

**A comparative evaluation of the influence of various storage Medias on the fracture resistance of tooth fragment re-attached using an adhesive system- An in vitro study**

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**Abstract**

**Aim:** A comparative evaluation of the influence of various storage Medias on the fracture resistance of tooth fragment re -attached using an adhesive system.

**Introduction:** Reattachment of the tooth fragment is a very conservative and cost-effective approach in dealing with crown fractures. Hydration maintains the vitality and original esthetic appearance of the tooth. A detached

fragment should be immediately recovered after trauma and placed in a preserving medium to avoid dehydration and discoloration. It has been previously proven that keeping fractured tooth fragments in suitable storage environments increases its bond strength to tooth. So, in this study we will evaluate and compare the influence of different storage medias; Saline, Egg white, 50% Dextrose & Gatorade on the fracture

resistance of tooth fragment re attached using composite

**Result:** 50% dextrose showed highest fracture resistance among all the tested storage Medias.

**Conclusion:** Hydration of the fragment does improve its fracture resistance significantly. 50% Dextrose offers the highest fracture resistance values among the tested media and Egg white was the second best found.

**Keywords:** Traumatic dental injuries, Fragment reattachment, storage media, fracture resistance, 50% dextrose.

### Introduction

Traumatic dental injuries are one of the most common emergencies presenting in clinical practice, with a huge impact on the patients social and psychological well-being. (1)

Traumatic dental injuries most frequently appear in the form of uncomplicated enamel fractures, usually on the maxillary incisors. (1)

As reported by Uddin et al, maxillary central incisors alone account for 96% of such traumatic dental injuries. (2) Among children and adolescents, uncomplicated crown injuries account for 18-22% of all dental traumatic injuries. (8)

Considering the young age of the patient, it is of utmost important to restore such traumatized incisors in the most conservative manner. One such conservative approach was introduced by Chosack and Eidelman in 1964, wherein they advocated the reattachment of the fractured tooth fragment using a suitable restorative material. (7)

This minimally invasive approach presented with several advantages such as maintenance of the natural shape and hue of the fractured tooth, fast, convenient, safe protocol. Reattachment technique also helps to preserve the much important developing dental tissues. (3,4)

However, the success of reattachment procedure depends on the time elapsed since the fracture of the crown

fragment. It is imperative, to immediately reattach the detached fragment after the traumatic injury to avoid possible complications such as fragment discolouration and dehydration. (5)

Another factor playing a key role in the success of fragment reattachment is the type of storage of the fragment following trauma. A successful fragment reattachment depends on the intact retrieval of the fragment at the time of injury and adequate hydration of the fragment outside the mouth. Hydration maintains a natural esthetic appearance of the tooth, avoids its dehydration and discolouration. (6)

No previous study has been done evaluating the effect of storage medias such as Gatorade, egg white, 50% dextrose and saline solution on the fracture resistance of reattached tooth fragments.

Hence, the present study aimed to evaluate the effect of these storage medias on the fracture resistance of reattached incisor tooth fragments.

### Material And Method

36 extracted permanent maxillary central incisors, free of cracks, caries or any developmental anomalies were collected. Ultrasonic scaling of all the samples was done thoroughly. For the purpose of standardisation, a fracture line was marked 3mm away from the incisal edge on each sample. Sectioning of this 3mm fragment was done using a diamond saw and straight handpiece. Handpiece was held parallel to the incisal edge, and perpendicular to the long axis of the tooth.



Fig 1: Collection of 36 extracted maxillary central incisors.



Fig 2: Marking a line 3mm away from incisal edge.

Now the sectioned specimens were ready for storage in the experimental storage medias. The sectioned fragments were divided into 4 groups of 9 samples each based on the storage medium and stored in them for 24 hours.

