

## Usage of different media for restoring tooth in tooth avulsion:

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**Abstract:** Replantation is widely accepted as an effective treatment option for an avulsed tooth. However, the long-term fate of replanted teeth is unpredictable; it is dependent on various factors such as the time interval between avulsion and replantation and the storage method of teeth during the extra-alveolar period. The appropriate use of storage media is an important clinical factor affecting the postoperative prognosis of avulsed teeth following replantation. Hanks Balanced Salt Solution (HBSS) or chilled milk are considered to be the most appropriate and clinically recommended storage media for avulsed teeth. The present review discusses the various available storage media for avulsed teeth and their potential maintenance of the vitality of periodontal ligament cells. A brief overview of the effect of clinical factors such as the storage time and temperature, and the osmolality of storage media on their efficacy is included.

**Keywords:** Hanks Balanced Salt Solution, Replantation, Avulsed tooth, extra alveolar period, Storage Media.

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### I. Introduction

The removal of whole tooth, as a result of trauma, from the socket is named as avulsion. Management of avulsion tooth is replantation of the tooth back into socket within 20-30 min after injury. The immediate concern is to stabilize the tooth in its normal position to allow re-attachment and re-organization of the periodontal ligament support. Immediate replantation is the recommended treatment for an avulsed permanent tooth. It is recommended to store the avulsed teeth in an interim storage medium, in cases of delayed replantation. Research has advocated the use of storage media such as milk and Hank's Balanced Salt Solution (HBSS), while condemning the use of others such as saline and saliva. Recently, agents such as propolis, culture media and growth factors have been suggested as suitable alternative storage media for avulsed teeth. The present review summarises the role of storage media in periodontal healing, the available media and the ongoing developments in this field. Management protocols for avulsed teeth should include management of the pulp and periodontal ligament (PDL) cells in order to improve the long-term prognosis and survival of these teeth(1). The use of an inappropriate transport or storage medium potentially increases the risk of PDL cell necrosis, which can result in ankylosis and replacement resorption of the tooth root(2).

#### Types of storage media:

There are many solutions that have been proposed and/or tested as storage media for avulsed teeth. The following were identified and reviewed as a result of the literature search: Hank's balanced salt solution (HBSS), Eagle's medium (EM), milk, ViaSpan, Gatorade, Custodiol, Dubelco's storage medium, propolis, tooth rescue box (Dentosafe), conditioned medium, contact lens solution, tap water, egg white, saliva, normal saline, salvia extract and coconut water.

#### Suitable media:

##### Hank's balanced salt solution:

HBSS is essentially a pH-balanced salt solution containing all of the essential metabolites and glucose necessary for the maintenance of cells. It contains some ingredients that can preserve cells and tissues for 24 h and both the pH (7.4) and the osmolality (280 mosmol kg<sup>-1</sup>) are ideal.(3,4) It can maintain the viability of PDL cells for several hours with a success rate of 90% reported when degenerated PDL cells were stored in HBSS for less than 30 min (3,4). The vitality, clonogenic and mitogenic capacity of PDL cells using this medium are excellent. HBSS is the only medium that can replenish metabolites in depleted PDL cells(2). It shows less root resorption.

##### Milk:

Milk as a storage medium is the most practical transport medium for the short-term storage of avulsed teeth because of its ready availability in almost all situations(8-10). It is reported that milk is a compatible short-term storage medium for teeth if they were placed in it within 15 to 20 min of being avulsed. Milk has a pH of 6.5 to 7.2 and osmolality of 270 mosmol kg<sup>-1</sup>. Milk can potentially maintain PDL cell viability for up to 2 h. The vitality, clonogenic and mitogenic capacity of PDL cells in milk are similar to the values for HBSS. At a cellular level, milk is ranked equal to HBSS as a storage medium although it loses its effectiveness after 2 h.

#### **Dubelco's storage medium:**

There is a variation of the Eagle's modified essential medium (EMEM), called Dubelco's modified Eagle's medium (DMEM), which contains approximately four times as much of the vitamins and amino acids present in the regular EMEM formulation and 2–4 times as much glucose. In addition to it, it contains iron and phenol red. DMEM is suitable for most types of the cells and tissues. (11) However, it is rarely available to the public and therefore of little value as a storage medium for avulsed teeth.

