

Latest Storage Media for Avulsed Tooth

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Abstract: Dental traumatic injuries are one of the most uninvited emergencies, resulting in emotional, aesthetic, functional and psychological stress. Tooth avulsion is the most common dental traumatic injury. It is associated with exarticulation or total luxation of the tooth out of its socket. Avulsion could arise as a result of trauma, sports injury or fights. Once the avulsion has taken the place, the tooth should be replaced back in its socket after proper cleaning and disinfection. This process of replantation, if cannot be carried out by the patient or friends/relatives at the site, tooth has to be carried to the dental clinic. The transport medium assumes importance, in the later situation. The transport media ought to be one that maintains the vitality of the periodontal ligaments of the tooth. Over the last few years various new transport media have been advocated for this purpose. This article focuses on the advantage and disadvantage of the contemporary transport media.

Keywords: Teeth, traumatic injuries, Avulsion.

INTRODUCTION

Avulsion of tooth i.e. total displacement out of socket is one of most stupefying dental trauma. Avulsion of teeth, comprise of 1–16% of all the dental injuries in permanent dentition with maxillary central incisor being the most frequently involved tooth [1, 2].

Avulsion is more commonly seen in children and young adults, since the alveolar bone is resilient and provides only minimal resistance to extrusive forces.

It is most common among 8–11 year old children, due to their involvement in sports activities at school and the frequency of avulsion is three times higher in boys as compared to girls because of their active sports participation [1-3].

The complete separation of the tooth from the socket results in tear of vascular blood supply, nerve supply and periodontal ligament with viable periodontal ligament cells on the root surface. The treatment of avulsion comprises of replacement of the tooth in the socket followed by endodontic treatment. For re-attached to be successful, the viability of periodontal ligaments in cardinal. Periodontal ligament cells predominantly comprise of PDL fibroblasts, constituting nearly 25% of the total cells. They are responsible for re-attachment of the avulsed tooth after re-implantation. Thus in maintaining the viability of periodontal ligament cells, extra-oral time assumes importance, towards this end an intermediate storage media is essential, for the storage and maintaining the viability of PDL cells of the tooth until the time tooth is re-implanted. The prognosis of success is dependent

upon the extra-oral time i.e. from avulsion of tooth to re-implantation in the socket [4, 5].

Storage Media

Numerous properties of the ideal storage media have been described in literature, some of the important ones are:-

- Maintains viability of periodontal fibers
- Clonogenic and mitogenic capacity
- Physiological osmolarity in pH
- No antigen antibody reaction
- Less risk of root resorption
- Effective under various conditions
- Antimicrobial
- Inexpensive
- Osmolality 290 – 330 mosm/L (critical role)
- pH of 6.6 – 7.8
- Non toxic
- Preserve functional capabilities.

Conventionally Used Storage Media

In the past various storage media have been used, some of the important ones are:-

Milk

The use of milk as storage media gained popularity due to its ease of availability, cost effectiveness and physiologic osmolality. Various form of milk including whole milk, skimmed milk, low fat content milk, baby formula and long shelf life milk has been employed. With a pH of 6.5 – 7.2 and the presence of essential nutrients important for maintaining the viability of cells, milk can be considered as an acceptable storage medium in most situations. It maintains the viability of PDL cells from 2 hours to 6 hours [6-8].

Coconut Water

Coconut water is a biological liquid which is pure, sterile and rich in nutrients like amino acids, proteins, vitamins and minerals with pH of 4.6 and 375 mOsmol/kg of osmolality. It is an isotonic solution which can be obtained fresh, directly from coconuts or commercially in packages and bottles. Coconut water is quite effective in maintaining the viability of PDL cells [7,9]

Egg White

The use of egg white as storage media was suggested due to easy availability and its major drawback is impracticality of use. It can be used to store avulsed teeth for up to 10 hours [8].

Tap Water

Use of tap water to store avulsed teeth is not recommended, as it is not compatible with PDL cells because of its hypotonic osmolality which causes cell lysis, and is reported to cause replacement resorption in avulsed teeth. It is considered one of the least desirable storage medium. (pH 8.2) [10].

Green tea extract

The use of Green tea extract as storage medium for the avulsed tooth was advocated because it is rich in anti-inflammatory and anti-oxidants. It maintains 90% PDL cells viability upto 24 hours [11].

Honey milk

Honey milk is used as storage medium for avulsed tooth due to the presence of essential amino acids, vitamins and minerals, which helps to maintain the PDL cells viability and store the avulsed tooth upto 8 hours.

Aloe-vera

Aloe-vera was used as storage medium for the avulsed tooth because of presence of 75 active ingredients such as vitamins, enzymes, minerals, sugars, salicylic acids, and amino acids and having pH 6.8 with osmolality of 280-300 mOsm/L. (12).It helps in

increase of fibroblast activity and collagen proliferation. It can be stored in 10%, 30% and 50% concentration and maintains PDL cells viability upto 2 hours.

Normal saline

Normal saline was used, but is unable to maintain the metabolism of PDL cells. It has comparable osmolality to the PDL cells but lacks nutrients. It can maintain 80% of PDL cells viability up to 30 min.

Contact Lens Solution

Contact lens solution is not recommended for storing and transporting avulsed teeth, as they were found to be harmful.

Oral Rehydration Solutions

Ricetral, a commercially available oral rehydration formulation, consisting of essential nutrients like glucose and vital salts, helps in maintaining cell metabolism. It does not promote cell mitosis and regenerative capacity of the PDL fibroblasts. It has the ability to maintain the vitality, clonogenic and mitogenic capacity of PDL cells for up to 48 hours.

