Eva Vacuum-Formed Alternative Splinting of Alveolar Fractures in Primary Dentition: A Case Report

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Alveolar fractures treatment includes repositioning of displaced segments and splinting. In children, splinting procedures may occasionally present clinical problems resulting from fewer teeth available for splinting or presence of occlusal disturbances. An alternative clinical approach for splinting in alveolar fractures of primary dentition is described. ***Clinical case:*** *A 4.5-year-old girl was referred to our clinic 8 hours after a fall accident. Clinical examination revealed mandibular alveolar process segmental fracture in the right canine area with frontal dislodgement of the labial cortical bone resulting to occluding inability. The area was anaesthetized, cleaned and the dislodged bone was manually repositioned, followed by an EVA copolymer splint for fixation as a result of patient's deep bite impeding regular wire-composite splint. The cap splint that was fabricated on a cast made after an alginate impression, was set on the mandibular dentition and immobilized in the primary molars with acid-etch adhesive and flowable resin composite. Following splint removal after 4 weeks and follow-up visits, successful healing was observed clinically and radiographically with no pathological signs and symptoms.* ***Conclusion:*** *The described alternative splinting method in alveolar fractures of primary dentition is a valuable clinical tool for peediatric dentists, easily accepted by children in cases where regular splinting methods cannot be used.*

Key words: *alveolar fractures, primary dentition, splinting, vacuum formed, EVA*

INTRODUCTION

Approximately 18% of all somatic injuries are observed in the oral region in children 0-6 years old,[1,2] while about 40% of all children have their first contact with the dentist because of a traumatic injury.[3] Injuries to the primary dentition may present either exclusively to the hard dental tissues and the pulp or in association with the periodontal tissues and the alveolar bone.[4,5] Findings from a prospective Swedish study reported that fractures involving the jawbones were recorded in 6% of all patients presenting with oral injuries,[6] while Borum and Andreasen found that alveolar process fractures contribute to 4.4% of the total traumatic injuries in children.[7]

The management of alveolar fractures in the primary dentition is complicated and differs from that of adults as a result of continuous mandibular growth and dentition development.[8,9] The small size of the jaw, the existing active mandibular growth centers required to remain intact and the proximity of the primary teeth to the permanent tooth buds and mandibular nerves are different aspects of mandibular dentoalveolar fractures splinting consideration in children. In general, the main treatment goal of mandibular fractures is the stable restoration of bone continuity to the preinjury position. In children this goal needs to be achieved in α minimal invasive manner with the least aesthetic and functional effect.[10,11]

In cases of alveolar fractures in primary dentition, according to the International Association of Dental Traumatology (IADT) guidelines, reposition of the displaced segment, splinting and regular recall appointments is the recommended treatment plan. Splinting of alveolar fractures is usually achieved by means of an acid-etch/resin splint, for a fixation period of 3-4 weeks.[12,13]

In certain cases, splinting procedures in children may present clinical problems as a result of fewer teeth available for splinting, reduced dental stability from the normal root resorption, conical shape of deciduous teeth, presence of occlusal disturbances and limited cooperation.[10] Children before the age of 2 years and without completely erupted deciduous teeth, are treated as though edentulous. Once the primary dentition is established and until the age of 6 years, teeth may be used for fixation. During the next period of the mixed dentition, dental stability is again more precarious as primary tooth roots are resorbing and teeth are often loose or absent.[10,14]

The present case report describes in detail an alternative clinical approach for splinting alveolar fractures of the primary dentition.

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Case Report

A 4.5-year-old girl was referred to our clinic 8 hours after a fall accident. The patient was free of any neurological or general physical symptoms related to the accident.

Clinical examination revealed a segmental fracture of the mandibular alveolar process with frontal dislodgement of the labial cortical bone in the region of the right primary canine (Fig. 1). The labial segment of alveolar bone was mobile and painful on palpation in contrast to the lingual segment that was less mobile, painless and not dislodged. The patient could not occlude properly as a result of the mandibular alveolar fracture.

Considering the short time elapsed from the injury, an immediate treatment approach was decided. The area was anaesthetized using a local anaesthetic (4% articaine, with 1:100.000 epinephrine) and was cleaned with saline and chlorhexidine. Any additional support by sedation was not necessary because of the mild degree of bone dislocation, the reasonable cooperation of the patient and the experience of the operators. Pain control was adequately achieved by the local anaesthesia while the expected patient's anxiety was managed by non-pharmacological behavioral management techniques.[15] The dislodged bone was gently repositioned manually (Fig. 2) and the child immediately could occlude normally. The correct placement of the dislodged bone was confirmed by an immediate panoramic radiograph.

