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Management Of Mandibular Symphyseal /Parasymphyseal Fracture In Pediatric Patient Using Vacuum Formed Splint: A Case Series

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ABSTRACT
Trauma to the dentofacial structures in children are often challenging and have a long-term psychological impact on children. Dentofacial injuries with fracture of mandible in symphyseal or parasymphyseal region may or may not be associated with the fracture of condyle, body, angle of mandible, avulsion of teeth and soft tissue injury.The management of a paediatric mandibular fracture is preferably directed towards the conservative one because of the anatomy, dentition, and growth of a child. Conservative management should be less time consuming, easy to fabricate and cost effective. Among variety of conservative treatment available, recently vacuum formed splints are gaining popularity for its multifold advantages. However, most of the published case reports are limited to one case only. Here, we present three cases with mandibular symphyseal and parasymphyseal fractures that were treated with vacuum-formed splint along with a short review of past treatment modalities. These cases, presented with a unique challenge to preserve the unerupted and developing tooth buds resulted in uneventful healing. On the basis of success of vacuum formed splint to manage symphyseal/ parasymphyseal mandibular fracture in three cases presented here and several ongoing cases in the department, it might be recommended to manage routine volume of cases to render cost effective treatment especially in a hospital setup.

Keywords*: Pediatric mandibular fracture, Conservative Treatment, Vacuum Formed Splint*

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I. INTRODUCTION

Pediatric facial fractures constitute 5% of all the facial fractures.[1]Motorvehicleaccidents, falls and sports are the most commonetiological factorsof mandibular fractures in children.[2]

Among maxillofacial trauma in children, mandibular fractures are one of the most common types of injuries comprising20–50%ofallfacial fractures.[3]Posnick et al reported in their study that 39% of all fractures were of the mandible. Mandibular fracture sites included the condyle (55%), parasymphysis (27%), body (9%), and angle (8%).[4] Among various types of mandibular fracture in children, symphysealfracturesaccountforapproximately2% -30%.[5] Symphyseal and parasymphyseal fractures occur more often in children,which may be partially explained by the presence of developing canine tooth budsresultingin a stresspoint at the inferiorborderof themandible.[6]The treatment of pediatric mandibular fractures is controversial and complicated by many factors such as: tooth eruption, short and resorbing primary roots, developing tooth buds and growth especially at the mixed dentition stage.

In 20th century, [7] the management of mandibular and maxillary fractures were limited to the application of bandages, maxillomandibular fixation or Gunning-type splints. Rigid fixation is a technique used in the management of facial fractures that has developed for more than 20 years.[8]However, their use in children is somewhat controversial. Open reduction and osteosynthesis of the pediatric fracture with titanium plates and screws orabsorbable plates screws have a negative effect on the skeletal growth anddamagingunerupted teeth. The treatment ofpediatric mandibular fracture has a long history, summarised in table-1.[7,9,10,11,12]

Table 1: Historical background of Mandibular Fracture

Year	Introductor	Treatment delivered	Outcomes
1650 BC	Papyrus	firstrecordedmentionofdiagnosingand treatingmandibularfractures	Satisfactory diagnosis and its management
356 BC	Hippocrates	discussed circumferential dental wiring	Not very conservative approach
1275	Salicetti	firsttoproposemaxillomandibularfixation	Difficult to open mouth- probability of ankylosis TMJ
1865 and 1866.	Gunning and Bean	This period wasknown as ‘‘Prosthetic era’’ in fracturemanagement.	Invasive procedure
1887	Gilmer	usedfixedfullarchbars	Negative effect on underlying toothbuds, loosening of arch bar
1960	Luhr	developed the vitallium mandibular compression plate	Risks of damaging permanent tooth buds/ failed eruption of permanent teeth/ affected skeletal growth
1968 and 1972	Luhr and Spiessl	reintroduced the idea of utilizing miniature bone plates	Risks of damaging permanent toothbuds/ failed eruption of permanent teeth/ affected skeletal growth

Nixon F[13]reported that open reduction with internal fixation has the drawback of increasing the risk of damaging growing tooth buds in pediatric patients. This complication can occur with both wire and screw fixation causing failed eruption of permanent tooth. The developing canine tooth was the most likely tooth to be damaged.

