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Dental Trauma: Restorative Procedures Using Composite Resin and Mouthguards for Prevention

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Abstract

Aim: The aim of this article is to describe a step-by-step protocol for emergency care of a patient with a dentoalveolar injury in the anterior region of the mouth as well as the fabrication of a mouthguard to prevent future trauma.

Background: Dental trauma is one of the most serious oral health problems in active children and adolescents. Care of traumatized patients requires immediate initial emergency treatment followed by integrated procedures to restore damaged oral structures along with a subsequent trauma prevention strategy. Dentoalveolar injuries in the anterior region of the mouth are often characterized by tooth avulsion and coronal fracture. They are managed using procedures such as dental splinting, endodontic therapy with its unique characteristics, and restorative techniques to re-establish function and esthetics as well as protective mouthguards.

Report: A 16-year-old male presented with avulsion of his maxillary central incisors as a result of a direct, unintentional impact with an opponent during a basketball game. The teeth had been stored in physiological serum immediately following the injury and the patient received immediate care. On clinical examination, the right central incisor was fractured at the incisal third of the crown but no bone fractures were found. The teeth were reimplanted and splinted. The fractured right central incisor was restored following endodontic treatment and a mouthguard was fabricated for the patient.

Summary: The dentist must be knowledgeable about the most efficient and suitable treatment for each traumatic scenario in order to provide appropriate care for dental injuries. Coordinated multi-disciplinary action is fundamental in the successful treatment of these injuries. The dental mouthguard is an effective device

for protecting the teeth and supportive structures during physical activities and must be part of the protective equipment used by athletes. It is the responsibility of the dental professional to make parents, trainers, and athletic associations aware of the risks associated with physical activities without orofacial protection; this should encourage the proper use of all protective devices to prevent dentoalveolar injuries that compromise oral functions, esthetics, and increase the cost of healthcare.

Keywords: Tooth avulsion, orofacial injuries, dentoalveolar injuries, tooth re-implantation, composite resin, mouthguard

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Introduction

At present, contact sports are encouraged and practiced by teenagers and young children and is one of the most prevalent factors related to dentoalveolar injuries.[1] Tooth avulsion, characterized by the complete displacement of a tooth from its alveolus, occurs with a frequency of 1 to 16% of the injuries to permanent teeth. The first treatment option for avulsion has been re-implanting, but retaining the tooth in the alveolus is dependant on several factors, especially in procedures carried out immediately prior to reimplantation.[2,3]

Time is the most critical factor in the success of tooth re-implantation with 20 minutes following tooth avulsion being the most promising time limit to re-implant a tooth.[4] When immediate re-implantation is not possible, the avulsed tooth must be stored in a humid storage media until the re-implant can be done.[5] Water and saliva modify the structure of fibroblasts along the root surface and are not advisable for use as storage media, although it is preferable to keep the tooth in water or saliva than allow it to dry out.[3]

Physiological serum is a suitable storage media for short-term preservation for it maintains fibroblast vitality for up to two or three hours due to its osmolarity and sterility.[3] Milk, despite the high level of lipids, is a good alternative storage media due to its pH, osmolarity, and its low bacterial count.[6] As a practical matter, milk has become the most common storage media because of its widespread availability and the difficulty obtaining alternative media when an unexpected tooth avulsion occurs.

Semi-rigid dental splinting following re-implantation of an avulsed tooth is commonly used to maintain its proper anatomical position without occlusal interference. This splinting technique allows physiological tooth movement, thus, preventing points of ankylosis from becoming permanent. There are clinical indications that semi-rigid dental splinting for 15 days is sufficient.[7] Shinohara et al.[8] using a mandibular incisor of a laboratory rat, demonstrated the mechanical properties of a healing periodontal ligament were gradually restored from seven to 21 days after re-implantation.

