Reinforced Open Cap Splint : A Novel Therapeutic Technique in Paediatric Mandibular Fracture

Dr. Muralee Mohan C. Professor
Dr. Smitha Bhat Assistant Professor
Dr. Arvind Karikal Assistant Professor
Dr. Niharika Gupta P.G. Student

Dept. of Oral & Maxillofacial Surgery, A.B. Shetty Memorial Institute of Dental Sciences, Mangalore (Karnataka).

Introduction

The paediatric mandible is dynamic, constantly changing with growth and development. The traumatic injury of the paediatric mandible requires an appreciation of the fundamental differences between the paediatric and adult mandibles[2]. The management of paediatric mandibular fractures is complicated by mixed dentition. The goal of treatment of these fractures is to restore the underlying bony architecture to pre-injury position, in a stable fashion, as non-invasively as possible, and with minimal residual esthetic and functional impairment[5]. The incidence of pediatric facial fractures ranges between the 1% to 14% for the victims under the age of 16 years and 0.87% to 1% for those younger than 5 years. The incidence of pediatric facial fracture among Indians is 5.5%. The etiologies of facial fractures in children include falls and sports injury usually[11]. In a study conducted by Matsuya et al[12], one hundred seventy-four paediatric patients younger than 16 years of age treated during a 15-year period were analyzed. The ratio of boys to girls was 2 : 1. Mandibular fractures were most common (56%) followed by fractures of the alveolar process (31%). Condylar fracture was common in children younger than 14 years, especially in those below 6 years. Fractures of the mandibular angle were the most common in those above 13 years.

Closed reduction is the treatment of choice in most paediatric facial fractures unless the fracture fragments are severely displaced. Various techniques of closed reduction have been used in the past in the treatment of paediatric mandibular fracture such as cap splints with circummandibular wiring, open cap splints, staples, modified orthodontic brackets etc. This article describes a simple and newer technique of closed reduction using a modified reinforced open cap splint in a ten years old boy who sustained a mandibular parasymphyseal fracture.

Case Report

A 10 years old boy (figure 1) reported to us, with history of alleged fall while playing following which patient sustained injury to his lower jaw. He presented with swelling and erythema on the chin (figure 2), sublingual hematoma and a step deformity (figure 3) between lower left central and lateral permanent incisors. No tooth was mobile.

Orthopantomogram (figure 4) revealed a radiolucent line between mandibular left permanent central incisor and lateral incisor passing through the tooth bud of permanent canine upto the inferior border of mandible with minimal (2mm) displacement of the fractured segments. Mandibular occlusal (figure 5) radiograph revealed a minimally displaced parasymphysis fracture. Plating of any type was contraindicated due to the proximity of the permanent tooth buds.

Maxillary and mandibular alginate impressions were made. Under local anaesthesia, the two fracture segments were reduced and figure of 8 wiring was done between the permanent central and lateral incisor on left side (figure 6). Casts were fabricated using dental stone. The fractured site was marked on the mandibular cast (figure 7) and split into two segments using an electric saw (figure 8). The two segments were rearranged (figure 9) and stabilized using sticky wax and occlusion established by mounting on an articulator. 21-guage orthodontic wire was used for adaptation of C clasp on the interproximal surface of primary left second molar and permanent left first molar and between primary right second molar and permanent right first molar to reinforce retention of the splint. The occlusal surfaces of all mandibular teeth were blocked with modeling wax (figure 10). Open cap splint was fabricated with self-cure acrylic (figure 11). The cap splint was then finished, polished and tried in the patient's mouth. The required adjustments were done after checking the occlusion of the patient, intraorally using articulating paper. The open cap splint was cemented on the teeth using Type I Glass ionomer cement (figure 12). The patient was administered intravenous antibiotics and analgesics for one week. Patient was followed at regular intervals. The splint was removed by the end of six weeks. On clinical examination, occlusion was stable (figure 13) and no mobility of the fractured fragments was elicited. Post-operative orthopantomogram revealed continuity of the lower border and healing of fracture (figure14).