The groups were as follows:

**Group A:** Saline

**Group B:** 50% Dextrose solution

**Group C:** Egg white solution

**Group D:** Gatorade solution. (PepsiCo)

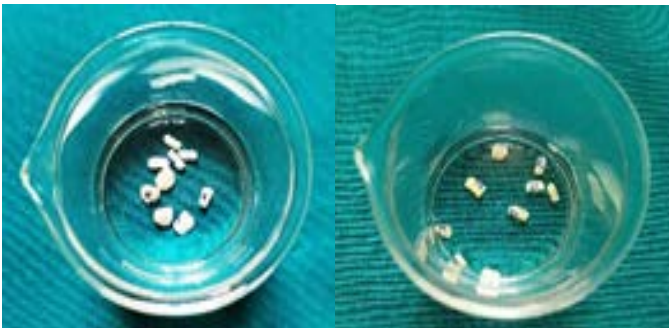


Fig 4 and 5: Samples stored in saline and 50% dextrose solution respectively.

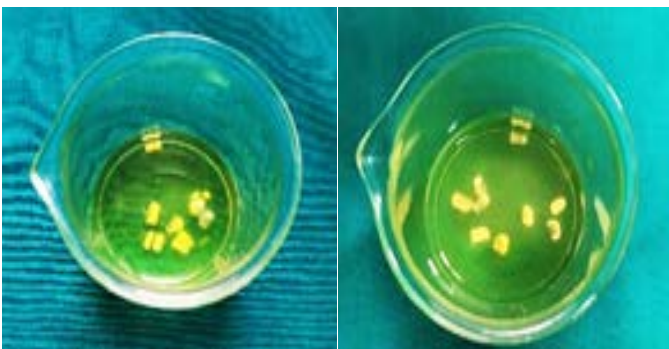


Fig 6 and 7: Samples stored in egg white and Gatorade solution respectively.

After 24 hours, each fragment was rinsed with water to wash away excess storage media solution.

Both the fragment and the remaining fractured tooth surface were kept in 0.9% saline solution until the restoration procedure was performed.

37% phosphoric acid etchant was applied to the fractured fragment for 15 secs followed by rinsing with water for 10 secs. A fifth generation total etch adhesive, fusion bond 5 (prevest) was applied in 2 consecutive coats. Then, the surfaces were dried for 5 s using an air syringe to allow solvent evaporation. The adhesive was light cured for 20 s.

A layer of composite resin, tetric n ceram was applied on both the bonding surfaces and the remnant and the fragment was pressed together for proper alignment.

Realignment of the fractured fragments at correct position was confirmed. Curing of composite resin was carried out from both labial as well as palatal aspect for a period of 40 secs per surface.

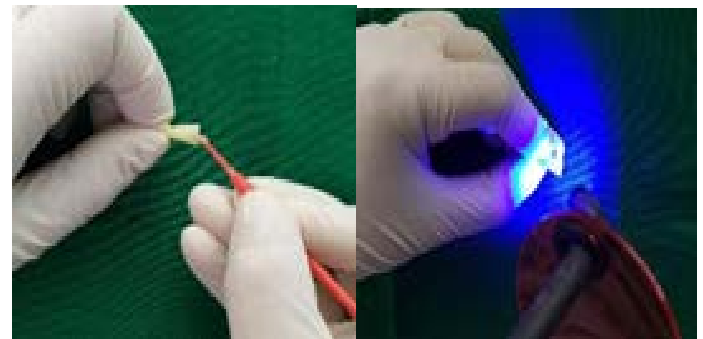


Fig 8 & 9: Etchant application, bonding agent application followed by light curing.



Fig 10: Clinical photograph of reattached sample, prior to testing.

Samples were then stored in physiological saline solution for 24 hours.

Samples were then embedded in self-cure acrylic resin blocks. All the samples were subjected to testing using universal testing machine and were subjected to a force of 1mm/min rate until failure. The rod of the universal testing machine was directed such that it was perpendicular to the labial surface adjacent to the reattachment line.

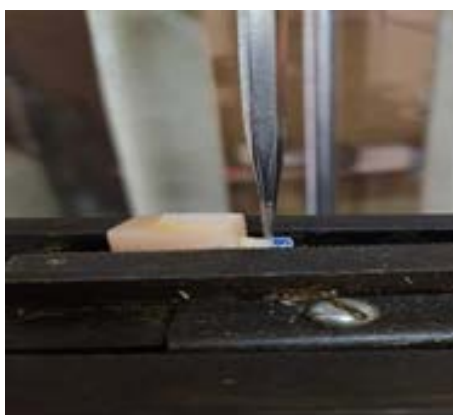


Fig. 11: Specimens evaluated in universal testing machine.

