



## Tooth Avulsion- A Dental Emergency

### KEYWORDS

Tooth avulsion, trauma, emergency

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**ABSTRACT** Traumatic dental injuries occur very frequently in children and adults due to various etiological factors such as fall, accidents, sports injuries etc. Tooth avulsion comprises around 1-16% of these injuries. It is one of the few emergencies in dentistry. The success of treatment depends on the viability of periodontal ligament cells on the root surfaces of the tooth. This decreases with the increase in duration of extraoral time. The storage medium for the avulsed tooth is a prime factor affecting prognosis. Proper diagnosis and treatment planning helps in a favourable outcome. This article reviews tooth avulsion as an emergency, the various storage media available and the guidelines for management of avulsed tooth in the dental office.

dental injuries (TDIs) pose a public dental health problem. These injuries tend to occur at an early age and the treatment continues for a long duration. Their prevalence in permanent dentition is around 33% for adults and 25% for children.<sup>1</sup> The most serious is the avulsion of permanent teeth, seen frequently in seven to ten years age group. The periodontal ligament (PDL) being loosely structured around the erupting tooth at this time provides minimal resistance to an extrusive force.<sup>2,3</sup> A favourable prognosis depends on emergency intervention at the site of accident or the time immediately following avulsion.<sup>4,5</sup>

### Consequences of tooth avulsion

Avulsion of permanent teeth is one of the few emergency situations in dentistry.<sup>6</sup> It involves separation of the tooth from the socket resulting in attachment damage.<sup>7</sup> Replantation of a necrotic periodontal ligament will produce a severe inflammatory reaction. In certain areas bone gets directly attached to the root surface. This is called replacement resorption or osseous replacement.<sup>8</sup> This process is usually progressive and irreversible in nature concluding in ankylosis.<sup>7</sup>

In an avulsed tooth, along with trauma to periodontal ligament cemental damage and pulp necrosis occur.<sup>9</sup> If revascularisation or endodontic therapy is not carried out the necrosed pulp is extremely susceptible to bacterial contamination.<sup>10</sup> The bacteria evoke an inflammatory reaction in the PDL causing bone and root substance destruction. This whole chain of events is called inflammatory root resorption.<sup>11,12</sup>

Thus the treatment objectives are directed towards limiting the resultant inflammation post avulsion. The maintenance of normal PDL cell physiology and morphology is of prime concern.

### Awareness

The incidence of dental trauma cases has increased in the last few decades, especially in the anterior teeth of children and adolescents.<sup>13</sup> Since the outcome of these injuries depends on early intervention, the establishment of emergency dental services in all geographical regions should be undertaken, ideally, providing 24-hour services. The dental clinics can minister treatment during office hours.<sup>14</sup> Around 60% of cases involving tooth avulsion occur close to home or school.<sup>15</sup> Awareness regarding first aid of tooth avulsion should be given as an educational offering to parents, teachers and school nurses and also through mass media campaigns.<sup>5,6</sup> Commu-

nities should be motivated to include Hanks Balanced Salt Solution (HBSS) as part of first aid kits

### Storage media for avulsed teeth

The ideal storage medium should be able to maintain the periodontal ligament cells so they can undergo mitosis to form clones of damaged fibroblasts of PDL which will cover the damaged surfaces of the root. The medium should also preserve the functional capacities of PDL cells.<sup>16,17,18,19</sup> Numerous media have been investigated for storing avulsed teeth.

Tap water is the least desirable because it has a very low pH and osmolality. The periodontal ligament cells will burst and die in the hypotonic environment.<sup>20</sup> The patient can place the avulsed tooth under the tongue or in buccal mucosa, making saliva as the transport media. The osmolality of saliva (17mOsm) is much lower than physiological (60-70mOsm) thus causing cell lysis due to hypotonicity. In addition, it is laden with micro-organisms which can infect the root and cause necrosis. It is used for short duration, around an hour, as a longer duration can damage the PDL cells.<sup>21,22,23,24</sup>

Though physiologic saline solutions have osmolality (280mOsm) compatible with PDL cells, they lack the essential nutrients required by the PDL cells for their metabolic function.<sup>20,25,26</sup>

