

Tooth Avulsion

PART II



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teeth has increased in the last fifteen years. Two factors that have a profound effect on the prognosis of replanted avulsed teeth are extraoral time of the avulsed tooth and the medium used to preserve the tooth before replantation. In these situations, a storage medium is necessary. Thus in order to optimize the chances for reimplantation success, the avulsed teeth should be placed in a good storage medium. There have been many storage media recommended and each will be discussed.

Dry storage leads to cell necrosis and compromised healing. Teeth prevented from drying will heal with normal ligament. The fundamental philosophy for the storage of avulsed teeth is that the teeth should be stored in an environment that most closely replicates the oral environment from which the teeth came. The normal metabolic, morphologic and physiologic conditions of the teeth should be paralleled as closely as possible.

Additionally, some storage media require refrigeration, for instance milk must be kept cold in order for it to function at an optimum level. This can become a problem if the child is rushed to a hospital emergency room where they may have to wait for hours before being seen, during this time, the teeth should be kept cold.

Another factor to consider is length of time the medium is effective. Only a few storage media have been tested for the length of time for which they remain effective. It has been determined by research that milk drastically loses its effectiveness after two hours of storage. Once again in the hospital scenario, milk will not be effective if the child waits for a long time. Some storage media, like HBSS and ViaSpan maintain their effectiveness for at least twenty-four hours.

Discussion of Storage Media

There have been many different storage media postulated for storage of avulsed teeth during transport to a dentist or emergency room. In order to provide the best opportunity for success following reimplantation, the best medium should be used.

Recent studies by Gopikrishna et al establish the potential benefits of coconut water on PDL cells of avulsed teeth. In this study it's concluded that coconut water statistically showed better viability of cells than propolis, HBSS, and milk. This might be due to the nutrients present in coconut water such as proteins, amino acids, vitamins, and minerals, which help in nourishing

the cells and maintaining their viability. The primary sugars present in coconut water are glucose and fructose, which are responsible for the high osmolarity of coconut water. It is also rich in many essential amino acids including lysine, cystine, phenylalanine, histidine, and tryptophan. Coconut (*Cocos nucifera* L.), popularly known as "Tree of Life," is a natural drink produced biologically and hermetically packed inside the coconut in a hygienic way without any contamination.

The electrolyte composition of coconut water resembles intracellular fluid more closely than extracellular plasma. The predominant cations are potassium, calcium, and magnesium. Sodium, chloride, and phosphate are found in much lower concentrations. It is a hypotonic solution that is more acidic than plasma, and has a specific gravity of approximately 1.020, comparable with blood plasma.

HBSS has unquestionably been the most tested solution. It stores and preserves avulsed teeth for at least 24 hours, needs no refrigeration, has ADA Seal of Acceptance FDA Approval. But it's only available in Save-A Tooth systems.

Eagle's Medium Stores and preserves teeth for 2 weeks, but it must be refrigerated and is not available except in research labs.

ViaSpan. Best preservation of all solutions, up to 72 hours Must be refrigerated Very expensive Not available in small containers.

0.9% normal sterile saline has a compatible osmolality with the PDL cells, but does not contain any nutrients to help maintain cell vitality. Therefore, sterile saline is only good as a short-term storage medium for avulsed teeth and should not be used if the tooth cannot be reimplanted within 1 hour.

Milk has a compatible osmolality with the PDL cells of an avulsed tooth and has been tested as effective to store teeth for no more than 2-3 hours. Milk does not contain the necessary nutrients to maintain the PDL cells for any longer periods of time. Additionally, there are issues related to the practicality of using milk that severely impact its efficacy.

Milk sounds, like an easy, inexpensive method for storage, however, using milk is not as effective as other media available and is logistically more difficult than other, more effective options. For example, if a child avulses a tooth on a remote sports playing field no milk

will be readily available. Additionally, the milk needs to be kept refrigerated during transport for the best prognosis.

Propolis, a substance made by the honeybee, is a potent antimicrobial, antioxidant, and anti-inflammatory agent. The main chemical classes present in propolis are flavonoids, phenolics, and various aromatic compounds. Flavonoids are well known plant compounds that have antioxidant, antibacterial, antifungal, antiviral, and anti-inflammatory properties. It has also been found that propolis is a superior transport medium to HBSS or milk in terms of maintaining PDL cell viability after avulsion and storage.

There is another commercially available product marketed for the storage of avulsed teeth called EMT Tooth Saver, which contains antibiotic-free protective medium. EMT Tooth Saver has not been tested for efficacy and does not have FDA approval or the ADA Seal of Acceptance. The compatibility of EMT ToothSaver cannot be known without research testing and therefore, this media cannot be recommended.

Water, Gatorade, and contact lens solution have all been tested as possible storage media for avulsed teeth. None of these possible media are compatible with the PDL cells and are therefore not recommended as a possible storage media. These media can actually harm the PDL cells that need to be protected.

Like water, saliva is not compatible with the PDL cells. In addition to the damage the saliva can cause to the cells, saliva also contains bacteria that can cause the PDL cells to become infected. Therefore, it is not recommended to store teeth in neither a cup with saliva nor in the mouth of the victim or another person.

Despite the fact that ViaSpan and Eagle's Medium provide the best storage environment, these media are not practical options. These media are not readily available to school nurses and are not packaged for individual uses. Despite the time advantages, these media may be cost prohibitive when compared to other options available, for example, ViaSpan is \$600 a gallon.

Coconut water, obtained from the fruit of coconut palm, grown in more than 93 countries around the world, which is natural, hygienic, and easily available in these geographical locations, can be advocated as a superior transport medium for avulsed teeth.

The ability of a storage/transport medium to support cell viability can be more important than the extraoral time to prevent ankylosis and replacement resorption. The American Association of Endodontics has recommended Hank's balanced salt solution (HBSS) as the storage medium of choice for avulsed teeth. Some authors suggested storing of an avulsed tooth in milk, HBSS, or saline (Buccal vestibule).

Tissue transport medium, such as Viaspan and Hank's Balance Salt Solution (HBSS) have exceptional ability to keep cells alive and are considered to be superior storage media. Readily available storage media for an avulsed tooth, in order of preference, are milk, saliva and saline. Water is not recommended because the hypotonic environment damages the PDL cells.

One study measured the average number of vital human lip fibroblasts remaining after 2-168 hours of storage in 3 media. This study showed that after 12 hours, Viaspan was effective at keeping 72.9% of cells vital while HBSS and milk maintained the vitality of 70.5% and 43.4% cells, respectively. In another study, HBSS, contact lens solutions, Gatorade, water and milk were compared at room temperature and on ice to determine which solution better maintained the viability of PDL cells after one hour of exposure.

This study found that HBSS was superior to the other liquids and that water had the most detrimental effect on PDL cells. Two percent milk followed by Gatorade preserved more viable cells than contact lens solution only if the liquids are kept on ice.

The Requirements for a Storage Medium for Avulsed Teeth

The prognosis for reimplantation of avulsed

