EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 5
Issue: 9
130-133
Year: 2018

STORAGE MEDIA FOR AVULSED TOOTH – A REVIEW

[1]*Dr. Shazia Nabi, [2]Dr. Kavikumar V. and [3]Dr. Tahir A.

[1]Post Graduate Student of Pediatric and Preventive Dentistry Maharaja Ganga Singh Dental College and Research Centre Rajasthan.
[2]Post Graduate Student of Pediatric and Preventive Dentistry.
[3]Post Graduate Student of Oral and Maxillofacial Surgery.

***Corresponding Author: Dr. Shazia Nabi**
Post Graduate Student of Pediatric and Preventive Dentistry Maharaja Ganga Singh Dental College and Research Centre Rajasthan.
DOI: 10.20959/ejbps20189-6206

Article Received on 30/06/2018 **Article Revised on 20/07/2018** **Article Accepted on 11/08/2018**

ABSTRACT
Dental avulsion is severe kind of dental traumatic injury characterized by complete displacement of the traumatic tooth from the socket and results in considerable damage to the supporting periodontium. The best treatment to comply dental avulsion is tooth reimplantation which depends upon the viability of PDL cells, severity of damage to supporting periodontium I.e. bone cementum, gingiva and also on storage media used for the avulsed tooth. The aim of this study was to perform review of literature on new and advanced storage methods used for avulsed tooth and their effectiveness in reimplantation.

KEYWORDS: Trauma, avulsion, reimplantation, storage media.

INTRODUCTION

Dental traumatic injuries are the most uninvited emergencies causing panic, emotional, aesthetic, functional and psychological disturbances. It one of the common reasons for emergency appointments in dental practice.[1] These injuries are common among children and young adults. Avulsion being the most common injury, it deals with exarticulation or total luxation of the tooth out of its socket and causes damage to several structures. It constitutes around 1- 16% injuries to the permanent anterior teeth.[2] The ideal situation is to replant an exarticulated tooth immediately after avulsion because the extraoral time is a determinant factor for treatment success and for a good prognosis. However, it is not always feasible to replant the tooth immediately that may be due to several factors like; the person's conscious state, lack of first aid knowledge, informed consent issue at the scene of accident.

Thus, extra oral time interval always exist for replantation before patient reaches to dental office. This leads to desiccation of the root surface, increasing the risk of loss of vitality of the periodontal ligament (PDL) cell.[3]

When immediate replantation is not possible, the tooth should be stored in an appropriate transport media to maintain viability. The appropriate use of storage media is an important clinical factor affecting the postoperative prognosis of avulsed teeth following replantation. Recent research has led to the development of storage media that produce conditions that closely resemble the original socket environment with adequate osmolality, pH, and nutritional substances including glucose.

Review of literature on storage media for avulsed tooth: The present review discusses the various available storage media with some new storage media for avulsed teeth and their potential maintenance of the vitality of periodontal ligament cells. The choice of storage medium for preserving traumatically avulsed teeth is important for the success of future replantation.

Two types of storage media:

a. Dry
b. Wet: Unphysiologic media (e.g. tap water) and Physiologic media e.g. milk, HBSS etc.

There are some requirements for ideal storage media like it should be capable of:

a. Maintaining PDL and pulpal cells and tissue viability,
b. Physiological pH and osmolality similar to the surrounding tissues,
c. Sterile with excellent antioxidant properties,
d. Readily accessible and having a low cost.[4]

SALINE

Normal saline consist of solution of 0.90% w/v of NaCl with osmolality of 280 mOsm/kg. Despite being compatible to the cells of PDL, it lacks essential nutrients such as magnesium, calcium and glucose which

are required for normal metabolic activity of PDL cells. Moreira-Neto et al.[5] evaluated the viability of cultured cells and found 55% of living cells after 4 h storage and Pileggi et al[6] evaluated the PDL cells viability when maintained in this medium for 45 min and resulted in only 20% mortality. Using a similar methodology, Martin and Pileggi[7] found that saline had a worse behavior compared with HBSS and milk but it may be employed for short periods of time. Also the tooth stored in gauze soaked in sterile saline, according to the procedure for Raghoebar has also been evaluated to show good results in reimplantation.[8]