Discussion

The paediatric facial trauma patient provides several considerations that are not present in the adult. The paediatric patient has the advantage of an accelerated ability to heal in a short duration with few complications, aided by the well vascularized tissues of the face. Also, through the assistance of growth and an inherent ability to adapt, recovery of damaged orofacial tissues and function is much better than in the adult. Inspite of these advantages, few distinctions exist in the paediatric facial trauma patient. These include an appreciation of the unique characteristics and anatomy of the developing immature face, the different facial injury patterns from certain trauma risk exposures that occur in the pediatric patient, and the potential growth implications from traumatized facial structures that make long-term follow-up of these patients important. These factors, combined with the relatively limited experience of most clinicians with significant facial injuries in children due to their low incidence, may make certain treatment decisions different than what one might do in the adult.[1] The low incidence of paediatric facial fractures is most likely because of a high cancellous to cortical bone ratio, lack of full pneumatization of the sinuses, small volume of facial mass relative to the calvarium, the relative resilience of the paediatric skeleton and the protected environment in which children live, leading to less exposure to the typical mechanisms of injury. Approximately 40% of paediatric fractures involve the mandible. It is more difficult to make use of the teeth in children for fixation, because deciduous teeth may be either insufficient in number or their roots may be resorbed, and permanent teeth may be incompletely erupted. The shape of the deciduous crown is also not favourable for retention of wires and splints, being bell-shaped with little undercut area. Elasticity of the bone in children, the relatively small size of the face and the growth process in the young bone are also among the factors that influence the pattern of fracture, its management and the postoperative period of fixation.[3] The elasticity of bones in a child prevents loss of continuity of bone and rather results in a bending of a cortex termed as a greenstick fracture. Occlusion is rarely a problem as there is no disruption or mild changes are remodeled during the development of permanent dentition.[4]

Techniques frequently utilized in the management of paediatric jaw fractures include[9]:

- Tape muzzles
- Circumferential wiring
- Acrylic splints
- Percutaneous skeletal fixation
- Open reduction
- Resorbable plates
- Orthodontic resin[6]
- Modified orthodontic brackets[11]
- Rubber elastics in combination with orthodontic brackets[6]
- Nickel-titanium staples[5]

The treatment of jaw fracture usually involves surgical intervention. But in children, due to incomplete ossification of jaw bones and the presence of underlying erupting teeth, surgical intervention for management of

jaw fractures is not a usual consideration. Mandibular fractures which occur during mixed dentition can be associated with subsequent failed eruption of permanent teeth when the fracture line is reduced using an open surgical approach[6]. Therefore simple splinting methods hold importance in trauma management in children. Children have greater osteogenic potential and faster healing rates than adults. Therefore, anatomic reduction in children must be accomplished earlier and immobilization times should be shorter[7].

In case of a severely displaced fracture the treatment option can vary from intermaxillary fixation, cap splints to plating with mini plates or resorbable plates. Miniplates need caution so as not to injure the tooth buds of the permanent teeth and may need to be removed after osteosynthesis in growing children. Resorbable plates, eliminates the need for the second surgical procedure for the removal but the risk of damage to the tooth buds does exist.[4]

Hofer first described the mandibular lingual splint in 1939. In 1973, Hardin reported a case of a triple mandibular fracture that was treated with a lingual splint and maxillomandibular fixation. Irby also described the lingual splint under the category 'simple splints' and he recommended its use in reduction and stabilization of displaced dentoalveolar fractures in children[10]. The application of acrylic splints in the treatment of various types of maxillofacial fractures mainly depends upon the number of remaining teeth that are important for the restoration of occlusion. The acrylic splints consist of intermaxillary, lingual and labiolingual types that hold a dental arch and a cap type that covers a dental arch. The intermaxillary type is best indicated for the loss of multiple teeth, the lingual type for the predicted intraversion of bone fragments and the labiolingual as well as cap types for the deciduous or mixed dentition[9].The treatment period with a removable splint averages 3 weeks in subluxated teeth, 3-5 weeks in luxated teeth, 4-6 weeks in apical third root fracture injuries, and more than 5 weeks in middle third root fracture injuries[9].