During the management of pediatric maxillofacial fractures, pedodontist and team have more challenges such as smaller jaw size, spacing between teeth, short and resorbing roots, shorter crown length, mobile teeth, centres of active bone growth, and unerupted permanent teeth. The goal in treating pediatric fractures is to restore the underlying bony structure to its pre-injury position as soon possible. Mandible should remain functioning to prevent ankylosis in temporo-mandibular joint area. As a general rule, conservative therapy with long-term follow-up should be favoured.**[14]**

However, the advancement of technique and skills provide numerous options to a clinician.Which include tape muzzles, circumferential wiring, acrylic splints, percutaneous skeletal fixation, nickel titanium staples, orthodontic resin, modified orthodontic brackets, and rubber elastics in combination with orthodontic brackets.[15]But all these procedures are more time consuming, require complete hospital admission and infrastructure and pediatric patient had to undergo general anaesthesia for such treatment options. Recently, vacuum-formed splints are being used successfully to treat mandibular fractures in pediatric patients.[16]

Lloyd in 2001 first reported the use of vacuum formed splint for the treatment of mandibular fractures. The splint is made up of a transparent thermoplastic sheet with the help of a vacuum-forming machine, which is then adapted to the individual dentition.[17]Table-2 presents a short review of the outcome of mandibular fracture in children treated with vacuum formed splint, the latest conservative option.[18]

Table 2: Short Review of Outcome of Mandibular Fracture

S.No.	Author, year of publicizing	Age, sex	Fracture site	Method of stabilizing	Outcome
1	Lloyd et al,[8] 2001	13/F	Left condyle fracture	Cementation of vacuum forming splints	Occlusion in centric relation, adequate mouth opening
2	Emmanuel A et al[9], 2010	4/F	Parasymphysis fracture	Circummandibular wiring of thermoforming sheet	Stable occlusion
3	Choubey S et al,[10] 2014	9/M	Parasymphysis fracture	Cementation of vacuum forming splint	Completely healed fracture site
4	Reddy KH et al,[11] 2016	4/ M	Parasymphysis fracture	closedreductionusingThermoformedsplints	No mobility at fracture site

5	Sanu OO et al,[12] 2017	5/M	Symphysis fracture	closed reduction using a vacuum formed thermoplasticsplintand circummandibular wiring	Stable occlusion

The splint obtains support the fracture segment of mandible through close adaptation to the teeth and alveolus. The splint attains exact anatomical duplication of the patient's dentition, thus providing excellent three-dimensional stability at the fracture site. The vacuum-formed splint might be a useful alternative to arch bars in managing dentoalveolar fractures, especially in pediatric patients with primary or mixed dentition, where arch bar adaptation is difficult due to retention problems.[19] This technique has been claimed minimally invasive, less time consuming, less cumbersome and can be carried out in outpatient settings, thus avoiding hospital expenses and general anaesthesia procedures.

On the basis of prevalence of mandibular fractures in children, given in first paragraph a hospital with 100 pediatric patients daily would have .3 exclusive parasymphyseal cases in a day. While all total OPD (including trauma centre)of atleast500 in a government hospital would expect 1.5 cases of exclusive pediatric parasymphyseal fractures daily. Handling routine OPD of 30-40 pediatric patients in department of Pediatric dentistry with behaviour problems, it is a difficult task to handle mandibular fractures of this volume. Operation theatres often have que for more complicated trauma or other surgical cases. If some of the pediatric mandibular fractures can be treated conservatively and rapidly without the need of general anaesthesia, the treatment would not only be cost effective but also of patient benefit functionally. Two modes of stabilization of vacuum formed splint has been described in isolated reports i.e.,circum mandibular wiring and cementation on dentate part of arch. Circummandibular wiring would not only require GA but also there remain a risk of wires cutting the softer splints. On the other hand, cementing it on a dentate arch seems a good method without the need of GA or OT (Table 2).Isolated case reports of vacuum forming splint using cement need further exploration to be used in volume of patients. This case series of 3 patients (completed and followed up) is reported with the aim to explore on advantages and complications of vacuum-formed splints in the management of a mandibular symphyseal/ parasymphyseal fracture.

