

**Recent Trends in Use of Storage Media Following Avulsion of Teeth in Pediatric Dentistry**

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**Abstract**

Tooth trauma in children continues to be common occurrence that every pedodontist must be prepared to assess and treat when necessary. Avulsion term is used to describe complete displacement of tooth from its alveolus. It is also called as exarticulation and shows clinical features of bleeding socket with missing tooth. The long term success of replantation depends on status of pulp and periodontal ligament so an avulsed tooth must be prevented from drying by use of storage media of proper osmolarity and pH. In order to achieve a favorable outcome of replantation, it is essential to have first aid

knowledge about various storage media available. This review explores various available storage media and highlights their characteristic features.

**Keywords:** Tooth avulsion, replantation, storage media, extra-alveolar time

**Introduction**

In children avulsion is most commonly occurring injury, where the development of root is still not complete and periodontium is very resilient. A traumatic dento/facial accident can compromise the integrity of a previously healthy dentition and results in an unsightly appearance, affecting the child’s self-esteem<sup>1</sup>. It can occur as a result

of fall, sports mishap, collision, automobile injury, assault torture, drug related injuries and accidents at home. Avulsion is the complete and total displacement of tooth from its socket. The value of a tooth should not be underestimated in children as they are important not only from esthetic point of view but also help in proper digestion of food. Immediate replantation is treatment of choice in permanent tooth avulsion at the site of accident but is rarely achieved. Before undertaking replantation of a tooth, pedodontist should thoroughly evaluate the care involved<sup>2</sup>. Further consideration should be given to type of anesthetic used and a radiograph should be taken to rule out any abnormalities. Moreover the storage media is also one of the crucial factors. Storage media is used during the time elapsed between avulsion and replantation. Teeth are normally subjected to a period of desiccation between this period so it is desirable to replant the tooth immediately but it is not always feasible<sup>2,3</sup>. Initially it was thought that the success of replantation is mainly depends on the extra alveolar time that means shorter the extra alveolar time better the prognosis. But with the advance researches and studies it has been proven that storage media is also one of the most important factor as short period of dry storage shows comparatively poor prognosis than the prolonged storage in suitable media<sup>4</sup>. The purpose of this article is to, provide an insight to the various storage medium currently available in the market with their pros and cons and which can be used by caretakers or parents before taking the child to the dental office.

### Discussion

Dental avulsion is an absolute dental emergency in which the prognosis of the tooth relies upon two crucial factors:

transitory storage media and extra alveolar time<sup>5</sup>. Best method for the prevention of knocked-out teeth is the use of helmets and mouth protectors. Pedodontist should always be prepared to give relevant advice to the public about first aid for avulsed teeth. In addition to increase the public awareness by mass media campaign, health care professionals, parents and teachers should receive information on how to proceed following these severe unexpected injury<sup>6</sup>. A storage medium may be defined as a physiological solution that closely replicates the oral environment to help preserve the viability of PDL cells following avulsion. Various types of storage media are available to maintain the viability of PDL cells which to encourage the prognosis of replantation<sup>7</sup>.

### Characteristics Of Storage Media<sup>3,13</sup>

1. Should be non- toxic.
2. Should reduce the risk of post re-implantation root resorption or ankylosis.
3. Should have a good shelf life.
4. Should be able to preserve viability of cellular PDL.
5. Should have antimicrobial properties.
6. Should preserve functional capabilities.
7.  $p^H$  should be between 6.6- 7.8
8. Osmolarity should be same as that of body fluids.

