

## Avulsion: From Facts To Treatment Algorithm

### Abstract

Avulsion of tooth is a grievous injury and ranges from .5-16 % of all injuries in permanent dentition and 7-21% in primary dentition, of which maxillary anterior are commonest. Most susceptible group is children between 7-14 years. Healing following avulsion and replantation is dependent on the extent of pulpal and periodontal ligament (PDL) tissue damage. Therefore, immediate replantation is the recommended treatment of choice for an avulsed permanent tooth. To achieve a more favorable prognosis following tooth replantation, minimal extra-oral dry storage for tooth & use of an appropriate interim transport medium is usually advocated. Replanted tooth should be monitored regularly and radiographically. To emphasize the various aspects of avulsion, research based information has been incorporated.

### Key Words

Avulsion, Replantation, Storage media, Splints.

### Introduction

An unexpected loss of anterior tooth is an appalling event for the patient having a comprehensive blow on the psychology as well as the overall personality of the individual.<sup>[1]</sup> Tooth avulsion or exarticulation is the loss of tooth following trauma.<sup>[2]</sup> "When the tooth is removed from its socket, consequence of a trauma, and the surrounding structures as periodontal ligament and neurovascular bundle injure, the situation is named as tooth avulsion."<sup>(World Health Organization's classification system modified by Andreasen).</sup><sup>[3]</sup> There has been an increase in the occurrence of avulsion due to increase in road traffic accidents, followed by fall and sport injuries.<sup>[4]</sup> Most susceptible group is children between 7-14 years<sup>[5]</sup> as the alveolar bone is resilient conferring minimal resistance to extrusive forces.<sup>[6]</sup> It is well established that the clinical prognosis of an avulsed tooth/teeth depends upon the promptness and immediate management by dental practitioner.<sup>[7]</sup> The success rate of reimplanted teeth is reported to be very low, which is 4 to 50 %.<sup>[8]</sup> However, immediate reimplantation is not always possible due lack of knowledge from parents/tutors at the moment of accident<sup>[9]</sup>, person's conscious state, informed consent issues, and lack of confidence in strangers gathered at site of accident.<sup>[10]</sup> If managed pertinently the avulsed tooth with viable periodontal ligament when reimplanted can maintain functionality for some years.<sup>[11]</sup> This

overview expounds the aspects for the clinical success and prognosis of exarticulated teeth in dental practice.

### Factors affecting success rate of replanted teeth:

**Age :** Progression of root resorption in teeth with extended extra-oral periods is age related. In patients 8-16 years old at the time of avulsion, the rate of resorption is higher compared to 17-39 years old patients.<sup>[12]</sup> Since most avulsions occur before the patient's facial growth is complete, it is critical to maintain the tooth and surrounding bone until facial growth is complete and a relatively uncomplicated permanent restoration can be made.<sup>[5]</sup>

### Mechanical damage during replantation:

In the processes of avulsion and replantation, maximal damage occurs to the convex buccal and lingual root surfaces, where physical contact occurs with the bone socket during rotary movement.<sup>[6]</sup>

### Timing of pulp extirpation:

Timing of pulp extirpation (PE) of a replanted avulsed tooth depends on tooth maturity and, if immature, the extraoral time. Unless the tooth is immature and has been replanted almost immediately, PE is generally recommended within 7 to 14 days<sup>13-17</sup> or 10 days post-replantation.<sup>[13]</sup> Extra-alveolar duration: Extra-oral dry storage for more than 60 minutes subjects the success rate of replanted tooth to a minimal<sup>[18]</sup> leading to

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tooth loss.<sup>[19]</sup> Teeth that are replanted within 5 minutes after avulsion have best prognosis.<sup>[20]</sup> Damage to PDL by dehydration & direct mechanical trauma affects the viability of cells, worsening the prognosis of replanted tooth<sup>[21]</sup> with the probability of resorption increasing by 29% for every additional 10 minutes of dryness.<sup>[22]</sup>

### Storage media:

An extra-alveolar time always exists before the patient arrives at the dental office leading to desiccation of the root surface, increasing the risk of loss in vitality of the PDL cells.<sup>[6]</sup> As dry storage is detrimental to the PDL viability, the avulsed tooth must be prevented from drying by use of storage media of appropriate pH, osmolality & efficacy. (Table 1) Tap water, saline, saliva and Gatorade<sup>[9]</sup> are inappropriate storage media due to their non-physiological pH