II. CASE SERIES

All the patients had complaint of trauma with the history of fall, one from motor vehicle and two from height. All these patients reported to the trauma unit on same day. None of these patients had a history of loss of consciousness, nasal bleed, ear bleed, seizures, or vomiting.As the protocol residents of department of Pediatric & Preventive dentistry received call from Trauma unit for the management of same.

A systematic and detailed physical examination was performed to avoid missing any associated injuries. All the patients were conscious and well-oriented.On inspection, the patient had swelling on the face and lacerated wounds on the lower third of the face in the chin region.

Fracture sites were tender to palpation and compression. And putting pressure on the fractured area of the chin causes discomfort and pain. There was no TMJ pain under compression.

Emergency treatment was done in trauma centre like tetanus prophylaxis and primary stabilization for bleeding control. The laceration in chin area was also debrided and sutured. The patient was kept on oral antibiotics, analgesic. General considerations for the injured young patient include airway maintenance, fluid and electrolyte balance, and rational nutritional intake throughout treatment.As in adults, the primary evaluation of a pediatric trauma patient pursue "ABCs" of advanced trauma life support.[20]

Patients were recalled next day in the Department of Pediatric and Preventive Dentistry for the definitive management of mandible fracture.

Case 1

A 5-year-old girl reported to the Department of Pediatric and Preventive Dentistry with history of fall 1-day back who was already treated in trauma centre for the primary emergency management. On extra-oral palpation of lower border of mandible,a step deformity was found in symphyseal region corresponding to the central incisor region. On intraoral examination, laceration wound was seen between mandibular deciduous central incisors associated with mobility of fractured segment. Mandibular occlusion was deranged with a step at 71 and 81 region along with left segment displaced mesially and upward, causing open bite on right side (Figure-1a).

Preoperative orthopantomogram revealed an oblique fracture line passing from mesial aspect of root of mandibular left and right central incisor, and reaching to lower border of mandible (Figure-1b). There was no other fracture line seen in both the condylar region or other bony structures. No individual tooth fracture was present and none of the teeth in line of fracture were mobile or missing.

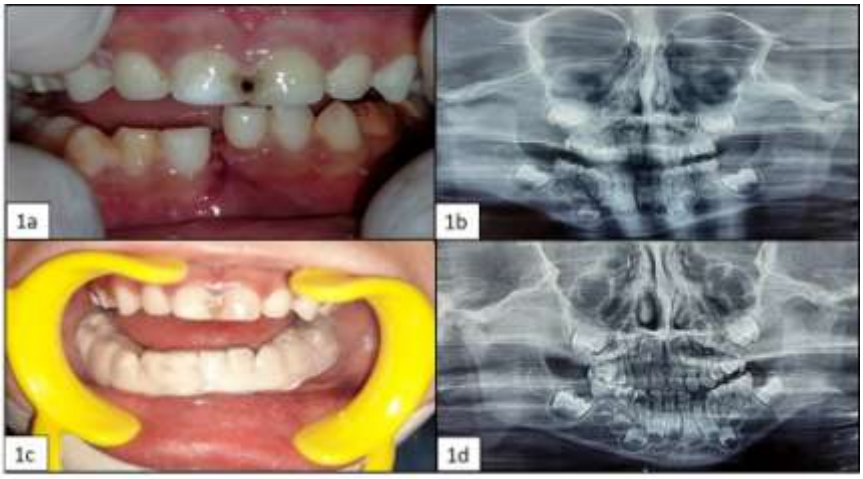

Figure 1: (a) Pre operative photographs (step deformity w.r.t 71 and 81); (b) Preoperative orthopantomogram showing fracture line w.r.t 71 and 81; (c) thermoforming splint cemented under local anaesthesia; (d) Post-operative orthopantomogram showing healing of fracture line.