Timing of endodontic treatment of avulsed teeth remains controversial. Pre-treatment of an avulsed tooth endodontically prior to re-implantation imposes an undesirable increase in the extra-alveolar exposure of the tooth to the elements. On the other hand, when calcium hydroxide paste is used, performing endodontic treatment immediately after re-implantation presents a potential risk. In such cases the paste can escape from the pulp canal and cause further injury to the already damaged periapical structures. The period between the second and fifteenth day following implantation seems to be suitable for beginning the first stage of endodontic treatment. This stage involves the removal of the necrotic pulp and filling the root canal with calcium hydroxide to limit inflammatory resorption for a period of six months.[9] Postoperative control of the patient is indispensable and should include clinical and radiographic evaluations every 30 days. If after 180 days there are no radiographic

signs of resorption, the root canal must be obturated.[9]

In terms of the prevention of dentoalveolar injuries the widespread use of mouthguards is an important safety device that should be used in contact sports. The mouthguard acts to redistribute direct forces on the jaws preventing violent contact between the mandibular and maxillary teeth during an impact to the mandible. Mouthguards also protect the lips and cheeks from bruising and laceration by the teeth during a facial impact.[10]

The aim of this article is describe a step-by-step protocol for emergency care of a patient with a dentoalveolar injury in the anterior region of the mouth as well for the fabrication of a mouthguard to prevent future trauma.

Case Report

Initial Evaluation and Emergency Treatment

A 16-year-old male presented at the emergency clinic at the Federal University of Uberlândia in Uberlândia MG, Brazil with avulsion of his maxillary central incisors as a result of a direct, unintentional impact with an opponent during a basketball game. The teeth had been stored in physiological serum immediately following the injury, and the patient was brought to the clinic where he received immediate attention. On clinical examination, the right central incisor was fractured at the incisal third of the crown but no broken bones were found. Blood clots were removed by from the alveoli followed by irrigation with physiological serum.[4]

After the maxillary central incisors had been carefully cleaned, they were reimplanted with gentle digital pressure and then a semi-rigid dental splint was applied to the teeth from right canine to the left canine. The splint was fabricated using nylon wire and composite resin and positioned to keep the avulsed teeth in position without occlusal interference and to allow physiological movement (Figures 1 and 2). Dental splinting was maintained for 15 days and then removed with care.

In the meantime, endodontic treatment was started on the seventh day after reimplantation. After coronal opening, the necrotic pulp was removed, the root canal instrumented (Figure 3), and filled with calcium hydroxide (Figure 4). The patient was then evaluated every 30 days for six months.

Restorative Treatment

The fractured right maxillary central incisor (Figure 5) was then restored with composite resin under rubber dam isolation to prevent contamination with saliva or other oral fluids that could jeopardize adhesion of the restorative material.[11] After splint removal, a bevel was placed on the labial surface (Figure 6) then

Figure 1. Vestibular view of the semi-rigid dental splint and the fracture of the right upper central incisor.

Figure 2. Palatal view of the semi-rigid dental splint.

Figure 3. Instrumentation of the maxillary central incisors.

Figure 4. Filling the root canals with calcium hydroxide paste.

Figure 5. Removal of the semi-rigid dental splint verifying the location the fracture margin of the maxillary right central incisor.

Figure 6. Bevel placement along the labial margin.

Figure 7. Acid etching with 37% phosphoric acid on enamel and dentin.

Figure 8. Reconstruction of the palatal surface with a translucent microhybrid resin.

Figure 9. Making dentin growth lobes with a cloudy shade of resin.

the fractured area was acid-etched with 37% phosphoric acid for 15 seconds on both the enamel and dentin[12] (Figure 7). The area was then rinsed with water for 15 seconds and gently dried with absorbent paper, taking care not to dehydrate the dentin.[13]"

The first layer of Single Bond® adhesive system (3M-ESPE, St. Paul, MN, USA) was applied; after waiting 20 seconds for the solvent to vaporize, another layer was applied and light cured for 20 seconds. Filtek Z250 microhybrid composite resin (3M-ESPE, St. Paul, MN, USA) was inserted in small increments in an effort to minimize shrinkage stress as a result of polymerization.[14] A translucent microhybrid resin was used for the reconstruction of the palatal surface with the addition of posterior lobes using a cloudy shade of the resin followed by placement of a translucent resin layer on the facial surface (Figures 8, 9, and 10).[12]

After removing the rubber dam isolation, an occlusal evaluation was performed to check for any contacts in the maximum habitual intercuspation of the anterior teeth and during protrusion movement. The anterior contacts during anterior guidance were distributed to avoid

Figure 10. The final layer of translucent resin placed on the labial surface.