Table 1 : Ideal Properties Of Storage Media

Maintain PDL cell viability
Physiological pH & osmolality
Clonogenic & mitogenic capacity
Should not induce antigen – antibody reaction
Antimicrobial
Effective under different conditions
Availability

& osmolality.<sup>[23]</sup> Milk and HBSS have the best results using the multiparametric assay, corroborating their use in cases of tooth avulsion.<sup>[9]</sup> Coconut water<sup>[24]</sup>, green tea extract<sup>[25]</sup> & ricetral<sup>[2]</sup> are comparable to HBSS and milk in maintaining PDL viability. Propolis, a recent development is an appropriate medium for avulsed tooth and can maintain the viability upto 6 hours.<sup>[6]</sup> **(Table 2)**

**Splinting - type and duration:**

semi-rigid or flexible fixation permits physiological jiggling movements of the teeth as functional stimuli which assists PDL healing. As compared to previous recommendations of 6 weeks (essentials of traumatic injury) splinting for up to 2 weeks & splinting for 1 week may be adequate for periodontal healing.<sup>[26]</sup> **(Table 3)** Recent guidelines recommend splinting for up to 2 weeks when extraoral dry time is less than 60 min, and for 4 weeks for both immature and mature teeth when extraoral dry times exceed 60 min.<sup>[26]</sup>

The splint should be replaced if undue mobility persists after 10 days.<sup>[13]</sup> The active term of splinting in dentistry is defined as the joining of two or more teeth into a rigid unit by means of fixed or removable restorations or devices.<sup>[27]</sup> Splints may be classified as temporary, provisional, or permanent and may be either fixed or removable. **(Table 4)** Treatment modalities of avulsed teeth Reimplantation refers to the insertion and temporary fixation of completely or partially avulsed teeth that have resulted from traumatic injury. In reimplantation complete reestablishment of vitality of periodontal fibers is the prime objective. The percentage of success of tooth reimplantation has been observed to be low, ranging from 4 to 50%.<sup>[28]</sup>

**Management:**

1. At the site of accident **(Figure 2)**
2. Management at dental office **(Figure 3)**
3. Follow up (every 2 weeks)
  - Check for pain, discomfort, swelling
  - Take radiographs
  - Remove splint
  - Check for excessive mobility
  - If teeth demonstrate considerable mobility – patient should be warned to be careful with eating etc At this point of treatment, if the tooth/teeth are completely symptomless and there is no radiographic evidence of

Table 2 : Different Storage Media

Media	pH / osmolality	Characteristic	Efficacy	Availability
Tap water	8.2 / 2	Non physiologic pH & osmolality, Readily available, Microbial contamination	inappropriate	++
Milk	6.8 / 283	Small bacterial contents, isotonic, physiological pH, osmolality, growth factors and nutrients	Excellent	+
HBSS	7.6 / 280	Physiological pH, osmolality and nutrients	Excellent	--
Coconut water	4.6 / 375	Sterile, natural product and contains nutrients	excellent	+
Saline	7 / 280	Physiological pH and osmolality	Poor	+
Saliva	6.3- 6.4 / 60-70	Microbial contamination, hypotonic, nonphysiological pH and osmolality	inappropriate	++
Egg white	8.6-9.38 / 258	Low microbial contamination, contains nutrients and water	Good	+
Viaspan	7.4 / 320	Physiological pH, osmolality and favorable to cell growth	Excellent	--
Gatorade	2.9 / 404	Non-carbonated sports drink Low pH and hypertonic	Poor	+

Table 3 : Splints For Avulsed Teeth

Type of splint	Characteristics
Acrylic resin and arch wire	Suitable for splinting single or multiple teeth, but may not be appropriate where adjacent teeth are unerupted, missing or injured
Approximal composite/ acrylic resin	Quick & easy to place, as only one tooth requires splinting and direct adjacent uninjured teeth are available
Composite/ acrylic sausage	<ul style="list-style-type: none"> <li>• Produces rigid splint using the minimum of materials</li> <li>• Emergency management/ intermediate splinting</li> <li>• Central area of buccal aspect of the crowns to be included are treated &amp; composite sausage on teeth</li> </ul>
Composite/ acrylic nylon monofilament suture	<ul style="list-style-type: none"> <li>• Flexible splint</li> <li>• Instead of flexible wire a short length of nylon monofilament suture or fishing line used.</li> </ul>
Orthodontic brackets with sectional wire	<ul style="list-style-type: none"> <li>• Flexible splint</li> <li>• Edgewise brackets or straight wire brackets used</li> </ul>
Sling suture	Where no adjacent tooth present Heavy nylon (2-0) monofilament suture passed through the interdental papilla on one side of the tooth, across the incisal edge of tooth and then passed deeply through the papilla on other side. Suture looped pulled tightly and two ends of suture knotted together
Vacuum formed splint	Do not offer sufficient support for luxated or avulsed tooth, but can be used for some minor subluxations to help avoid further trauma or to give pts more confidence when eating Rigid – cemented by zinc phosphate cement
Removable acrylic resin plate	Flexible splinting

