DENTAL AVULSION

Dr. Uzma Zubair, Dr. Puja Bansal, Dr. Deepak Bhargava

1Intern, 2Professor & PhD Scholar, 3Professor & HOD
1,2,3School of Dental Sciences, Sharda University, Greater Noida, Uttar Pradesh, India.

Corresponding Autor: Dr. Puja Bansal

ABSTRACT: Dentoalveolar traumatic injuries occur due to external impacts on the teeth, gingiva, and alveolar bone. These injuries can vary from simple tooth contusion to complete dislocation of the tooth, also known as tooth avulsion. Tooth avulsion is a time-dependent emergency that poses a threat to the survival of the affected tooth. These injuries are commonly seen in both children and adults, often occurring during play or accidents. The success of treatment depends on the viability of periodontal ligament cells, the condition of the root surface of the tooth, and the choice of storage medium for the avulsed tooth. The storage medium plays a crucial role as a prime prognostic factor. Unfavorable outcomes are often observed after replantation of avulsed teeth, primarily due to damage to the delicate periodontal ligament. To improve treatment outcomes, stem cell-based regenerative medicine has emerged as a promising clinical approach. Prognosis typically depends on several factors, including the timing and location of the accident, the choice of storage medium for the avulsed tooth, and the treatment provided after the accident. Prompt and appropriate management of dental traumatic injuries is essential to enhance the chances of successful treatment and minimize long-term complications.

INTRODUCTION

An avulsion is considered one of the critical injuries to a tooth, involving the complete dislodgement of a tooth from its socket. The peak age for avulsion ranges from 6-9 years, and it often involves the maxillary anterior teeth [1]. Injuries leading to avulsion are commonly caused by falls during sporting activities or accidents [2]. The avulsion injury results in damage to the periodontal ligament, cementum, alveolar bone, and neurovascular bundle. Certain anatomical factors may increase the chances of avulsion, such as protruded maxillary anterior teeth, class 2 malocclusion, incompetent lips, and overjet. According to Anderson et al., erupting teeth with incompletely formed short roots and loose periodontal ligament are more susceptible to avulsion [3]. The treatment of avulsed teeth is complex and requires timely management. Replantation is a common choice for treatment, and time management plays a crucial role. The main challenge is to maintain the vitality of periodontal cells, which can be achieved using physiologic storage media like milk or saliva until professional help is obtained [1]. Avulsion is the most damaging injury to the periodontal ligament, and the critical factor determining a better prognosis is the timing of reimplantation. In some cases, reimplantation may not be indicated due to factors like periodontal disease, extensive caries, immunosuppression, severe cardiac conditions, or an uncooperative patient [4]. Newer techniques, such as anti-resorption therapy, which prevents inflammation after reimplantation, are being used along with antibiotics. Follow-up appointments are necessary to assess the clinical and radiographic vitality of the tooth and check for ankylosis [5]. Stem cell-mediated regeneration therapy has shown promise in potentially lowering the incidence of resorption after reimplantation, especially when the extra-oral dry time is extended. Agents like antibiotics, corticosteroids, and enamel matrix proteins have been observed to improve cellular viability and decrease inflammation in such cases [6].

MANAGEMENT

Storage Media

Storage media for the avulsed teeth is generally classified as laboratory prepared and natural source shown in table 1 [3].

<table>
<thead>
<tr>
<th>STORAGE MEDIA PREPARED IN LABORATORY</th>
<th>STORAGE MEDIA OBTAINED FROM NATURAL SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORMAL SALINE</td>
<td>MILK</td>
</tr>
<tr>
<td>EAGLE’S MEDIA</td>
<td>HONEY MILK</td>
</tr>
<tr>
<td>DUBELECO’S STORAGE</td>
<td>EGG WHITE</td>
</tr>
<tr>
<td>ASCORBIC ACID</td>
<td>SALIVA</td>
</tr>
<tr>
<td>HANK’S BALANCED SALT SOLUTION</td>
<td>COCONUT WATER</td>
</tr>
<tr>
<td>CATALASE SUPPLEMENT</td>
<td>MORUS RUBRA</td>
</tr>
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A single product or solution doesn’t possess all the characteristics that are indicated as the ideal medium for the storage of avulsed teeth, preserving the vitality of pulp cells and periodontal ligament while presenting antioxidant properties, colonogenic capacity, compatible pH, high availability, and easy accessibility. The International Association of Dental Traumatology and the American
Academy of Pediatric Dentistry indicate milk as the best storage medium for avulsed teeth due to its compatible pH and osmolarity, little or no bacterial content, and easy availability [1]. Ideal requirements of storage medium [2]:

- Should possess antimicrobial properties.
- Should not react with body fluids.
- Good shelf life.
- Should have the same osmolarity as that of body fluids.
- Should have a balanced pH (7.2-7.4).
- Should wash out toxic waste products.
- Should maintain viability of periodontal fibers for an acceptable period of time.