SALIVA

It is of short period of time having osmolality 60-70 mOsm/kg (much less than physiologic). So if storing duration goes for 2 to 3 hrs it may causes swelling and membrane damage of PDL cells.[9]

Lindskog et al in an in vivo study concluded saliva is less suitable compared to milk because of its low osmolality and higher risk of bacterial contamination.

MILK

Milk is knowns traditional interim storage media. Due to its physiologic properties like pH (6.5 to 7.2) osmolarity (270 mOsm/kg) and nutritive value, relatively free from bacteria & highly availability has made it an acceptable interim transport medium for avulsed teeth.[11] Several investigators like Blomlof and Otteskog 1980, Marino et al. 2000,[10] Lekic et al. 1998,Patil et al. 1994 compared milk with several other storage media and found that milk was superior to the others in maintaining the viability but not as good as HBSS.[12] Avulsed teeth stored in chilled milk can maintain sufficient number of viable periodontal ligament cells to support replantation of the tooth and the possibility of periodontal ligament healing compared to milk at room temperature.

HANK'S BALANCED SALT SOLUTION

It was introduced by John H Hank by 1975 for preserving the tissue cultures. It is a standard saline solution that is widely used in biomedical research to support the growth of many cells types. It is non-toxic, biocompatible with periodontal ligament cells, pH balanced at 7.2 and osmolality of 320 mOsm/kg.[13] It is composed of 8 g/L sodium chloride; 0.4 g/L of D-glucose; 0.4 g/L potassium cloride; 0.35 g/L sodium bicarbonate; 0.09 g/L sodium phosphate; 0,14 g/L potassium phosphate; 0.14 g/L calcium chloride; 0.1 g/L magnesium chloride and 0.1 g/L magnesium sulphate.

Ashkenazi et al Showed that Hank's balanced salt solution was the most effective medium for preserving viability, mitogenicity and clonogenic capacities of periodontal ligament cells for up to 24 hours at 4◦. The presence of magnesium, glucose and calcium reconstitutes and sustains the PDL cell layers.

ViaSpan

It is cold transport organ storage medium & has been effective medium for avulsed teeth. Its osmolality is 320 mOsm/kg, pH around 7.4 at room temperature, which is ideal for the cellular growth. Generally, ViaspanR is considered as a medium close to ideal, but the limited access to it, especially at the moment of the accident, makes it difficult to use.[10]

According to Ashkenazi et al, the clonogenic capacity of stored cells kept in ViaSpan for 8 hours was high & comparable to HBSS & superior to milk. This capacity was diminished 65% after 24 hours & was inferior to milk & HBSS. The drawback of viaspan was its high cost, short vitality expiration & difficulty in availability.

Eagle's medium

Eagle's Minimal Essential Medium contains 4 ml of L-Glutamine; 105 IU/L of Penicillin; 100µg/mL of Streptomycin, 10µg/mL of Nystatin and calf serum (10% v/v).[14] Ashkenazi et al[28] Eagle's medium had relatively high viability, mitogenic and clonogenic capacity up to 8 hours of storage at 4◦C. When the storage time was up to 24 hours, Eagle's medium was less effective than milk or HBSS.