Case 2

A 6-year-old boy reported to the Department of Pediatric and Preventive Dentistry, with a history of fall from motor vehicle 1-day back. He presented pain and swelling in lower face region. On intraoral examination, a step deformity (displaced fracture) in symphyseal region corresponding to the both lower primary central incisors region i.e., 71 and 81. On intraoral examination, laceration wound was seen in between both lower deciduous central incisors associated with mobility and displacement of fractured segment. Derangement of occlusion was seen with a step at 71 and 81 region (Figure 2 a).No individual tooth mobility was seen, and there were no teeth in the line of fracture mobile or missing.

Preoperative orthopantomogram revealed an oblique fracture line passing from distal aspect of root of mandibular right lateral incisor, and reaching to lower border of mandible (Figure 2 b). There was no other fracture line on temporomandibular joint or other bony structures seen.

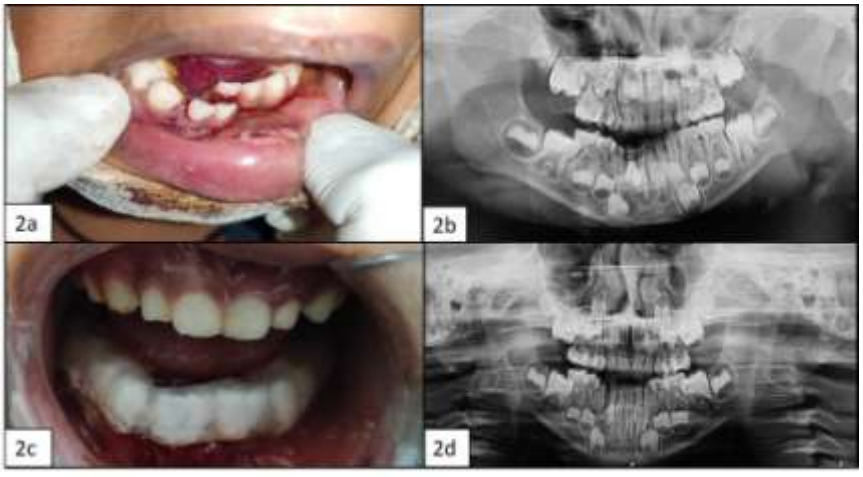

Figure 2: (a) Pre operative photographs showing fracture line w.r.t 71 and 81; (b) Orthopantomograms showing fracture line passing from distal aspect of root of mandibular right lateral incisor, and reaching to lower border of mandible; (c) Thermoforming splint cemented; (d) Post-op radiographs showing alignment of teeth and healing of fracture line.

Case 3

An 8-year-old female patient reported to the Department of Pediatric and Preventive Dentistry with history of fall 1 day back. The patient was conscious, well oriented, and had no history of convulsions or vomiting. She presented with a step deformity (displaced fracture) in parasymphyseal region corresponding to the deciduous canine and permanent lateral incisor region on the right side. On intraoral examination, laceration wound was seen in between right lateral incisor and deciduous canine associated with mobility of fractured segment. Derangement of occlusion was seen with a step at 42 and 83 region (Figure 3a).

Preoperative orthopantomogram revealed an oblique fracture line passing from distal aspect of root of mandibular right lateral incisor, and reaching to lower border of mandible (Figure 3b). There was no other fracture line on temporomandibular joint or other bony structures seen. No individual tooth fracture was present and none of the teeth in line of fracture were mobile or missing.