The American dental association has segregated the management of avulsed tooth in a dental clinic into three categories [7]:

1. Firstly, reimplantation of tooth into socket.
2. Secondly subsequent appointment involving radiographical and clinical assessment.
3. Lastly root canal treatment if indicated.

FIRST AID FOR AVULSED TOOTH

Replantation of the tooth within the first five minutes will almost always show a positive prognosis [2].

- The avulsed tooth should be held gently only by the crown and not by the root.
- Firstly, wash the tooth briefly for approximately 10 seconds if it's dirty, and then place it in the socket. In case the tooth is not placed in the socket, make sure it is stored in a suitable storage medium according to preference or availability.
- Encourage the patient, teacher, or others to reimplant a tooth at the site of the accident [8].
- Once the tooth has returned to its original position, the patient should bite on gauze, handkerchief, or cloth to maintain its position [4].
- In case the tooth is not placed in the socket, make sure it is stored in a suitable storage medium according to preference or availability. Once the tooth is placed in the storage medium, it should be brought to the dental clinic immediately [9].

Immediate and proper handling of the avulsed tooth is critical for the best chances of successful reimplantation and long-term prognosis [4].

Treatment Guidelines for Avulsed Tooth:
The treatment of the avulsed tooth depends on the maturity of the root (closed or open apex) and the viability of the periodontal ligament (PDL) cells. The state of PDL cells is influenced by the storage media where the avulsed tooth was kept and the duration the tooth was outside of the mouth. Minimizing the dry time is crucial for the survival of these cells. If the extraoral dry time exceeds 30 minutes, most PDL cells become non-viable. This underscores the significance of having accurate information regarding the dry time of the tooth before reimplantation and before placing it in a storage medium. Proper management and timely treatment are essential to improve the chances of successful replantation and long-term tooth survival [4].

Guidelines For The Clinician:
Guidelines consists of the recommendation for the treatment and diagnosis of traumatic dental injuries which consist of [8]:

- Clinical examination.
- Radiographic examination.
  - 90 degree horizontal angle with dental beam through the tooth.
  - Occlusal view.
  - Lateral view from mesial and distal aspect.
- Sensibility test refers to, electric pulp test and cold test which is used to determine the vitality of tooth pulp.

Management In a Dental Office for Avulsed Tooth [2]:

- The position of the reimplanted tooth should be checked, and a proper history should be taken to assess the outcome. If the tooth is placed in a storage medium, the storage medium should be properly evaluated.
- A proper clinical examination of the surrounding tissues, including the socket, should be done. A radiograph should be taken to rule out any fracture of the alveolar bone. The fracture of the alveolar bone can be suspected if there is movement of multiple teeth. To confirm horizontal root fractures, radiographs should be taken from three vertical angulations. Soft tissue lacerations should also be noted.
- Preparation of the root depends on how mature the root is and on the dry time before the tooth is placed in the storage medium.

Tooth With Closed Apex:
If the tooth has been reimplanted before coming to the dentist, the area should be properly cleaned using saline, water, or chlorhexidine. Within 7-10 days after reimplantation, endodontic treatment should be started, and calcium hydroxide should be used as an intracanal medicament until obturation is done [2][4].

- In case the extra oral dry time of the tooth is less than 60 minutes Clean the tooth surface with saline to remove gross debris. In case any debris is present, remove it by agitating in a storage medium [9].
• Keep the tooth in storage media while taking history and doing complete examination and preparation of the patient for reimplantation procedure.
• Administration of local anaesthesia is done and irrigates the socket with saline. The viability of pdl cells remains high up to 15-20 minutes [4].
• Examine the socket properly to rule out fracture in case the socket wall is fractured and reposition the fragment into its original position [9].
• Replant the tooth slowly by applying light pressure.
• Verify the position of the tooth clinically and radiographically.
• Stabilise the tooth for 2 weeks using a flexible wire of diameter 0.0016.
• In case of gingival laceration suturing is done [10].
• Root canal treatment is done after 2 weeks.
• Antibiotics are prescribed.
• Follow up [9].

