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Storage Media for Avulsed Tooth: A Brief Review of Literature

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Abstract

Avulsion is the total displacement of a tooth from its socket, which causes the periodontal ligament to be torn. The cells of the PDL start to dehydrate after the avulsion. The effects of tooth avulsion will be limited if the PDL affixed to the root surface does not dry out. Since immediate replantation at the trauma site is not always realistically feasible, a "interim transport" medium is frequently needed to preserve the viability of PDL cells during the extra-alveolar time frame. The optimal storage medium should be able to maintain the cellular PDL so that the cell can undergo mitosis and create copies of the PDL's damaged fibroblasts and its generating cells. The aim of present review of literature is to discuss various storage medium in detail.

Keywords: *Avulsion, Transport medium, Replantation*

Introduction

Traumatic dental problems in children and teenagers around the world frequently involve injuries to the teeth and their supporting structures. Avulsion is the most severe type of traumatic dental injury because it completely separates the tooth from the socket.**[**1**]** The primary cause of the tooth becoming "separated" from the cavity is the periodontal ligament's (PDL) tearing, which leaves viable PDL cells on the majority of the root surface. Avulsion is characterized by the total displacement of the tooth from the socket, seriously impairing the neurovascular supply to the tooth and possibly causing its death. The cells of the PDL start to dehydrate after the avulsion.**[**2**]** If the PDL attached to the root surface does not dry out, the consequences of tooth avulsion will be minimal.**[**3**]** As immediate replantation is not always practically possible at the trauma site, an “interim transport” media often required to maintain the vitality (clonogenic and mitogenic capacity) of PDL cell during the extra-alveolar time period.**[**4,5**]** The aim of present review of literature is to discuss various storage medium in detail.

Ideal Properties of Storage Media:

A physiological solution that closely resembles the oral environment can be referred to as a storing medium in order to help maintain the viability of PDL cells after avulsion. Ideal properties of storage media are as follow: **[**6,7,8**]**

1. Good shelf life.
2. The cellularity of the remaining PDL should be preserved so that new cells can be generated.
3. Adherence of osteoclasts to the PDL fibers should be minimized.
4. Should have osmolarity and pH closer to physiological condition to maintain the viability of PDL cells.
5. It should not produce any antigen-antibody reaction.
6. It should be readily available at the site of accident so that the tooth can be immediately placed into it.
7. Should be capable of reducing inflammatory reactions and root resorption.
8. Antioxidant property to protect the damage of the cells from oxidative radicals.
9. Capable of removing toxic products.
10. Helps in restoring depleted PDL cells.

Commonly Available Storage Media

Tap Water:

As tap water's hypotonic osmolarity causes cell lysis and is reported to induce replacement resorption in avulsed teeth when they are placed in it, using it to store avulsed teeth is not advised. It is viewed as the least preferable storing option.**[**9**]**

Saliva:

A easily available, organic storage medium is saliva. Despite this, this can only be used as a temporary storage medium due to the existence of elements like enzymes and bacteria as well as its non-physiologic osmolarity, which can harm PDL cells. (no longer than 30 minutes). The functional ability of PDL cells is significantly reduced if stored for longer than 60 minutes.**[**10**]**

Milk:

The most widely accessible substance is milk. The use of milk as a storage medium is extremely advantageous due to a number of factors. Milk is superior to other storage options due to its physiologic characteristics, compatibility with periodontal ligament cells, ease of access, and lack of germs, but it must be consumed within the first 20 minutes of an avulsion in order to be effective. The presence of nutritional components like vitamins, amino acids, and carbohydrates contributes to milk's successful

outcomes as a storage medium. It contains hardly any or no microorganisms. It includes cell-essential nutrients and growth hormones. It is widely available, simple to obtain, and inexpensive. Even after up to 72 hours, the periodontal ligament cells have a survival rate of 70 to 90% and a reduced frequency of root resorption. Milk is recommended by Blomlof et al., as a great storage option for 6 hours; however, milk cannot restore the damaged cells.**[**11,12**]**

Normal Saline (NS):

Although NS is compatible with PDL cells and has an osmolarity of 280 m0sm/kg of sodium chloride, it lacks important nutrients like magnesium, calcium, and glucose that are needed for the PDL cells' typical metabolic requirements.**[**13**]** In a research to assess posttraumatic PDL cell viability in NS, Pileggi et al.**[**14**]** discovered that 55% of living cells remained after 4 hours of storage and 20% of cells died after 45 minutes.

Hank's balanced salt solution (HBSS):

Hank's balanced salt solution is a common saline solution that supports the development of various cell kinds. This fluid is non-toxic, pH-balanced at 7.2, has an osmolality of 320 mOsm/kg, and is biocompatible with periodontal ligament cells.**[**15**]** It contains 0.4 grammes of D-glucose, 0.4 grammes of potassium chloride, 0.35 grammes of sodium bicarbonate, 0.09 grammes of sodium phosphate, 0.14 grammes of potassium phosphate, 0.14 grammes of calcium chloride, 0.1 grammes of magnesium chloride, and 0.1 grammes of magnesium sulphate. (Biological Industries, Beit Haemek). It has components like glucose, calcium, and magnesium ions that can replenish the periodontal ligament cells' exhausted cellular components.**[**16**]**