Following the repositioning of the fractured site it was evident that fixation by means of wire and composite resin splinting was impossible as a result of patient's deep bite. Therefore, the placement of a 3 mm thickness Ethylene-Vinyl Acetate copolymer (EVA copolymer) splint was decided as an alternative splinting method. The working cast was made in the Lab by hard plaster following an accurate dental impression with alginate. The working cast was then trimmed to a height of 20 mm at the cutting edge of all mandibular teeth and the EVA sheet was molded using a suction-type molding device (Ultraformer1, Ultradent Products Inc., UT, USA) at 140^{o}C heating temperature. The sheet was crimped against the cast for 2min and cooled for at least 3h at a temperature of about 24^{o}C. In the Clinic, the EVA splint was immobilized in the first and second primary molars of the patient using the acid-etch/adhesive technique and photopolymerized flowable resin composite (Fig. 3,4). The patient instructions included soft food for 2 weeks, brushing with a soft brush and rinsing with chlorhexidine 0.1% in order to prevent accumulation of plaque and debris.

The splint was removed after 4 weeks. A day later, complete healing of the region, restoration of dental occlusion (Fig.5,6) and

Figure 1: Initial mirror view of the mandibular alveolar process fracture. Note the frontal dislodgement of the labial cortical bone in the region of the right primary canine.

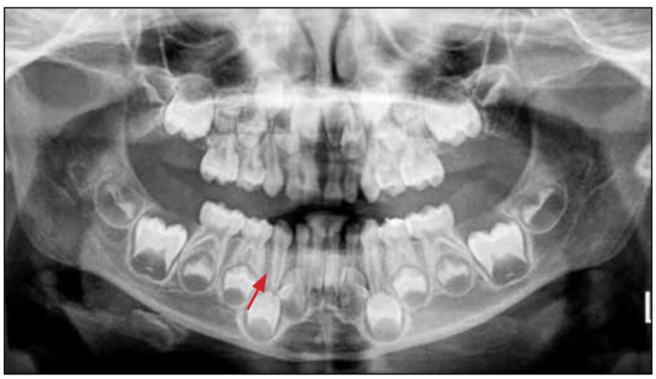
Figure 2: Clinical mirror view of the fracture following repositioning of the dislodged bone. Note the achieved continuity of the alveolar process in the fractured site.

Figure 3: The EVA copolymer splint with the flowable resin composite in the first and second primary molars, before cementation and photopolymerization.

Figure 4: The EVA copolymer splint in place following adhesion to first and second mandibular primary molars. Note the proper fabrication of the splint without covering the gingival area.

Figure 5: Clinical appearance one day after splint removal following a 4-week fixation period. Note restoration of the occlusal relationship and absence of gingivitis or debris accumulation.

Figure 6: Radiographic appearance one day after splint removal following a 4-week fixation period. Note complete healing of the region and absence of any pathological signs.



absence of mobility and pain were evident clinically and radiographically. TMJ function was clinically checked and no pathological post traumatic symptoms including swelling in the pre auricular area, tenderness, pain in function, limited mouth opening or deviation of the mandible were observed. Clinical and radiographic follow-up 4 weeks later showed no pathological signs and symptoms, absence of mobility, normal occlusion, no crown discoloration and no signs of apical pathology, external inflammatory root resorption or root canal obliteration of the traumatized primary teeth. Vitality tests including electric and thermal pulp tests were not performed, as they usually present invalid and inconsistent results in primary teeth.[16] The patient was scheduled for further clinical and radiographic monitoring in a year post traumatically and then each subsequent year until eruption of the permanent successors.[12]

DISCUSSION

The protective anatomic facial features of children decrease the incidence of paediatric maxillofacial fractures compared to those observed in adults and adolescents.[10,17,18] However, alveolar fractures may consist 32% of all childhood facial fractures, at later ages.[17] From the above data, it is clear that this particular fracture pattern is not uncommon and clinicians should be aware of its proper management.

Treatment of alveolar fractures includes reduction and immobilization using splinting for a period of 3-4 weeks.[1] In addition and following any segmental fracture manipulation, associated soft tissue lacerations should be sutured to enhance healing.[1,12,13,19] In the present case, reposition and splinting of the alveolar fracture for 4 weeks were performed, while no soft tissue lacerations were present.

