A comparative analysis of storage media for avulsed teeth

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The prognosis for reimplantation of avulsed teeth has increased in the last fifteen years. One of the primary reasons for this has been the recognition that the type of storage media used can greatly affect the prognosis. It is accepted by most dentists that the best treatment is always immediate reimplantation. However, this is not always possible, as may frequently be the case with frightened children. 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.

The Requirements for a Storage Medium for Avulsed Teeth

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 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. These have been listed in Table 1. A summary of the salient points regarding each medium has been included in this table.

Storage solution	Pros	Cons
Hanks Balanced Salt Solution[1] (HBSS)	Most tested storage medium Stores and preserves avulsed teeth for at least 24 hours Needs no refrigeration	Only available in Save-A-Tooth systems ADA Seal of Acceptance FDA Approval
Eagle's Medium	Stores and preserves teeth for 2 weeks	Must be refrigerated 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 compatible osmolality with PDL cells	Doesn't contain metabolites necessary for PDL cell metabolism
Milk	Has compatible osmolality with PDL cells Available to general public	Needs to be fresh and cold Doesn't replace depleted cell metabolites Doesn't facilitate cell mitosis Only effective for 2-3 hours Must be kept cold during transport and storage
Antibiotic-free protective medium	Found in a commercially-available device called EMT Toothsaver	Doesn't have ADA seal of acceptance No research testing of Antibiotic-free protective medium has ever been completed No FDA approval for sale
Enfamil	Available to the general public Some compatibility with PDL cells	Does not preserve PDL cells well Must be kept cold during transport Only viable for short term storage
Water	Available at most accident scenes	Incompatible, harmful osmolality that causes cell destruction
Gatorade	Available at some sporting events	Incompatible, harmful osmolality that causes cell destruction
Contact lens solution	Available to general public	Incompatible, harmful osmolality that causes cell destruction
Saliva	Available at every accident scene	Incompatible, harmful osmolality that causes cell destruction Bacteria found in saliva can cause infection of PDL cells

[1] It is important to note that Hank's Balalnced Salt Solution is NOT a saltwater solution. Some organizations recommend using water with a pinch of salt to store avulsed teeth. This is very damaging to the PDL cells.

In order to provide the best opportunity for success following reimplantation, the best medium should be used. The best media tested during research in descending order were ViaSpan, Eagle's Medium, and Hank's Balanced Salt Solution (HBSS).

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.

HBSS has unquestionably been the most tested solution. Of the other suggested solutions (see chart 1), the options that provide acceptable storage have limited availability and the options that are readily available are either far inferior to HBSS or are actually damaging to the PDL cells.

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 osmolalty 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. Therefore, a school nurse should have a storage media that can be located at the scene of any accident.

There is another commercially available product marketed for the storage of avulsed teeth called EMT ToothSaver, which contains antibiotic-free protective medium. EMT ToothSaver has not been tested for efficacy and does not have FDA approval nor 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.

There have been some recommendations to use tap water with a pinch of salt. The author believes this recommendation to be a misunderstanding of what HBSS and sterile saline are. HBSS is not a salt-water solution, but a scientifically designed researched fluid that contains all of the essential metabolites and glucose necessary for maintenance of cells. Adding salt to water will create a solution that is damaging to PDL cells.

HBSS is the author's recommendation for the optimal storage media for use in schools. HBSS, found in Save-A-Tooth has been tested for efficacy and is able to be kept in the school nurse's office as well as at sporting events without temperature control methods. Hopefully, this article provides information that will enable a school nurse to select the best storage medium for avulsed teeth. This selection can significantly affect the ultimate prognosis for avulsed replanted teeth.