Milk has been indicated by the American Association of Endodontists as the second best solution for transport of avulsed teeth after HBSS.<sup>26</sup> According to literature it had the following benefits: (I) The physiological properties like pH (6.5-6.8) and osmolality (250mOsm) are compatible with PDL cells;<sup>19</sup> (II) the presence of nutrients like amino acids, carbohydrates, vitamins and growth factors;<sup>19,21</sup> (III) Pasteurisation makes it free of bacteria.<sup>21</sup> In addition, milk has a short supportive time of only 1-3 hours.<sup>19</sup>

Hank's Balanced Salt Solution (HBSS) is a standard saline solution used to support the growth of many cell types in research.<sup>27,28</sup> It contains metabolites necessary to maintain normal metabolism of cells.<sup>20</sup> HBSS is pH balanced (7.2), has an osmolality of 320mOsm/kg which provides an ideal osmotic pressure for PDL cells, biocompatible and is non-toxic in nature.<sup>18,26,27</sup> It is available in a container-Emergency Tooth Preserving System (ETPS), invented by Paul Krasner, which serves as both an optimal storage and transport media.

### First aid for avulsion

A positive prognosis is almost assured when the tooth is replanted within the first five minutes.<sup>29</sup> Replantation at the accident site requires personnel with some knowledge of treatment protocol. Information can also be given over the phone by the dentist.<sup>2</sup> The avulsed tooth should be held gently and not by the root but by the crown. The tooth should be briefly washed for around ten seconds if it is dirty and then repositioned in the socket.<sup>30</sup> The root surface should never be scrubbed. If this is not possible or there is doubt, avulsed tooth should be placed in a suitable storage medium and the patient should immediately sought dental treatment. The media suggested in order of preference and availability are milk, saliva, physiologic saline with water being the least desirable.<sup>31</sup>

### Management in dental office

#### Emergency visit:

#### Diagnosis and treatment planning

The position of an already replanted tooth should be assessed and a complete history taken to assess the outcome.

If the tooth is outside the mouth, the storage medium should be evaluated.

#### Clinical examination

A thorough clinical examination of the socket and the surrounding soft tissues is done. Alveolar fractures can be suspected if there is movement of multiple teeth together or a segment of bone. Radiographs should be taken in three vertical angulations to ascertain horizontal root fracture in adjacent teeth. Remaining teeth should be examined and soft tissue lacerations noted.<sup>13</sup>

#### Preparation of root

It depends on the maturity of the root and the dry time of the tooth before it was placed in storage medium. The point where the chances of survival of PDL cells become remote is considered to be 60 minutes.<sup>32,33</sup>

#### Tooth with a closed apex

##### a) Tooth has already been replanted prior to coming to the dental office

The area is cleaned using water, saline or chlorhexidine and normal position of tooth verified both clinically and radiographically. Endodontic treatment is initiated 7-10 days after replantation and calcium hydroxide to be used as an intracanal medicament until obturation.<sup>6</sup>

##### b) Tooth with extraoral dry time of less than 60 min

root should be cleaned with a stream of saline and placed in the socket gently. 15-20 min is considered the optimal time upto which the viability of PDL cells remains high.<sup>33,34</sup>

Endodontic treatment is initiated at the second visit which is 7-10 days after the emergency visit.<sup>35</sup> Calcium hydroxide is considered the drug of choice in preventing and treating inflammatory root resorption.

##### b) Extraoral dry time longer than 60 min

The periodontal ligament is not expected to survive and the root is prepared to be as resistant to resorption as possible. The tooth is soaked in acid for 5 min to remove all necrotic tissue including the PDL to prevent the initiation of inflammatory response.

It is then placed in 2% sodium fluoride for 20 min and replanted.<sup>36,37</sup>

Endodontic treatment can be performed extraorally prior to replantation or 7-10 days later as in other cases.