GATORADE

It is non-carbonated sport drink consumed by non-athletes. Have osmolarity 280 to 360 mOsm/L & pH of 3.According to Harkacz et al, its not adequate storing medium for avulsed teeth due to its high osmolality and low pH. Better than tap water both at room temperature and on ice.Chamorro et al. 2008 showed that it contains fructose and glucose polymers as an energy source for the cells. But in contrast, it has an apoptotic trigerring effect in human PDL cells as it causes mild cell membrane damage due to the low pH which is not conducive to cell growth or survival.[15]

Emdogain (Enamel Matrix Derivative, EMD)

Emdogain commercial Enamel Matrix derivative extracted from developing embryonic enamel of porcine origin and contains several matrix proteins. Studies have shown that it can influence the migration, attachment, proliferative capacity and biosynthetic activity of PDL cells.[10] Can be also used in antiresorptive-regenerative therapy along with topical glucocorticoids and systemic doxycycline. However, no firm conclusion regarding the efficacy of EMD application on healing of replanted and autotransplanted permanent teeth can be drawn because of a lack of randomised controlled trials and clinical controlled trials.[13]

Soymilk

It is water extract of soybean which is rich source of high-quality protein and amino acid. Emmanuel j. N. L. Silva et al compared cytotoxic effects of soymilk with different storage media & concluded similar cytotoxicity values as that of whole milk, and HBSS solutions. It showed a physiologically compatible pH and osmolality.

Ascorbic acid

Osteoclastic cell lines along with ascorbic acid can stimulate type I collagen production followed by expression of specific markers associated with osteoblastic phenotypes (ALP & osteocalcin). Ishikawa et al observed that ascorbic acid increased the ALP activity which is important for binding of PDL cells to type I collagen via 2 beta 1 integrin, whose expression is again increased by ascorbic acid. Type I collagen being as a initial process in differentiation of PDL cells may be serve as storage medium.[16]

Salvia Officinalis

Perennial, evergreen shrub with long history of medicinal & culinary use.Has been confirmed as storage medium as it has antioxidants effects caused due to presence of its phenolic components (rosmarinic acid, camosic acid, salvianolic acid).Studies shows Salvia extract at 2.5% helps in maintaining PDL cells viability over longer periods of time (3, 6, 12 or 24 hours) compared to phosphate buffered saline, HBSS & tap water.

Green tea extract

Epigallocatechin-3-gallate [EGCG] is a major polyphenol of green tea having anti-oxidative, anti-carcinogenic, anti-mutagenic, anti-inflammatory, anti-microbial & anti-viral activities. Study stated that it have adequate efficacy as storage medium than HBSS & milk to promote reimplantation with less risk of root resorption & Ankylosis. Hwang et al & Jung et al concluded green tea maintain 90% of cell viability for upto 24 h which is similar to HBSS. Jung et al also observed that higher the extract concentration the more efficient is the medium. So it can be use as a suitable storage medium for avulsed tooth.[10]

Coconut water

It is biologically pure, sterile and natural isotonic fluid having pH of 4.1 and is rich in amino acids, proteins, vitamins and minerals. Gopikrishna *et al. has proposed coconut water as a promising medium for avulsed tooth but other studies suggested it as less efficient than milk.* Pearson et al. and Thomas et al. observed that inflammatory resorption was more frequent when the tooth was maintained in coconut water compared with milk.[16] *So m*ore research studies are required for its acceptance as storage medium.

PROPOLIS

Sticky resin that seeps from the buds or bark of trees, chiefly conifers. Main composition of propolis includes; a)Resin (rich in flavonoids) – 45-55%, b)Waxes & fatty acids- 23-35%, c)Essential oils - 10%, d) Pollen proteins – 5% and d)Other organic compounds & minerals. Antiseptic, antibiotic, antibacterial, antifungal, antiviral, antioxidant, anti carcinogenic, antithrombotic & immunomodulator properties. Mori et al concluded efficacy of the medium increases if maintained for 6 hours because the contact with the product is beneficial for cell maintenance.[18]

HONEY MILK

It is 8% non – fat solid milk, 3 gm protein, 11 gm carbohydrate, 0.1 gm calcium, 0.6 gm minerals & 0.12gm phosphorous & natural honey(5%). The storage capacity is of at least 6 months without need of refrigerator. After 9 hrs, long shelf life of honey milk showed better result than fresh milk.[19]

EGG WHITE

Another good choice for storing avulsed tooth as it contains high protein content, vitamins, water, lack of microbial contamination & easy accessibility. Ph is 8.6 to 9.3 & osmolality 258 mOsmol/kg. Khademi et al compared milk & egg white, results showed teeth stored in egg white for 6 to 10 hours had better repairing capacity than those of milk.[20] However there was no significant difference when compared with HBSS.