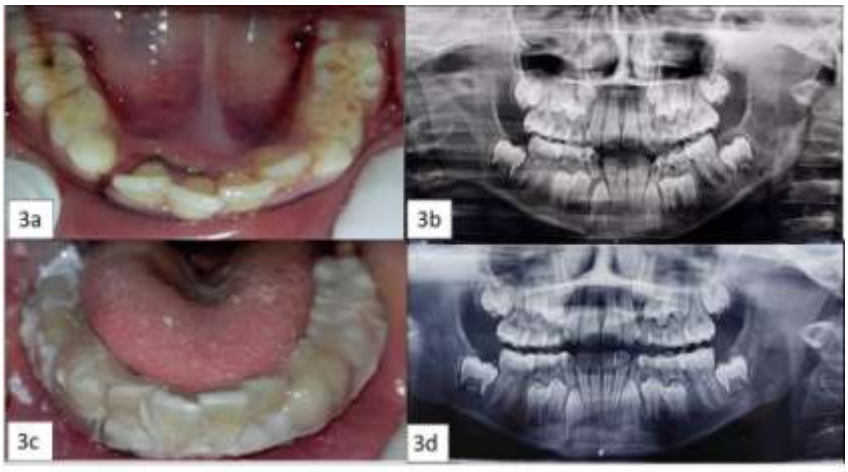

Figure 3: (a) Pre operative photographs showing Derangement of occlusion was seen with a step at 42 and 83 regions; (b) Orthopantomogram revealed an oblique fracture line passing from distal aspect of root of mandibular right lateral incisor, and reaching to lower border of mandible; (c) Thermoforming splint cemented with reduced fracture segment; (d) Post-op radiographs.

III. PROCEDURE

Under local infiltration of anesthesia (2% lignocaine with 1:200000 adrenaline, Xylocaine Cadila Healthcare Ltd, Gujarat), upper and lower impressions were made using rubber base impression material (VivadentIvoclar, Liechtenstein). Cast was poured using dental stone (Kalabhai type III stone, Kalabhai Karson Private Limited, Mumbai). The casts were then occluded to check occlusal discrepancy. The fracture site was marked on mandibular cast and cast was split into two segments using a saw (mock surgery was performed). Then cast was held in their reduced position and proper occlusion with opposing maxillary cast was confirmed with the help of plaster of Paris (Figure 4a to 4h). In the cases of displaced fractures, in order to reinforce thermoforming splint, a19 guage orthodontic wire on buccal and/or lingual surfaces was adapted. It was secured with quick-fix on the cast.BiocrylR close cap splint (Bioacrylic sheet 1.5*1.25mm Duran Scheu-Dental, Gmbh, Germany) was fabricatedwith a vacuum forming unit (BiostarR) on cast. Buccal and lingual extensions of splintwere reduced upto vestibular folds only and frenums were relieved with the help of scissors and bur beforehand trying in the mouth. Finally, the splint was tried in patient's mouth for any sharp points. Closed reduction was done under local anesthesia (Bilateral Inferior Alveolar Nerve Block) and the splint was cemented with type I glass ionomer cement (GC, Japan) (Figure 1c, 2c and 3c).

The patient was administered with antibiotics and analgesics medications for 5 days. Soft diet was advised to the patient for the next 4 weeks. Oral hygiene instructions were given which included brushing and oral rinsing after every meal. Patient was recalled after 4 weeks for removal of splint. Splint was removed by the end of 4th week. On clinical examination, no signs of inflammation and a healthy healing were observed. No mobility of fractured segments was elicited. Panoramic radiograph after 1 month revealed healing fracture site and continuity of lower border of mandible (Figure 1d, 2d,and 3d)