Figure 11. Esthetic and functional re-establishment of anterior teeth.

Figure 12. Patient's smile after integrated treatment was completed.

Figure 13. Cast positioned on the platform of a vacuum plasticizer with a sheet of heated silicone sagging from the heating element above.

overloading the restored teeth. The occlusal interferences during excursive movements were removed to allow free mandibular movement. After 24 hours, the finishing and burnishing of the restoration was done using aluminum oxide discs and silicone tips to create a natural appearance of the restored tooth which added to the patient's comfort and satisfaction (Figures 11 and 12).

Mouthguard Fabrication

The patient was psychologically insecure at this time due to his injury. To finalize integrated care, a mouthguard was made to protect the athletic patient from future dentoaveolar injury and to enhance his performance through self-confidence. An ideal mouthguard must have the characteristics listed in Table 1.

Fabrication of the mouthguard involved making a working cast with gypsum type IV from an alginate impression. Holes were made through the central region of the cast to improve the vacuum of the plasticizer during the adaptation of the warm mouthguard material to the cast. This also enabled the mouthguard to be shaped in a horseshoe form. The work area was delimited in compliance with the norms of the "American Society for Testing and Materials." This prepared cast was then placed on a vacuum plasticizer platform with a sheet silicone mouthguard material heated until it sags and vacuum adapted to the cast (Figure 13).[15,16,17]

The vacuum adapted material and cast were removed and the excess material removed with shears. Finishing and burnishing of the periphery of the mouthguard was done by using a mounted aluminum oxide stone for initial shaping followed by rounding the edges with a Hanau torch. The mouthguard comfort and fit was evaluated on the plaster model and then intraorally by the patient (Figures 14 and 15).

Summary

The dentist must be knowledgeable about effective clinical techniques in order to appropriately guide an athlete about the most efficient and suitable treatment for each type of dentoalveolar injury. Coordinated and multi-disciplinary action is fundamental to achieve successful treatment. The dental mouthguard is an effective device for protecting the teeth and

Table 1. Characteristics of a favorable mouthguard.[15,16]

A favorable mouthguard must
1. Be odorless
2. Not cause pain
3. Be comfortable
4. Be of resistant but flexible material
5. Be 3-4 mm thick on the facial, 2 mm on the palatal, and 3 mm thick on the occlusal aspect
6. Finish 3 mm beyond the limits of the facial marginal gingiva and 10 mm beyond the palatal marginal gingiva
7. Not interfere with speaking and breathing
8. Be retentive and stabile

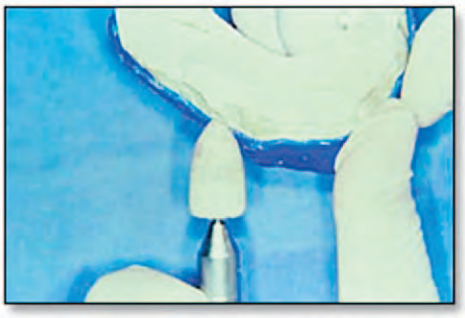

Figure 14. Initial finishing of the periphery of the mouthguard with a mounted aluminum oxide stone.

Figure 15. Evaluation of the mouthguard in the oral cavity.

supportive structures during physical activities and must be part of the protective equipment used by athletes. It is the responsibility of the dental professional to make parents, trainers, and athletic associations aware of the risks associated with physical activities without orofacial protection. They should encourage the proper use of all protective devices to prevent dentoalveolar injuries that compromise oral functions, esthetics, and increase the cost of healthcare.

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