In our case, we used a modified reinforced open cap splint as an effective method of closed reduction in a minimally displaced parasymphysis fracture. The modified reinforced open cap splint offers several advantages. Besides being a simple and reliable method, it provides adequate stability of the fractured fragments and avoids intermaxillary fixation. By virtue of its design, modified reinforced open cap splint eliminates the need for occlusal coverage thereby providing the patient with better masticatory efficiency and thus offers better patient compliance. The clinical outcome in the present case indicates that the management of mandibular fractures in paediatric patients using reinforced modified open cap splint is an effective and more reliable method than open reduction or intermaxillary fixation in terms of ease of application and removal, less time consumption, cost-effectiveness, good stability during healing period and minimal trauma to surrounding tissues. Therefore, we strongly recommend the use of the modified reinforced open cap splint in paediatric patients with mandibular fractures as a method of closed reduction.

References

1. Use of Resorbable Plates and Screws in Pediatric Facial Fractures: Barry L. Eppley. J Oral Maxillofac Surg 63:385-391, 2005
2. Reconstruction of the paediatric mandible: Robert J. Havlik. Operative Techniques in Plastic and Reconstructive Surgery, Vol 3, No 4 (November), 1996: 272-288
3. Fractures of the facial skeleton in children: a survey of patients under the age of 11 years: Chima Oji. Journal of Cranio-Maxillofacial Surgery (1998) 26, 322 325
4. Thermoformed splints in the management of pediatric mandibular fracture - A case report. Emmanuel Dhiravia Sargunam A, Ramkumar S, Deepak Abraham P. Streamdent Volume 1, Issue 3, October - December 2010
5. Management of mandibular body fractures in pediatric patients: A case report with review of literature : Baby John, Reena R John, A Stalin, Indumathi Elango. Contemporary clinical dentistry Vol 1, Issue 4 , 2010, 291-296
6. The management of mandibular body fractures in young children. Aizenbud D, Hazan-Molina H, Emodi O, Rachmiel A. Dental Traumatol 2009;25:565-70
7. Pediatric facial fractures: recent advances in prevention, diagnosis and management: C. E. Zimmermann, M. J. Troulis, L. B. Kaban. Int. J. Oral Maxillofac. Surg. 2005; 34: 823833
8. Pediatric injuries in maxillofacial trauma: a 5 year study: Kumaraswamy SV, Nanjappa Madan, Keerthi R, Deora Shakti Singh. J Maxillofac Oral Surg 2009;8(2):150153
9. Conservative Treatment Of Pediatric Mandibular Fracture With Removable Acrylic Splint: Nidhi Madan , Neeti Bajaj , Arun. Indian Journal of Dental Sciences 2(4):22-24,2010
10. The Lingual Splint: An Often Forgotten Method for Fixating Pediatric Mandibular Fractures: Abdulaziz Binahmed, Claudio Sansalone, Justin Garbedian, George K.B. Sándor. Journal of Canadian Dental Association July/August 2007, Vol. 73, No. 6
11. Modification Of Orthodontic Brackets For Use In Intermaxillary Fixation. Magennis P, Craven P. Br J oral maxillofac surg, 1990;28;136-7
12. Paediatric maxillofacial fractures: their aetiological characters and fracture patterns: Seiji Iida, Tokuzo Matsuya. Journal of Cranio-Maxillofacial Surgery (2002) 30, 237241

Legends

Fig. 1
Fig. 2 Swelling and erythema on chin
Fig. 3: Step deformity
Fig. 4: Pre-treatment OPG
Fig. 5: Pre-treatment mandibular occlusal radiograph
Fig. 6: Figure of eight wiring
Fig. 7: Fabricated cast
Fig. 8: Segments split
Fig. 9: Segments rearranged
Fig. 10: Block out
Fig. 11: Fabricated splint
Fig. 12: Splint in-situ
Fig. 13: 6 weeks post-treatment occlusion
Fig. 14: 6 weeks post-treatment OPG
Fig. 15: 6 weeks post-treatment mandibular occlusal radiograph