Table 4 : Splints For Avulsed Teeth (Contd.)

Titanium trauma splints	<ul style="list-style-type: none"> <li>• pure titanium, 0.2 mm thick</li> <li>• easily adapted to the contour of the dental arch</li> <li>• available in two lengths- 52 mm and 100 mm</li> <li>• rhomboid mesh structure makes it flexible in all dimensions, thus allowing physiologic tooth mobility without transferring orthodontic forces to the splinted teeth</li> </ul>
Polyethylene fibre (ribbon)	Polyethylene fiber mesh bondable reinforcement ribbon used with composite
e-glass fibres	• Labial surfaces of the traumatized and adjacent teeth are etched & flowable composite is applied to etched surfaces.

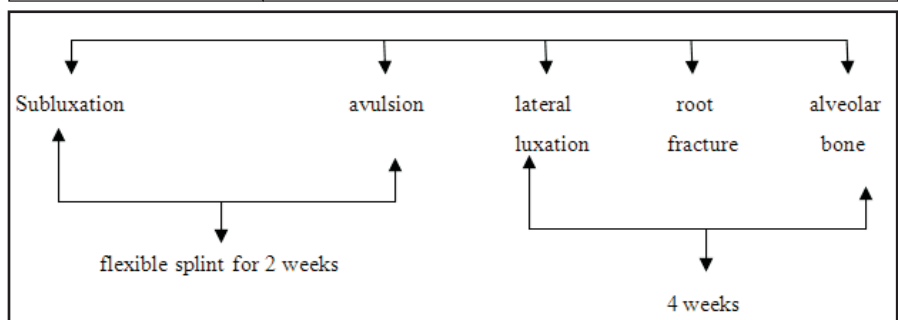


Fig:1 Duration of splints

any pathology, such as external or internal resorption, etc. an appointment can be made to carry out a final RCT. If the apices of the affected tooth are open, the usual procedures to achieve a hard tissue

barrier are carried out Some authors prefer to treat the teeth with calcium hydroxide for at least 9-12 months before the final root canal filling is placed.<sup>[29]</sup>

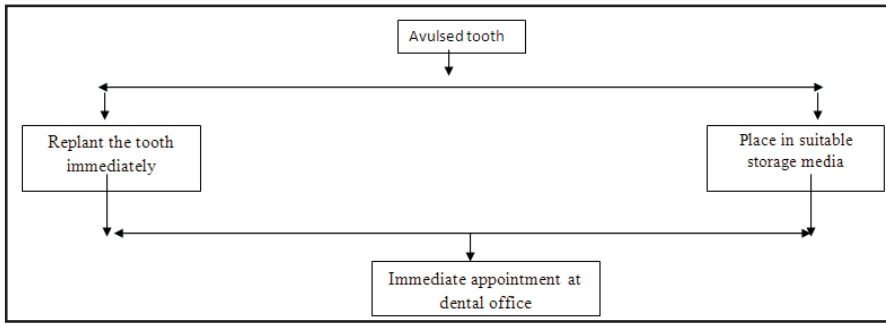


Fig:2 Management at site of accident

### Conclusion

Dental practitioner will occasionally face the task of replantation of avulsed teeth & need to be aware of newer developments to maximize the success of the procedure. Search for what to do when such an emergency emerges in a clinic is utmost importance. The successful long-term surviving of replanted teeth is very satisfying for the dental practitioner and generates goodwill in the community.