Concerning the splinting procedure, several methods have been proposed. The suture splint,[19] the arch bar splint,[20] the orthodontic appliances,[21,22] the wire-composite splint,[22,23,24] the resin splint and the prefabricated metal splinting materials[22,23,25] are the most common splinting methods used in the clinical practice. According to Andreassen[1] an optimal splint should fulfill most or all of the following requirements: direct intraoral application, easy construction with materials available in dental practice, no increase of periodontal injuries or promotion of caries, no irritation of oral soft tissues, passive, versatile in achieving rigid, semi-rigid or flexible splint, easy to remove with no damage to the dentition, ability for pulp testing and endodontic treatment, hygienic and esthetic.

The properties of various suitable splinting materials are compared in Table 1. Taking into consideration the demands of modern dental splinting and the advantages and disadvantages of the different splinting types presented in the Table, the most suitable splints seem to be the resin, wire-composite and titanium trauma splints (TTS), all of which fulfill the above mentioned properties.[1]

In the present case none of the above mentioned regular splinting methods could have been used because of the patient's overbite, since upper primary incisors covered totally the crown of lower primary incisors resulting to inability of any labial splinting placement.

In the literature, there are few studies suggesting alternative splinting methods for the non-surgical fixation. The placement of a modified orthodontic splint appliance consisting of second molar bands soldered to rounded stainless steel lingual and buccal arch wires with small cross-arch wires was proposed for the fixation of a parasymphyseal fracture in a 5-year-old boy.[26] Stabilization of mandibular fractures with splints made from dual laminate material or thermoplastic sheet with or without orthodontic elastics guide have been also referred.[27,28,29] The use of a similar to the present case cap splint, but made of polycarboxylate and polyacrylic, has been previously proposed in few studies, especially in cases where initial reposition and splinting are not considered optimal, resulting to occlusal trauma.[30,31,32,33] In some of these cases, the retention of the splint with interdental or circum mandibular wiring is suggested although this appears traumatic in young children.[32,33] Cementation of these cap splints is made only on non-traumatized teeth, avoiding damage to the traumatized ones, when the splint is removed.[30,34]

In the present case, the cap splint was made by ethylene vinyl acetate (EVA) copolymer. This material appears suitable for fabrication of splints because of its excellent mechanical behavior, easy acquisition and handling, low cost, conformability at low temperatures and satisfactory results under compressive and shear forces.[35,36] Its elastomeric softness and flexibility provides great protection potential while the shock-absorbing capacity ensures low transmission of energy to the teeth, meaning less risk of further injury in case of repeated trauma.[35] In a recent study, Verissimo *et al* [37] demonstrated that the EVA material, during an impact with a rigid object, absorbed most of the impact deformation allowing the decrease of the stress and strain on the tooth structure. Finally, the many color

Table 1: Comparison of properties of different types of splints (modified from Andreasen *et al*, 2007 [1]).

Type Of Splint	Accuracy Of Reposition	Easily Discolored	Flexibility	Rigidity	Easily Fractured	Easy To Construct	Suitability After Dental Trauma
Suture splint	+		+	-	+	+	±
Arch bar splint	-	-	-	+	-	-	-
Orthodontic appliances	+	+	+	+	-	+	+
Flexible wire-composite splint	+	±	+	-	-	+	+
Rigid wire-composite splint	+	±	-	+	-	+	±
Resin splint	+	±	+	-	±	+	+
TTS splint	±	±	+	±	-	±	+

Plus (+) illustrates that the feature is strongly related, plus-minus (±) that the feature is slightly related and minus (−) that the feature is not related to the splint concerned.

variations of EVA, also contribute to its popularity, especially in children.[38] The above mentioned properties are the advantages of EVA copolymer when compared to other alternative cap splinting materials, fulfilling many of the requirements of the optimal splint.[1] Although a disadvantage might be the inability of the patient to follow suitable oral hygiene, in the present case no gingivitis or excess accumulation of plaque and debris were observed as a result of the proper splint fabrication and the careful oral hygiene followed by the child and the parents.

CONCLUSIONS

The presented EVA vacuum-formed method of splinting mandibular alveolar fractures in the primary dentition phase appears to be a valuable simple clinical tool for paediatric dentists. It is easily accepted by children in specific circumstances where the regular splinting methods cannot be used.

Conflict of interest and ethical standards

All authors declare that there is no conflict of interest. Also the patient presented in the case was informed and her parents have given their informed consent prior to the inclusion in the study.

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