#### Tooth with an open apex

##### a) Tooth has already been replanted in the mouth before reaching the dental clinic

Wash the area with saline, water or chlorhexidine, do not extract the tooth and verify the position.<sup>6</sup>

##### b) Extraoral dry time is less than 60 min

The tooth is replanted with the goal of revascularisation of the tooth pulp. The tooth is cleaned with a stream of saline and soaked in doxycycline for 5min or covered with minocycline hydrochloride crystals. The tooth is treated similar as a closed apex tooth ,i.e, it is gently rinsed and replanted. In these patients, endodontic treatment is not initiated until signs of pathosis occur. The patient is recalled every 3-4 weeks for vitality testing to check for revascularisation.<sup>38,39</sup>

##### c) Extraoral dry time more than 60 min

The periodontal ligament becomes necrotic and healing is not expected to occur. Replacement resorption will ensue progressively leading to ankylosis of the tooth. The International Association of Dental Traumatology recommends that avulsed teeth be replanted, in children as well.<sup>6</sup> There are several advantages to this approach.

Post avulsion a coordinated treatment plan involving specialists from different fields of pedodontia, prosthodontics, endodontics, orthodontics and oral surgery should be initiated for comprehensive evaluation. This is not feasible during emergency treatment. Replantation allows interdisciplinary consultation and the formulation of a definite treatment plan.

Replanting the tooth can alleviate the embarrassment faced by the patient.<sup>40</sup>

Another aim of doing delayed replantation in immature teeth is to maintain alveolar ridge contour. Once the tooth is replanted, apexification procedure is started at the second visit.

A procedure was described by Malmgren in 1984 which was a conservative approach towards the management of ankylosed teeth and attempted to preserve the surrounding alveolar bone. This method was called 'decoronation'. It involved the subcrestal removal of tooth crown. The root will resorb gradually while vertical bone growth occurs simultaneously, coronal to it. The existing bone volume is maintained avoiding the need for future ridge augmentation procedures. Malmgren recommended decoronation to be done in patients where the severity of infra-occlusion was moderate or is an index score of two ( $\geq 1/8$  but  $< 1/4$  of crown height of neighbouring tooth) or more.<sup>41,42</sup>

Dental implants are only considered after the patient had completed skeletal growth.

#### Preparation of socket

The socket should be cleaned and free of obstacles before replantation is done. A blunt instrument is used to reposition a collapsed socket wall.

#### Splinting

The splinting should be functional that allows physiologic movement of teeth. It is recommended for 7-10 days. However in cases of avulsion occurring in association with alveolar fractures, it is done for 4-8 weeks.<sup>35</sup>

#### Management of soft tissues

Soft tissue lacerations are sutured and the assistance of a plastic surgeon might be prudent in areas of aesthetic importance like the lips.

#### Adjunctive therapy

Pharmacologic treatment: It is recommended to prescribe antibiotic therapy to

prevent the occurrence of infection and root resorption in the

first week after replantation. The antibiotic of choice is doxycycline given twice daily for seven days. In children under 12 years of age, penicillin V(500 mg, four times daily for seven days) can be prescribed.<sup>43,44</sup>

**Tetanus:** If the tooth has contacted soil, the patient should be referred to a physician regarding tetanus booster.

**Diet:** The patient should be advised to take soft diet for two weeks.

**Oral hygiene:** Patient is advised to brush after every meal and rinse with chlorhexidine mouthwash twice daily for one week.<sup>6</sup>

#### Obturation visit

If endodontic therapy is initiated 7-10 days after avulsion, obturation can be done if

there are no clinical or radiographic signs of pathology. If, however, it was started after 7-10 days obturation is done when intact lamina dura is seen on radiographs.

#### Follow-up care

The tooth should be evaluated at three months, six months and yearly for the next five years.

#### Conclusion

The treatment objectives of avulsion focus primarily on the prevention of ankylosis and inflammatory resorption of the tooth after replantation. This is only possible if the vitality of periodontal membrane is maintained and pulp is protected from bacterial invasion. All efforts should be made by the personnel involved towards immediate replantation as the PDL starts degenerating after 15-20min of extra-oral dry time. Replantation of teeth of teeth is advised even in circumstances of assured replacement resorption taking place. The benefits far outweigh the drawbacks. Also, the chances of resorption having an agreeable outcome cannot be ruled out.

Increasing awareness about tooth avulsion amongst parents and teachers and at community level can lead to better emergency management and a favourable prognosis.

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