Hank's Balanced Salt Solution

HBSS is a salt solution which is pH (pH 7.2 & Osmolality 320 mosm/L) balanced and contains essential metabolites needed for vitality of PDL cells. It is considered as a gold standard for storage media used in transport of avulsed teeth and is used to compare the efficacy of other storage media. It has the ability to maintain the vitality, clonogenic and mitogenic capacity of PDL cells for up to 48 hours. It is considered superior to many other media in this regard and can be used to store the avulsed tooth for at least 24 hours [7, 10].

New Storage Media

In the recent past several new storage media have been advocated and used, the prominent ones among those are

Viaspan

This is a medium which was formulated for use in transplant procedures. It is used for cold storage of organs, when they are removed from a donor. It is clear to light yellow in colour, sterile and non – pyrogenic, with a pH 7.4. [13] It maintains the viability of PDL cells effectively, along with cell morphology. Drawbacks of using viaspan include the need for refrigeration, high cost and inaccessibility.

Dentosafe

It is the commercial name of a tooth rescue box containing special cell culture medium (SCCM) which is a combination of amino acids, vitamins and glucose. Dentosafe has demonstrated the maintenance of vitality of PDL cells for 48 hours at room

temperature. If it is not opened then it has a shelf life of 03 years [14].

Salvia officinalis

Salvia officinalis is a perennial, evergreen shrub with blue to purplish flowers. The extract from this plant has been used as spasmolytic, antiseptic and astringent. This extract has been proposed as a storage medium for avulsed teeth because of the anti-oxidant effects caused due to the presence of its phenolic components like rosmarinic acid, camosic acid, salvianolic acid and derivatives. These antioxidants help to prevent root resorption by inhibiting the effect of osteoclastic cells. 2.5% of *Salvia* extract helps to maintain PDL cells viability over longer periods of time[15].

Gatorade

Gatorade was originally developed for athletes in order to replenish electrolytes lost during physical activities. This drink has been proposed as storage medium hence it is not recommended for long term storage medium.

Emdogain

Emdogain is a commercial name of enamel matrix derivative EMD which diminishes the percentage of fibroblasts of the periodontal ligament with capability of forming colonies and delays the replacement the resorption, hence alone it is not sufficient.

Euro – Collins

This has been proposed as a storage medium for the avulsed teeth because of its electrolytes and phosphate buffer to control cell acidosis as well as potassium decreases the intracellular cation loss. It has a low concentration of sodium and chlorine, which avoids cell edema, minimizes the damages to PDL cells and provides favourable conditions for cell proliferation.

Autologous serum

Maintains the vitality of the PDL during the critical extra-alveolar period. Its combination with PRF gives better results. It tends to maintain the 90% viability of PDL cells upto 48 hours[13].

Redmulberry (Morus Rubra)

Belongs to the Moraceae family and active components contains the flavonoids, alkaloids and polysaccharides. It has storage period limit up to 12 hours[16].

Pomegranate juice

This medium contains polyphenolic flavonoids, Punicalagin ellagic acid. These antioxidants help to prevent root resorption by inhibiting the effect of osteoclastic cells. 7.5% of pomegranate juice extract helps to maintain PDL cells viability over longer periods of time 6 to 24 hours[17].

Propolis

Propolis is a resin obtained from conifer tree. It is a non – toxic biological material with anti – inflammatory, anti–bacterial, anti–oxidant, anti–fungal and tissue regenerative properties. The main ingredient of propolis is flavonoids. 10% of propolis has been found to be an effective storage media [7,18,19].

Culture media

Culture media including Eagle's medium, alpha minimum essential media and alpha – MEM –S. Eagle's medium contains many nutrients like amino acids, vitamins and bicarbonates considered essential for maintaining the viability and proliferative capacity of PDL cells for longer time periods[14].

Dubelco's Storage medium

It has 4 times vitamins and amino acids than that present in the regular EM formulation and 2-4 times as much glucose. Moreover and it is compatible with all types of cells.

DISCUSSION

So as to preserve the viability of the periodontal ligament cells for the longest period of time, numerous storage agents have been tried and tested. All these agents have to be compared with HBSS since, it still retains the numerous position amongst all the storage media. Viaspan has been advocated widely by Udoye *et al.* In their studies Udoye *et al.* have compared the potential of various agents and found Viaspan to be best in preserving cell viability. Its prohibitive cost and lack of easy availability are the detrimental factors. Dentosafe is another agent which has been widely studied. Pohl *et al.* concluded that dentosafe is successful in preserving the periodontal cell viability, has long shelf life, and it has the potential of replacing the presently used storage media. Ashkenazi & Shaked have advocated Emdogain. Ozan *et al.* have found Propolis to be an excellent storage media for avulsed teeth.

According to various studies Tap water, saliva and salt solution must be avoided, as the storage media of avulsed teeth, because they do not offer any benefit in healing. Propolis and egg white need additional studies. Furthermore, propolis is not easily available in emergency situations. Egg white, in accordance with Khademi *et al.* and Sousa *et al.* is a promising storage medium for avulsed teeth.

According to various past studies, HBSS can preserve periodontal ligament cells in vitro for 120 hours (5 days) and vivo for 96 hours (4 days). This is still the best solution for the storage in tooth avulsion, because it does not need refrigeration, has two years of shelf life. It has been most widely recommended and used with success by clinicians and researchers.

CONCLUSION

Amongst the new generation of tooth storage media – Propolis, Viaspan, Dentosafe, Emdogain and Autologous serum are being tested widely. In the next few years, one of these has the potential to emerge, as the perfect storage media. Till then Hank's Balanced Salt Solution can be considered, the gold standard amongst the tooth storage media.

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