Tooth rescue box

It contains Special Cell Culture Medium (SCCM) including amino acids, vitamins and glucose. In Europe it is marketed as Dentosafe and in the USA as EMT Tooth Saver. Unopened box shelf life is 3years.[21] For 15 minutes its shows functional healing irrespective of storage duration. At room temperature, it maintains the vitality and viability of PDL cells for at least 48 hours. After the introduction and distribution of rescue box in Germany, the rate of healing after replantation has increased to 50%. So its advise to distribute it in accident prone areas (schools, sports, public pools etc.) & emergency units (hospitals etc.)

Morus rubra

Recently the juice of the fruit of *Morus rubra (red mulberry) has been recommended as a suitable transport medium for avulsed teeth.* It is considered as natural therapeutic belonging to the Moraceae family which is rich in flavonoids, alkaloids and polysaccharides components which are the most potent active constituents. At 4% concentration, *M. rubra is found to be more effective than HBSS up to 12 hours, in maintaining the PDL cells' viability*.[10] Since less studies have been conducted on red mulberry juice further more research are required to confirm its use as storage media for avulsed tooth.

Cling film

It is another recent alternative transport medium for a storage period of up to 6 hours. A study was done by Anja Zeissler et al in which they compared SOS ZahnboxR, UHT milk (4 °C), sterile isotonic saline solution, water (tap water), and cling film. According to Anja Zeissler et al, cling film storage medium shows probability of cell growth at the withdrawal time of 2 hours shows 86% and thus very high compared to tooth rescue box.[22] Up to the time of 6 hours it remained constant, then decreased to about half (43%) at 24 hours.

Cling film, by retaining the thin fluid film on the root surface, can create a physiologic environment necessary for cell survival.

Castor oil

Vegetable oil with antimicrobial and antioxidant properties, low toxicity, and glutathione preservation capability, low cost, and high availability. Also has the capacity to repair bone defects. Mohammadreza Nabavizadeh evaluate and compare the capacity of castor oil with HBSS and milk. The percentage of viable cells treated with castor oil, HBSS and milk counted immediately after removal from these media were 46.93, 51.02 and 55.10 % respectively. Castor oil was not able to preserve the viability of PDL cells efficiently comparable to HBSS and milk.[23]

CONCLUSION

Up to now, there is not a single product or solution that possesses all the characteristics required to be indicated as the ideal storage medium for avulsed teeth, that is, be capable of preserving the vitality of the PDL and pulp cells. Taking together the characteristics, efficacy and availability and accessibility, milk appears as the best indication of a temporary storage medium for avulsed teeth before replantation, and its use is recommended by the International Association of Dental Traumatology[24] and the American Academy of Pediatric Dentistry.[25]