The viability of periodontal ligament (PDL) cells remains high up to 15-20 minutes after avulsion. On the second visit, after 7-10 days, the endodontic procedure must be carried out [10]. When the extraoral dry time exceeds 60 minutes, the periodontal ligament is unlikely to survive, and the root is more susceptible to resorption [4]. To prevent an inflammatory response and removal of the necrotic tissue and PDL, the tooth is soaked properly in acid for around 5 minutes, and then it's placed in 2% sodium fluoride for 20 minutes before reimplantation [11]. In this case, the endodontic procedure can be carried out extraorally before reimplantation or after 7-10 days, similar to other cases. However, it is essential to note that delayed reimplantation leads to a poor prognosis, as the PDL is not expected to regenerate and becomes necrotic. Despite the extraoral dry time exceeding 60 minutes, reimplantation should still be carried out to restore at least temporary function and aesthetics. The main goal in such cases is to salvage the tooth and provide some functional and aesthetic benefits to the patient, even though the long-term prognosis may be compromised [4].

**Tooth With Open Apex:**
If the tooth has been re-implanted before reaching the dentist, do not remove the tooth from the socket. Instead, properly clean the surrounding area and verify the position of the tooth with the help of a radiograph. If the extra-oral dry time is more than 60 minutes, the periodontal ligament is most likely necrotic, and healing is not expected to be successful in most cases. In such situations, the prognosis for the tooth's survival and reattachment is significantly reduced, and the focus should shift towards other treatment options, such as dental implant placement or prosthetic solutions. It is still important to seek immediate dental attention to assess the situation and explore the best course of action for the affected tooth [2].
• Clean the tooth surface with saline to remove gross debris. In case if any debris is present remove it by agitating in storage medium [9].
• Keep the tooth in storage media while taking history and doing complete examination and preparation of patient for reimplantation procedure [2].
• Administration of local anaesthesia is done and irrigate the socket with saline. The viability of pdl cells remain high up to 15-20 minutes.
• Examine the socket properly to rule out fracture in case the socket wall is fractured and reposition the fragment into its original position.
• Replant the tooth slowly by applying light pressure [4].
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For extraoral dry time less than 60 minutes, the primary goal is the revascularization of the pulp. The tooth is properly cleaned with saline and completely soaked in doxycycline for around 5 minutes. Then, it is reimplanted, and the procedure is continued as that of a closed apex tooth. In patients with an open apex, endodontic procedure is not initiated until any sign of pathosis occurs. The patient is recalled every 3 weeks to check the vitality and revascularization progress. This ensures timely monitoring and necessary interventions if needed for the best possible outcome of the replanted tooth [2].

**ANTIRESORPTION THERAPY**
Antiresorption therapy involves soaking the avulsed tooth in a solution containing antibiotics. This therapy is believed to prevent inflammation caused by necrotic cells or microbes. The storage medium for the tooth should contain 800 µg of doxycycline and 640 µg of dexamethasone for 20 minutes. During this process, the alveolus (tooth socket) should be irrigated with a 0.9% physiologic saline solution, and if there is any obstruction caused by a blood clot, aspiration should be performed to clear the obstruction. This approach aims to minimize inflammation and promote a better environment for the replanted tooth to heal and potentially prevent or minimize root resorption [6].

**POST REIMPLANTATION PROCEDURES FOR AVULSED TOOTH**
Once the tooth has been reimplanted in the socket, complete immobilization should be carried out using a semi-rigid splint. The splinting helps the damaged periodontal ligament fibers develop a connection from the alveolus to the cementum. Splinting
should be done for 2 weeks, and in cases where the extra-oral dry time exceeds 60 minutes, 4 weeks of splinting is recommended [6]. Replacement resorption ranges from 9.5% in teeth with short dry storage of below 15 minutes to 100% in teeth with dry storage exceeding 60 minutes [6]. Splinting provides proper stabilization to maintain the replanted tooth in the correct position, providing comfort to the patient and improving function. Some studies have shown that healing of the periodontal ligament and pulp is promoted if the replanted tooth shows slight mobility, which can be achieved using a stainless steel wire with a diameter of 0.016 mm bonded to the tooth using resin. The replanted tooth should be stabilized for two weeks, depending on the maturation of the root. The wire should be placed on the labial surface to enable lingual access for endodontic procedures or palatal access if necessary. An additional week of splinting is done only if excessive trauma from opposite teeth may further traumatize the avulsed tooth [4][12].