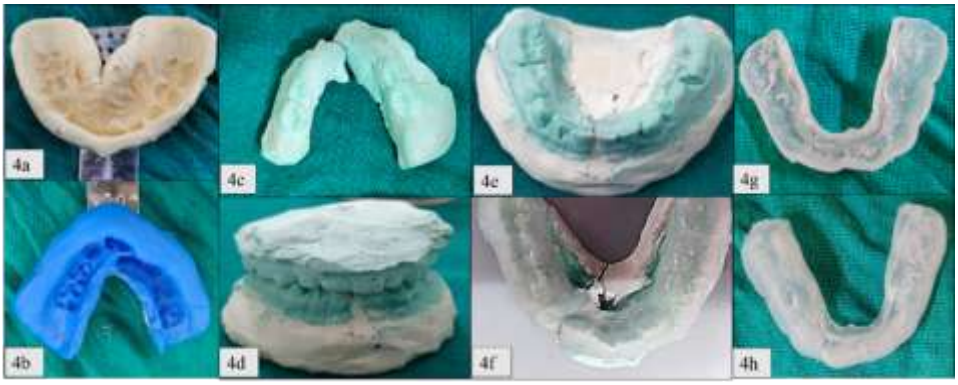

Figure 4: Photographs of preparation of splints on cast in occlusion after performing mock surgery; (a) Impressions of maxillary arch with alginate; (b) Fractured mandibular arch with silicon based putty; (c) Fractured segments splitted with diamond disk; overhanging plaster material was trimmed to bring segments in the shape of arch; (d) Both mandibular segments were brought in occlusion with maxillary arch and fastened with sticky wax; (e) Approximated segments, stabilized on the base of plaster of paris; (f) Vacuum formed splint fabricated on the mandibular cast; (g) Tissue surface of splint before cementation; (h) Occlusal surface of splint before cementation.

IV. DISCUSSION

Pediatric facial fractures mostly occur in the mandibular region. Management of mandibular fractures is performed having various goals in mind such as restoration of occlusion, restoration of function as well as restoration of normal growth and development of mandible along with developing permanent teeth. The important factors which affect the treatment plan in managing these fractures include patient's age, duration between trauma and treatment, location and extent of injury, stage of root formation, and the presence of other bony fracture.[21]

There are various treatment options available for the management of mandibular fractures which already discussed above and enlisted in table-1. However, all these procedures are invasive[2], more time consuming, require complete hospital admission and infrastructure as cases are done under general anaesthesia. Moreover, Choubey et al[22]reported a case of 9-year-old boy having an unfavourable parasymphyseal fracture of mandible and was first treated with arch bar stabilization, eventually was unsuccessful.Then, it was stabilized with vacuum-formed splint and healing was seen as early as 4 weeks.

In a hospital set up where plenty of pediatric patients are being treated require conservative, quick, less cumbersome, and predictable treatment option. As healing of the fracture site in pediatric age is faster than an adult, stabilization only upto 4 weeks is recommended in the literature. Vacuum-formed splints fulfilled all the desired criteria to treat mandibular fractures in pediatric patients thatnot only simulated the occlusal morphology but also helped in maintaining occlusion by providing optimum stabilization and retention of the fractured segment upto 4 weeks successfully. The splint was further reinforced by extending its margins upto muco-buccal and lingual folds. In the cases of displaced fractures these collapsible splints were further reinforced with 19 gauge wire on lingual and/or buccal side depending on the degree of displacement, indicative of muscle pull.All Other advantages of vacuum-formed splints include improved patient comfort and acceptability, reduced bonding time, reduced chairside time, less laboratory time, non-invasive and biocompatible, less chances of perforation, sufficient longevity of the splint, protection of injured teeth, elimination of custom wire bending, ease of access to oral hygiene, and enhanced patient compliance.[23]

V. CONCLUSION

Vacuum-formed splinting provides maximum stability during the healing period in a cost-effective, easy to apply and remove method which gives minimal traumatic experience to child thus increasing patient compliance.

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