#### **Propolis:**

Propolis is a multifunctional material used by bees in the construction and maintenance of their hives. It has several biological activities which includes anti-inflammatory, antibacterial, anti-oxidants and anti-fungal(12). It is relatively non-toxic. It has been reported that 10% propolis more effective than milk, HBSS, tap water. It can inhibit the late stages of osteoclast maturation so it may be useful as an intracanal medicament to reduce resorption of traumatised teeth(14). In another study, cells stored in propolis showed the highest variability over those stored in HBSS, milk or saline in another study(15). As with most substances for natural therapies, propolis has no standard recommended weight per volume of solution. A recent study showed that propolis could be used for avulsed teeth and that a 6-h period of storage was more appropriate than 60 min of storage(16). The major disadvantage of propolis is that it is not readily available to the public and therefore of little value as a storage medium for avulsed teeth.

#### **Saliva:**

Saliva may be used as an immediate interim storage medium(17). Though very readily available, avulsed teeth should not be stored for longer than 30 min in saliva. Saliva contains potentially harmful substances, such as enzymes, bacteria and their by-products(18). A clonogenic capacity of 1.5% is obtained when PDL cells are stored in saliva for more than 30 min. The osmolality and clonogenic capacity are 60–75 mosmol kg<sup>-1</sup> and 7.6%, respectively. A clonogenic capacity of more than 3% is required for PDL healing(19). A precipitous decrease in functional capacity occurs within 60 min and saliva can potentially damage stored cells. Saline and saliva were suitable storage medium for protection against root resorption.

#### **Coconut water:**

Coconut water is biologically pure, sterile and rich in amino acids, proteins, vitamins and minerals. It is widely consumed to replace fluids, electrolytes (potassium, calcium and magnesium) and sugar lost from the body(20). This natural isotonic fluid is available in its natural form directly from the coconut or in long shelf life pack-ages and plastic bottles, mainly in tropical countries. Recently, the use of coconut water as a storage medium was investigated. Characteristics of pH, and osmolality directly influenced the capacity of the storage medium to maintain cell viability after a certain time(21). As a result of its high osmolality, composition and ready acceptance by the human body, coconut water has been studied as a potential interim storage medium for avulsed teeth but the pH of 4.1 is deleterious to cell metabolism. Coconut water by itself is less effective than coconut water and sodium bicarbonate(22). When compared with HBSS, propolis and milk using the trypan blue exclusion technique, it is found that coconut water was most effective. However, overall, the use of coconut water as a storage medium for avulsed teeth is not feasible under clinical conditions because of the difficulty of neutralising the coconut water to obtain a pH of 7.0.(23)

#### **Inappropriate media:**

##### **Tap water:**

Tap water is not compatible with PDL cells and causes rapid cell lysis. Blomlöf reported that water is damaging to PDL cells and is not a good storage medium at any time. As a result, it is not recommended as a possible storage medium. It has a pH of 7.4 to 7.79 and an osmolality of 30 mosmol kg<sup>-1</sup>. As it is hypotonic, it causes lysis of the cells(5). Although some studies have suggested that it may be accepted as a storage medium for very brief periods when there are no alternatives, it should be remembered that it is the least desirable storage medium available and its use will lead to ankylosis and replacement resorption(24).

##### **Contact lens solution:**

Contact lens solutions were initially thought to be of possible benefit as a storage solution for avulsed teeth because they are essentially saline solutions. However, subsequent studies showed that these solutions were damaging to PDL cells(25), and therefore, they are not recommended.

### Gatorade:

Gatorade was originally formulated as a drink for sports- people to replenish electrolytes during training and sports events. However, it can also be consumed as a routine beverage. Harkacz et al were the first to test its effectiveness as a storage medium(26). When compared with other media, Gatorade on ice was better than tap water on ice, and that Gatorade may be viable for the short-term storage of avulsed teeth. Gatorade is often available at sporting events but it has incompatible, harmful osmolality that causes cell destruction so it is not an ideal solution to use(27).

### Egg white

Egg white has a pH of 8.6–9.3 and its osmolality is 258 mosmol kg<sup>-1</sup>. No significant difference between egg white and HBSS at storage times of 2, 4, 8 and 12 h has been found and egg white was more suitable than water and milk(18). There was also no difference between egg white and Ca<sup>2+</sup>/Mg<sup>2+</sup> free HBSS. In a microscopic study, de Sousa et al. could not find any difference between milk and egg white. However, notwithstanding these findings, egg white as a storage medium suffers the setback of impracticality(18).

## II. Conclusion

All these media used for storing tooth are considered to be choice of storage media. The most suitable media are Hanks Balanced Salt Solution (HBSS) and coconut water. As above seen that HBSS is essentially a pH-balanced salt solution containing all of the essential metabolites and glucose necessary for the maintenance of cells and Coconut water is biologically pure, sterile and rich in amino acids, proteins, vitamins and minerals which is natural isotonic solution, they are considered to be so.

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