### References:

1. Bodh M, Namdev R, Jain M, Dutta S. A Conservative And Biological Approach For Rehabilitation Of Anterior Edentulous Space Using Natural Tooth Pontic (Ntp) And Fibre Reinforced Composite – A Case Report. Indian J Dent Scien. October 2014;4(6):35-37

2. Rajendran P, Nettiyyat Oommen Varghese, Varughese JM, Murugaian E. Evaluation, using extracted human teeth, of Ricetral as a storage medium for avulsions – an in vitro study. Dent Traumatol 2011; 27: 217–220
3. Glendor U, Halling A, Andersson L, Eilert-Petersson E. Incidence of traumatic tooth injuries in children and adolescents in the county of Vastmanland, Sweden. Swed Dent J 1996;20:15–28
4. Adil NF, Ahmed SS, Jindal MK, Arshad SH. Delayed replantation of avulsed teeth. J Indian Soc Pedod Prevent Dent 2007;(s):s17-19
5. Trope M. Avulsion of permanent teeth: theory to practice. Dent Traumatol 2011 Aug;27(4):281-94.
6. Malhotra N. Current developments in interim transport (storage) media in

dentistry: an update. Br Dent J 2011;211(1):29-33.

7. Kargul B, Welbury R. An audit of the time to initial treatment in avulsion injuries. Dent Traumatol. 2009 Feb;25(1):123-5.
8. Andreasen JO, Borum MK, Jacobsen HL, Andreasen FM. Replantation of 400 avulsed permanent incisors. Factors related to periodontal ligament healing. Endod Dent Traumatol 1995; 11:76-89.
9. Silva EJ, Rollemberg CB, de Souza Coutinho-Filho T, Zaia AA. A multiparametric assay to compare the cytotoxicity of soy milk with different storage media. Dent Traumatol 2013;29(4):319-22.
10. Andreasen FM, Andreasen JO. Textbook and color atlas of traumatic injuries to the teeth, 3rd ed. Copenhagen: Munksgard, 1994:383-425.
11. Jovanovska M. Delayed tooth replantation after traumatic avulsion. Stomatološki vjesnik 2014;3(1)
12. Petrovic B, Marković D, Peric T, Blagojevic D. Factors related to treatment and outcomes of avulsed teeth. Dent Traumatol 2010 Feb;26(1):52-9.
13. Gregg TA, Boyd DH. UK National Clinical Guidelines in Paediatric Dentistry. Treatment of avulsed

