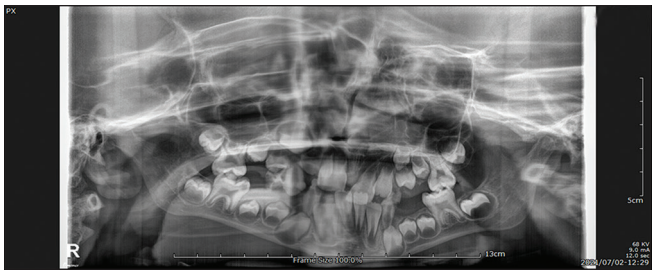

Figure 1: Preoperative orthopantomogram showing left dentoalveolar fracture

Figure 2: Preoperative occlusion

Figure 3: Splint for maxilla to stabilize the fractured dentoalveolar segment

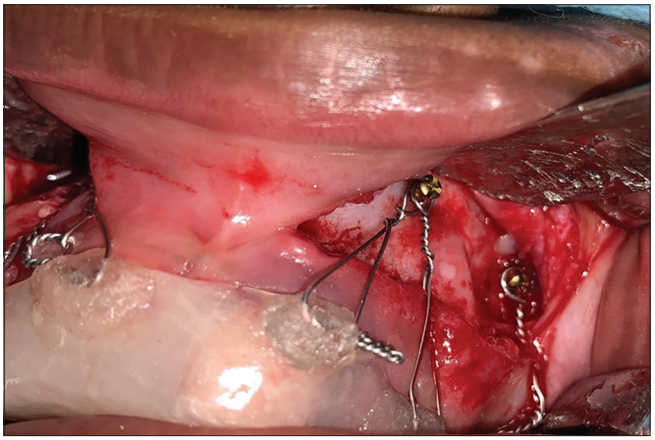

Figure 4: Splint *in situ* and suspended from the maxilla using titanium screws and stainless steel wires

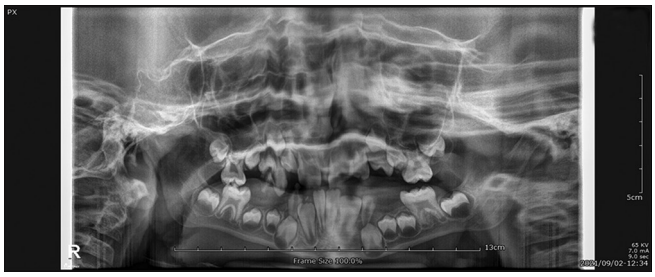

Figure 5: Postoperative orthopantomogram

Figure 6: Postoperative occlusion

DISCUSSION

Approximately 15% of all facial traumas are seen in the pediatric age group and are most commonly seen in the mandible.[19] The treatment is challenging due to anatomic variations and concerns regarding the growth and development of the facial skeleton.[12] Maxillary fractures are the least common in the craniofacial region and management depends upon patient cooperation during the treatment duration.[20,21] In our case, since the patient has GDD, the ability of the patient to convey her concerns and her compliance to our instructions was questionable. Hence, we decided to do a semi-rigid type of fixation using modified cap splint for stabilization of the fractured maxillary segment.

The key elements in the management of these fractures is the consideration to avoid future growth disturbances as well as to do an adequately stable fixation to allow for bone healing. It has not been established whether the growth disturbance is due to trauma itself or the subsequent surgical management.[12] Since healing is faster in children, treatment duration and the need for rigid fixation is reduced. However, the treatment depends upon the patient's age, cooperation and status of permanent tooth buds. Maxillomandibular fixation (MMF) is considered gold standard treatment in pediatric maxillary fractures, was difficult to achieve in our case because of the insufficient number of teeth, dental caries, and root resorption as well as the presence of the permanent tooth buds.

In severely displaced fractures usually the treatment of choice includes intermaxillary fixation, cap splints, mini plates, or resorbable plates.[12] Miniplates should be used with caution to prevent injuries to the permanent tooth buds. Nonresorbable miniplates also require a second surgery for removal in pediatric patients since they have the potential to hinder growth. Resorbable miniplates eliminate the need for a second surgical procedure since they get metabolized in the body, but the risk of damage to tooth buds still remains.[22,23] Minimally displaced fractures are treated conservatively by the means of soft diet, analgesic, and antibiotic prophylaxis. However, healing might be delayed because of the insufficient cooperation of young patients in following postoperative instructions. To overcome this, a modified closed cap splint can be fabricated and by using wires suspension from screws fixed in the maxilla, it can be used to maintain stability.

MMF is successfully used to managed maxillary fractures and elastics can be used when the adequate number of teeth have erupted.[24] In mixed dentition period and primary dentition, use of Ivy loops and circummandibular wires are advantageous according to some authors.[25,26] At the same time, some authors believe that skeletal fixation at the pyriform aperture and zygomatic buttress using stainless steel wires provides adequate stabilization to the MMF.[9] We have utilized the principle whereby in maxillary fractures suspension wires inhibit mobility of the maxilla which occurs due to the inferior pull caused by MMF.[27] It is believed that in children the zygomatic buttress is thin and due to the presence of underlying teeth, the pyriform aperture suspension may be preferred.[28] In cases with partial or complete edentulousness, the use of splinting techniques by custom-made acrylic lingual or occlusal splints is also advocated by some authors.[29]

CONCLUSIONS

A successful management of pediatric maxillofacial trauma requires an experienced surgical team with an innovative approach to the various considerations in surgical treatment. Extensive knowledge of the growth and development of the face is imperative. The ability to delineate differences between the child and adult is a prerequisite in both diagnosis and rehabilitation. There may be several factors such as inability to communicate, incomplete examination, and difficulty in imaging which can lead to misdiagnosis of pediatric fractures. Age of the patient, compliance, reduction technique, materials, and duration of chosen therapy should be taken while formulating the comprehensive treatment plan. Further investigations are needed to optimize the treatment protocols in the pediatric population with special considerations to special needs children. Various controversies still exist and demand clarification.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the legal guardian has given his consent for images and other clinical information to be reported in the journal. The guardian understands that names and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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