### Types of Storage Media

- 1- Naturally occurring storage media
- 2- Synthetic

**In the below tables we have described merits and demerits of various storage media which are commonly used in avulsion of tooth-**

Table 1: Natural Storage Media

Sn	Storage Media	Merits	Demerits
1.	Milk and milk products	Isotonic, physiological pH, easily accessible, presence of nutritional substances, excellent efficiency <sup>5</sup>	Should be used in first 20mins of avulsion, cannot revive degenerated cells <sup>5</sup>
2.	Coconut water	Biologically pure, contains vitamins & amino acids, increase mitogenesis, long shelf life, naturally isotonic, good efficiency <sup>7</sup>	Deleterious to cell metabolism due to acidic pH, inflammatory resorption present <sup>7</sup>
3.	Egg white	High content of protein & vitamins, low microbial contamination, good accessibility <sup>8</sup>	Less efficacy due to increased pH <sup>8</sup>
4.	Tap water	Least desirable, used when no alternatives and very short duration <sup>3</sup>	Bacterial contamination, ankylosis, replacement resorption <sup>3</sup>
5.	Saliva	Acceptable for short duration(less than 30mins), better than tap water and dry storage <sup>1</sup>	Non physiological pH, microbial contamination, hypotonicity <sup>1,13</sup>
6.	Red mulberry	Contains flavonoids, alkaloids, antioxidants, storage time upto 12hrs, good efficacy <sup>13,21</sup>	Non-availability
7.	Propolis	Contains essential oils, vitamins, antibacterial, antifungal, antiviral, anticarcinogenic, excellent efficacy <sup>9,10</sup>	Non-availability, cytotoxic response at higher concentration <sup>9</sup>
8.	Green tea extract	Anti-inflammatory, antioxidant, anticarcinogenic, 90% of cell viability upto 2hrs <sup>30</sup>	Non-physiological pH and Osmolarity <sup>30</sup>
9.	Aloe vera	Increases fibroblast activity, contain essential oils, storage upto 2hrs <sup>27</sup>	Biological contamination <sup>27</sup>
10.	Pomegranate juice	Polyphenolic flavonoids, strong cell attachment, significant PDL cell viability, ease of accessibility <sup>16</sup>	Biological contamination, sometimes allergic reactions <sup>18</sup>
11.	Salvia extract	Presence of sterols and flavonoids, antimicrobial, antioxidant <sup>13</sup>	Not easily available

Table 2: Synthetic Storage Media

Sn	Storage Media	Merits	Demerits
1.	Normal saline	Physiological pH, isotonic, ease of access is good <sup>5</sup>	Lack of nutrients like magnesium, calcium and glucose, cannot be used for more than 2hrs <sup>5</sup>
2.	HBSS	Non-toxic, biocompatible, isotonic, physiological pH, long shelf life, replanish depleted cellular component For short period of storage when other <sup>28,29</sup>	Low accessibility and high cost <sup>28</sup>
3.	Contact lens solution	Favorable for occasional use, essential nutrients similar to HBSS <sup>30</sup>	Presence of preservative harmful for cells of PDL fibers and pulp <sup>30</sup>
4.	Eagle's Minimal essential media	Presence of L-glutamin, penicillin, streptomycin, Nystatin, bovine serum and nutrients <sup>19</sup>	Lower temperature leads to aggregation, lower the cell's functional capacity <sup>19</sup>
5.	Emdogain	Decrease the rate of development of replacement resorption <sup>31</sup>	Do not regenerate the injured PDL cells, Lack of availability <sup>31</sup>
6.	Viaspan	Good for cell growth, contains adenosine and help in cell division <sup>32</sup>	Must be refrigerated, high cost, not readily available <sup>32</sup>
7.	L- DOPA	Mitogenic effect, promote healing <sup>24</sup>	Lack of availability
8.	Euro Collins	Good repair capacity, favorable for cell growth <sup>25</sup>	Not readily available, high cost <sup>25</sup>
9.	Patients own serum	Has essential metabolites, good efficacy <sup>23</sup>	Accessibility is difficult

**Recently some materials like Propolis, Salvia extract and Pomegranate juice are gaining popularity because of their favorable properties.**