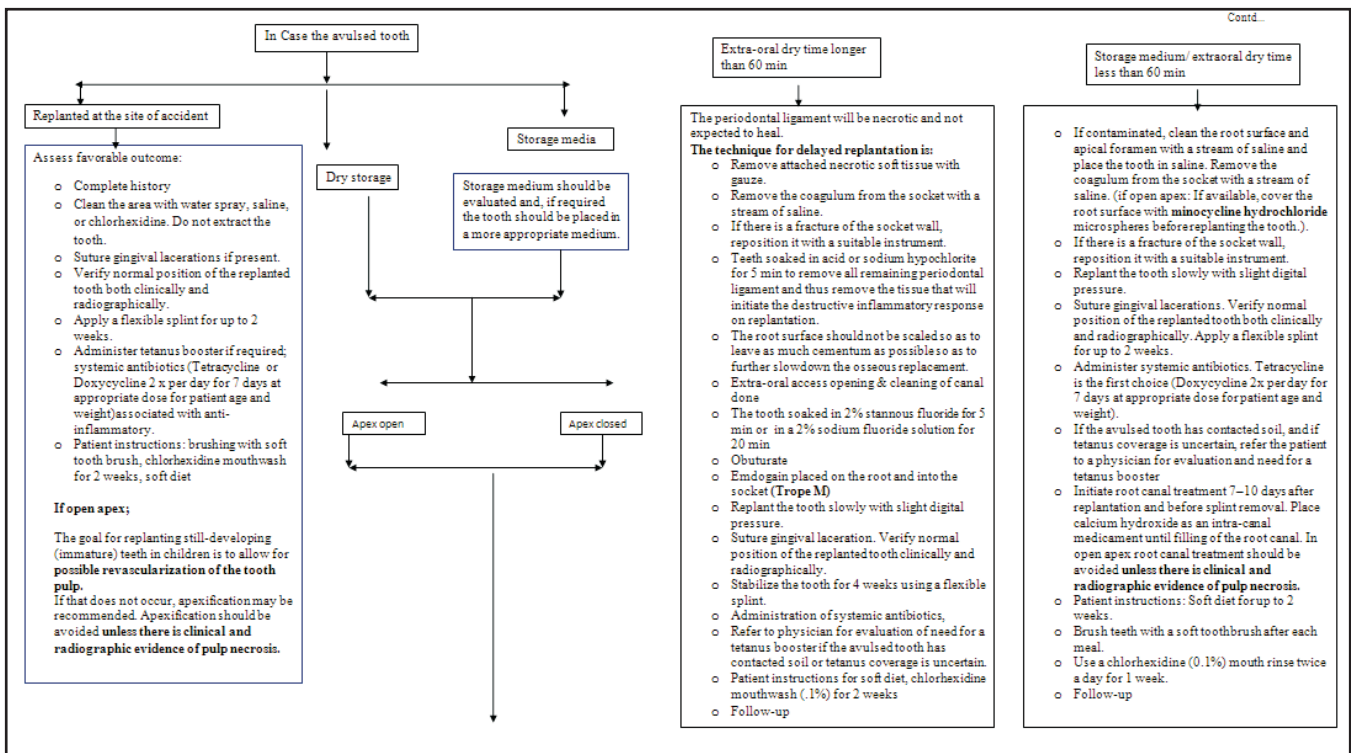


Fig 3: Management of avulsed tooth when at dental office in different circumstances

- permanent teeth in children. *Int J Paed Dent* 1998;8:75–81.
14. Flores MT, Andreasen JO, Bakland LK. Guidelines for the evaluation and management of traumatic dental injuries. *Dent Traumatol* 2001;17:193–6.
  15. Trope M. Clinical management of the avulsed tooth. Present strategies and future directions. *Dental Traumatol* 2002;18:1–11
  16. Ram D, Cohenca N. Therapeutic protocols for avulsed permanent teeth: review and clinical update. *Pediatr Dent* 2004;26:251–5.
  17. Flores MT, Andersson L, Andreasen JO, Bakland LK, Malmgren B, Barnett F et al. Guidelines for the management of traumatic dental injuries. II. Avulsion of permanent teeth. *Dent Traumatol* 2007;23:130–6.
  18. Curzon MEJ, Duggal MS, Fayle SA, Toumba KJ. Handbook of dental trauma: a practical guide to the treatment of trauma to the teeth. Oxford: Wright, 1999:p80-98.
  19. Veloso HHP, Sampaio FC, Guedes OA. Interdisciplinary treatment of an avulsed permanent tooth in patient with incomplete facial growth. *Dental Press Endod* 2011 Oct-Dec;1(3):65-70.
  20. Munavalli AN, Sachhi RJ, Kambale S S, Bandekar S D. Maintaining vitality of immediately reimplanted avulsed tooth: Two-year follow-up case report. *J Indian Soc Pedod Prev Dent* 2013;31:113-7
  21. Bryson EC, Levin L, Banchs F, Trope M. Effect of minocycline on healing of replanted dog teeth after extended dry times. *Dent Traumatol* 2003;19:90-5.
  22. Khalilak Z, Shikholislami M, Mohajeri L. Delayed Tooth Replantation after Traumatic Avulsion: A Case Report *Iran Endod J* 2008 Summer; 3(3): 86–89.
  23. Bazmi BA, Singh AK, Kar S, Mubtasum H. Storage media for avulsed tooth- A review. *Indian J Multidiscip Dent* 2013;3:741-749
  24. Moreira-Neto JJ, Gondim JO, Raddi MS, Pansani CA. Viability of human fibroblasts in coconut water as a storage medium. *Int Endod J* 2009 Sep;42(9):827-30.
  25. Ghasempour M, Moghadamnia AA, Abedian Z, Amir MP, Feizi F, Gharekhani S. In vitro viability of human periodontal ligament cells in green tea extract. *J Conserv Dent* 2015 Jan-Feb; 18(1): 47–50.
  26. Hinckfuss SE, Messer LB. Splinting duration and periodontal outcomes for replanted avulsed teeth: a systematic review. *Dent Traumatol* 2009 Apr;25(2):150-7.
  27. Ansari I, Maria R, Virang B, Parverkar P. Splinting : A Review *NJDSR* 2014;2(1)
  28. Mittal N, Swain G. Management of traumatically avulsed tooth by reimplantation. *Guident* 2014
  29. Andreason JO, Andreason FM. Essentials of Traumatic Injuries to the Teeth: A Step-by-Step Treatment Guide, Second Edition. 2nd ed. Munksgaard: Wiley, 2008:p113-132.

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