REFERENCES

1. Sangappa SK. Kumar AP. Shruti. Srivastava P. Extra-alveolar storage media for teeth: A Litreture review. International journal of Advanced research, 2014; 2(7): 963-72.
2. Andreasen JO, Andreasen FM. Textbook and color atlas of traumatic injuries of the teeth. 3rd ed. Copenhagen: Munksgaard, 1981; 174.
3. L. Treatment of non-vital permanent incisors with calcium hydroxide. III. Variation of occurrence of ankylosis of reimplanted teeth with duration of extra-alveolar period and storage environment. Odontol Revy, 1974; 25: 43-56.
4. Hwang JY, Choi SC, Park JH, Kang SW. The use of green tea extract as a storage medium for the avulsedtooth. J Endod, 2011; 37: 962-967.
5. Moreira-Neto JJS, Gondim JO, Raddi MSG, Pansani CA. Viability of human fibroblasts in coconut water as storage medium. Intern Endod J, 2009; 42: 827-830.
6. Pileggi R, Dumsha TC, Nor JE. Assessment of post traumatic PDL cell viability by a novel collagenase assay. Dent Traumatol, 2002; 18: 186-189.
7. Martin MP, Pileggi R. A quantitative analysis of propolis: a promising new storage media following avulsion. Dent Traumatol, 2004; 20: 85-89.
8. Auto-Transplantation Of Mandibular Third Molar: A Case Report Tahir Ahmad, Syed Wakeel, Shajah Hussain, Shaista Rehman, Tahir Ahmad et al /Journal of Science, 2017; 7(1): 28-33.
9. Malhotra N. Current developments in interim transport (storage) media in dentistry: an update. Br Dent J, 2011; 211: 29-33.
10. Marino T, West LA, Liewehr FR, Mailhot JM, Buxton TB, Runner RR. et al.. Determination of periodontal ligament cell viability in long shelf-life milk. J Endod, 2000; 26: 699-702.
11. Courts F, Mueller W, Tabeling H, Milk as an interim storage medium for avulsed teeth. PD, 1983; 5: 183-186.
12. Schjott M, Andreasen JO. Emdogain does not prevent progressive root resorption after replantation of avulsed teeth: a clinical study. Dent Traumatol, 2005; 21: 46-50.
13. Franklin S. Weine. Endodontic Therapy.6th edi. St Louis:C.V. Mosby Company, 2004.
14. Goswami M, Chaitra TR, Chaudhary S, Manuja N, Sinha A. Strategies for periodontal ligament cell viability: an overview. J Conserv Dent, 2011; 14: 215-220.
15. Bazmi BA, Singh AK, Kar S, Mubtasum H. Storage media for avulsed tooth - A review. Ind J Multidis Dent, 2013; 3(3): 741-749.
16. Toby T, Gopikrishna V, Kandaswamy D. Comparative evaluation of maintenance of cell viability of experimental transport media “coconout water” with Hank’s balanced salt solution and milk, for transportation of an avulsed tooth: an in vitro cell culture study. J Conserv Dent, 2008; 11(1): 22–29.
17. Poi WR, Sonoda CK, Martins CM, Melo ME, Pellizer EP, Rogerio de Mendonca M et al. Storage media for avulsed tooth: a literature review. Brazilian Dental Journal, 2013; 24(5): 437-45.
18. Siddique F, Karkare S. Storage media for an Avulsed tooth: Nature to the Rescue. Br J Med Health Res, 2014; 1(3).
19. Trope M, Friedman S. Periodontal healing of replanted dog teeth stored in ViaSpan, milk, Hank’s balanced salt solution. Endod Dent Traumatol, 1992; 8: 183-188.
20. Udoye CI, Jafarzadeh H, Abbott PV. Transport media for avulsed teeth: a review. Australian Endod J, 2012; 38: 129-136.
21. Lajtman AZ, Connert T, Kuhl S, Filippi A. Cling film as storage medium for avulsed teeth.An in vitro pilot study. Swiss Dental Journal SSO, 2017; 127: 954–959.
22. Nabavizadeh MR., Abbaszadegan A., Shamseddin Ahzan Sh., Mehrabani D. Efficiency of castor oil as a Storage Medium for Avulsed Teeth in Maintaining the Viability of Periodontal Ligament Cells. J Dent Shiraz Univ Med Sci., 2018 March; 19(1): 28-33.
23. Flores MT, Andersson L, Andreasen JO, Bakland LK, Malmgren B, et al., International Association of Dental Traumatology. Guidelines for the management of traumatic dental injuries. II. Avulsion of permanent teeth. Dent Traumatol, 2007; 23: 130-136.
24. International Association of Dental Traumatology.
25. American Academy of Pediatric Dentistry.