• Endodontic Considerations:
  In the case of a closed apex, the ideal time for root canal treatment is 7 to 10 days post replantation. Calcium hydroxide is usually used as an intracanal medication for one month until an acceptable root canal filling material is used.
  In the case of an open apex which has been replanted immediately or kept in a storage media, pulp revascularization is possible [4].
  Avulsed Primary Teeth: Avulsed primary teeth should not be replanted due to the burden of replantation. Splint placement can cause damage to the permanent tooth or its eruption and can lead to a medical emergency due to the aspiration of the tooth [13].
  Cell Mediated Regeneration Therapy: Periodontal stem cells have shown great potential for regenerating PDL and repairing periodontal bone defects. Therefore, using stem cells on the avulsed teeth may help in managing these cases. Studies have been going on for the management of avulsed teeth using stem cell therapy [6].
  Antibiotics: It is recommended to prescribe antibiotics to prevent any signs of infection. The patient should be prescribed amoxicillin or doxycycline for 5 days. In the case of children under 50 kgs, the initial dose of doxycycline prescribed is 100 mg, followed by 50 mg for the next 4 days [5].
  Tetanus: The patient should be referred to the physician for the tetanus booster within 48 hours if the tooth was contaminated or its status is uncertain [1].
  Diet: The patient is advised to mainly take a soft diet for almost 2 weeks [9].
  Oral Hygiene: The patient should brush twice a day with a soft bristle toothbrush and rinse the mouth with chlorhexidine mouthwash twice a day for 2 weeks.

• Favourable Outcomes [8]:
  For Closed Apex: Asymptomatic, no pain percussion, normal mobility, no radiographic evidence of root resorption, no radiolucencies, lamina dura appearing normal.

  For Open Apex: Asymptomatic, Asymptomatic, no pain percussion, normal mobility, pulp canal obliteration is expected, radiographic evidence of complete root formation.

• Unfavourable Outcomes [4]:
  For Closed Apex: Patient may or may not present with the following symptoms:
    • Presence of swelling.
    • Excessive mobility.
    • Ankylosis.
    • High pitched metallic sound.
    • Radiographic evidence of inflammatory resorption or both.

  For Open Apex: Patient may or may not present with the following symptoms:
    • Presence of swelling.
    • Excessive mobility.
    • Ankylosis.
    • High pitched metallic sound.
    • Radiographic evidence of inflammatory resorption or both.

• Follow-Up Appointments:
  • The splint should be removed after 2 weeks and the tooth should be examined both clinically and radiographically, the mobility of the tooth should be checked after removal of the splint, and the vitality of the pulp should be checked.
  • In case the pulp is non vital and there is no chance of revascularization the root canal treatment is indicated [5].
  • If the pulp is Vital radiograph is taken and appointment after 1,3,6 months is given and every time a new x ray is taken to check for signs of resorption. In case of no resorption patient is recalled after 1 year, if the tooth shows signs of resorption root canal treatment is advised [12].
  • If the extra oral dry time is over 90 minutes the tooth should be placed in fluoride to decrease chances of resorption.
  • The tooth has a greater chance of revascularization if the tooth is immature after soaking in doxycycline [5].

• Complications
  The major complication seen are [5]:
• Pulp necrosis.
• Tooth discoloration.

• Ankylosis of root to alveolus.
• Root resorption.
• Fistulas.
• High risk of loss of vitality.

The complete absence of the periodontal ligament (PDL) leads to the direct connection of bone and cementum. An abnormal attachment after healing occurs when more than 20% of the PDL is injured. Initially, after inflammation, the root surface is without cementum, and the surrounding PDL will try to repopulate it. However, bone precursor cells may move from the socket wall and repopulate the damaged root, leading to ankylosis of the tooth. Eventually, the root will be replaced by bone. In growing patients, when ankylosis occurs, it is likely to cause disturbances in facial and alveolar growth over the short, medium, and long term [6].

CONCLUSION

Avulsion has physiological, esthetical, and functional consequences and is considered one of the most serious dental injuries. An appropriate storage medium, if used, can provide desiccation of periodontal cells. The proper combination of preventive and educational actions can decrease the rates of avulsion and improve the long-term prognosis. The population should be made aware of emergency management related to avulsion. The patient should be motivated during the emergency, and posters and videos should be designed and used during public camps to increase awareness among the people [1]. The poster "Save a Tooth" is written for the public in several languages, such as Spanish, English, Portuguese, and Italian, and it can be obtained online [8].

REFERENCES


"https://www.jcdr.net/article_fulltext.asp?issn=0973-