**Propolis** – Propolis is a natural aromatic brownish-green sticky material produce by the honeybees from exudates

and buds of the plant. It has amazing antibacterial, anti-inflammatory, antioxidant and antiviral properties<sup>8</sup>. Ozan et al.<sup>9</sup> compared the efficacy of propolis 10%, propolis 20%, milk and HBSS. He revealed that at 3, 6, 24, 72 hours interval Propolis was considerably more competent

than HBSS and milk. However at one hour no significant difference existed among the groups. Propolis 20% had a worse result than HBSS but better than HBSS and milk at three and six hours. These results agreed with martin et al<sup>10</sup>. Buttke and Trope<sup>11</sup> have advocated that the medium containing antioxidant can enhances the replantation success of avulsed tooth. Propolis contains flavonoids which is a powerful antioxidant. Al-Shaher et al<sup>12</sup> investigated the effect of fibroblasts of the dental pulp and periodontal ligament cell to propolis and disclosed that exposure of PDL cells or pulp fibroblasts propolis resulted in > 75% viability of cells thus propolis can be used as a advisable transport medium for avulsed teeth.

**Salvia extract-** Salvia officinalis has been suggested as an alternate choice for transport of avulsed teeth. Salvia is the largest genus of lamiceae and is native to the Mediterranean region. Salvia officinalis has remarkable antiseptic, astringent and spasmolytic activity<sup>13</sup>. Essential oil obtained from it has some antioxidant properties. It also has excellent antimicrobial activity as well as scavenging activity of their active oxygen forms. Antioxidant activity of S. officinalis is due to its phenolic contents as rosmarinic acid, carnosic acid, salvianolic acid, and its derivatives carnosol, rosmanol, epirosmanol, rosmadial & methyl carnosate. Ozan et al<sup>14</sup> noticed that viability of PDL cells' is comparable for 2.5% S.officinalis and HBSS at 1-3hr interval, but the efficacy of 2.5% S.officinalis is considerably superior than HBSS at 24 hours interval. Thus, S.officinalis can be recommended as a suitable transport medium for avulsed teeth. Because storage media containing S. officinalis are not available, HBSS is still the first choice.

**Pomegranate juice-** Punica ganatum is grown as a fruit crop. It can be grown in dry places. It is potent natural alternative against variety of bacterial and viral pathogens<sup>15</sup>. In traditional medicine, pomegranate fruit has

been used to treat acidosis, dysentery, microbial infections, diarrhea, hemorrhage, respiratory pathologies, and hypertension. Various studies suggest that pomegranate juice is very efficient in reduction of pathogenic dental bacteria and it also has capacity to reduce plaque, gingivitis, and periodontal diseases. They have the property to scavenge free radicals and restrict lipid oxidation to carry out. Tzulker et al<sup>16</sup> proposed in their study that the elementary source for antioxidant property is punicalagin while anthocyanins play only limited role. Contradictory to him Madrigal-Carballo et al<sup>17</sup> said that the polyphenolic molecules' performance of redox reactions forms the purpose behind their antioxidant activity. Pomegranate extract has been suggested to be useful in decreasing inflammatory signs in cases of chronic periodontitis. Hojatti et al<sup>18</sup> compared PDL cell viability of avulsed tooth between Pomegranate juice, 1% HBSS and Tap water and concluded that 7.5% Pomegranate juice was the most effective solution for maintaining periodontal cell viability amongst all the experimental solution. It is known that pomegranate flavonoids have anti-inflammatory and antibacterial properties, while pomegranate polyphenols have antioxidant and antiviral properties which may result in higher viability of PDL cells.

### Conclusion

Tooth avulsion in children results in PDL attachment damage and pulp necrosis. Most of the avulsion injuries of children occur close to home or school, so it would be beneficial to have knowledge and availability of storage media in emergency kits at these sites. Storage media help to maintain viability of PDL fibres for extended periods. Suggested media in order of preference are milk, saliva, HBSS most commonly. Recently Propolis, salvia extracts and pomegranate juice are available which can also be used as storage media to preserve the viability of avulsed

tooth. However, any solution does not provide the natural inhabitant to the tooth as the tooth's socket. These are adjuncts and provide a transitory storage medium with respect to the limit to the time, to when the viability of the ligaments to the replantation of the tooth. With the recent solutions, the success of these has been proven to increase the probability of the tooth's vitality and the adaptation to the tooth back into its place. A further study research and development is much needed in this domain as trauma to the tooth is inevitable and prevention is the only option.

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