Hank's balanced salt solution was discovered to be the best option for storing avulsed teeth in a study by Krasner. It does not require cooling and has a two-year shelf life. If an avulsed molar is soaked in this solution for 30 minutes, PDL cells are effectively preserved, degenerated PDL cells are renewed, and a higher success rate is maintained.**[**15**]**

Blomlof et al.'s research demonstrated that keeping the tooth in HBSS could increase the extraoral duration by up to 4 hours.9 In a thorough study, Hiltz et al. **[**22**]** demonstrated that HBSS is effective for 24 hours, with 71.3% of vital cells still present. At 48 hours, 38% of vital cells were present, and at 120 hours, no cell survived.**[**17**]**

Coconut Water:

Coconut water, also known as tender coconut water, is a natural beverage that is hermetically sealed inside the hard skin of the coconut. There is no contamination because it is clean and unadulterated. Because it more closely mimics intracellular fluid than extracellular plasma, it can serve as a replacement for plasma. Coconut water is regarded as a magical beverage because it replaces depleted sugars, fluids, and electrolytes. An avulsed molar can be stored using these qualities. The coconut water group showed noticeably more live PDL cells than Hank's balanced salt solution (HBSS) and milk, which are typically thought to be the best storage media, according to Moreira-Neto et al.'s comparison of various storage media.**[**18,19**]**

Current Trends in Storage Media

Propolis:

Honeybees naturally make a substance called propolis. It is a reddish or brown resin that honeybees gather from tree buds and use to cover cracks and to repair and varnish honeycombs. It can be found in green, scarlet, black, and white depending on the source, but typically it is a dark brown colour. It has anti-inflammatory, antimicrobial, and antioxidant effects. Propolis was tested as a storage medium for avulsed teeth by Mori et al., who came to the conclusion that the product's efficacy was enhanced if the medium was kept in place for 6 hours because it is good for cell maintenance.**[**20**]** Gjerston et al. conducted a study to assess the effect of propolis on proliferation and apoptosis of PDL fibroblast and found that propolis decreased the apoptotic levels of PDL fibroblasts activity of PDL cells when compared with HBSS.**[**21**]**

Soya Milk:

The soybean's product, soy milk, is a nutrient-dense food that is high in protein, amino acids, vitamins, and vital minerals. It has a physiological pH and includes very little saturated fat acids. The use of soy milk as a storage medium has been used because of its beneficial impacts on cell growth and its biochemical activities. According to research, when avulsed teeth are stored in soy milk for 24 hours, over 90% of the periodontal cells' viability is preserved, demonstrating the importance of soy milk as a storage medium. The excellent potential of soymilk as a storage medium and for the proliferation of various cell types has been described by the authors.**[**22,23**]**

Powdered Milk:

This is the most recent addition to milk alternatives and products that has been shown to sustain PDL cells' viability and has been suggested as a beneficial transport medium. One of the presentation forms of cow's milk is powder, and it's regarded as a workable solution in cases of postponed teeth replacement.**[**24**]**

Emdogain:

Emdogain (Biora, Malmo, Sweden) is a commercial EMD made from porcine embryonic enamel that is still in the process of developing and includes a number of matrix proteins. It can affect PDL cells' ability to migrate, adhere, proliferate, and engage in metabolic activity, according to studies.**[**25**]**

Egg White:

Water, minerals, and proteins make up egg whites. According to Khademi et al., in an animal study, teeth stored in egg white for 6 to 10 hours were more effectively restored than those stored in milk.**[**26**]** In a different study, Khademi et al. discovered that there was no discernible difference between egg white and HBSS and that it was superior to tap water and milk as well.**[**27**]** Egg white might be viewed as a suitable alternative storage medium due to its high nutritional value and accessibility at the trauma site.**[**28**]**

Aloe Vera:

The Liliaceae genus includes the cactus-like plant known as aloe vera. Aloe vera's interior gel is made up of more than 75 active substances. The residual 1-2% of the gel is made up of active substances like aloesin, aloin, aloe-emodin, aloemannan, acemannan, aloeride, naftoquinones, methylchromones, flavonoids, saponin, sterols, amino acids, and vitamins. 98–99% of the gel is made up of water. Aloe vera gel has pharmacological effects that reduce inflammation, fight bacteria, strengthen the immune system, and lower blood sugar levels. Chantarawaratit et al., studied the effect of acemannan on periodontal regeneration in furcation defect models. They found that acemannan significantly increased PDL cell proliferation, vascular endothelial growth factor, type I collagen and alkaline phosphatase activity. The potential of A. vera towards successful replantation can be attributed to periodontal cell proliferating potential of its active components.**[**4**]**

Dentosafe:

The brand name for a tooth rescue kit that contains a unique cell culture medium made up of vitamins, amino acids, and glucose is Dentosafe (Miradent, Germany). It is sold as EMT tooth saver in the USA. (Phoenix, USA). It has proven that PDL cells can remain healthy for 48 hours at ambient temperature. This medium has a three-year shelf life if it is unused.**[**4**]**

Conclusion

A number of variables, including the width and length of the root canal, the degree of damage sustained during avulsion and replantation, and storage media, affect the effectiveness of replanting an avulsed tooth. Due to their affordability and ability to sustain the viability of PDL cells for extended periods of time, natural products like coconut water, milk, and propolis can serve as suitable storage media. Additionally, there are natural products that are readily accessible at the injury site that can improve the prognosis for avulsed teeth

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