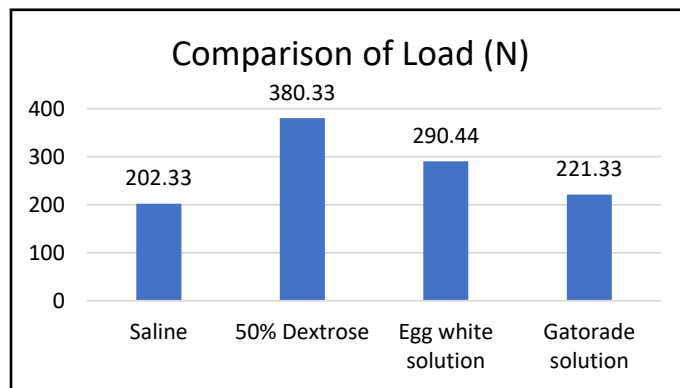
Bond strength values were then calculated as the force recorded by the fracture test in proportion to the area of the surface.

### Result

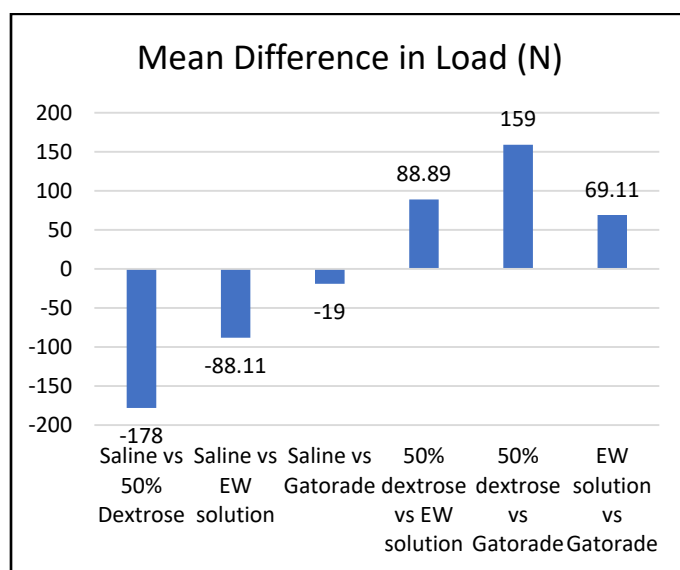
Load values (in newton) at the time of fracture of reattached specimen

	(LOAD IN NEWTON)								
GROUP 1 : (N=9) : SALINE	S1	S2	S3	S4	S5	S6	S7	S8	S9
	189N	197N	219N	205N	200N	212N	198N	195N	206N
GROUP 2 : (N=9) : 50% DEXTROSE	D1	D2	D3	D4	D5	D6	D7	D8	D9
	373N	469N	409N	345N	420N	382N	320N	356N	349N
GROUP 3 : (N=9) : EGG WHITE SOLUTION	E1	E2	E3	E4	E5	E6	E7	E8	E9
	298N	297N	263N	272N	310N	315N	283N	299N	277N
GROUP 4 : (N=9) : GATORADE SOLUTION	G1	G2	G3	G4	G5	G6	G7	G8	G9
	234N	220N	215N	207N	232N	212N	237N	212N	223N

Comparison of the average fracture load values in newton among the study groups



Mean difference in fracture load value among the study groups (in Newton)



Groups	N	Mean	Std. Deviation	p value
Saline	9	02.33	9.192	0.001*
50% Dextrose	9	380.33	45.793	
Egg white solution	9	290.44	17.636	
Gatorade solution	9	221.33	10.863	

Pairwise comparison of the mean difference in fracture load values among study groups

Pair	Mean Difference	p value
Saline vs 50% Dextrose	-178.00	0.001*
Saline vs EW solution	-88.11	0.001*
Saline vs Gatorade	-19.00	0.405 (NS)
50% dextrose vs EW solution	88.89	0.001*
50% dextrose vs Gatorade	159.00	0.001*
EW solution vs Gatorade	69.11	0.001*

On comparison of the fracture resistance for the various storage Medias, highest values were obtained for 50% dextrose solution, followed by egg white solution, Gatorade solution, and saline (control group).

The comparison of average load values in newton before fracture shown by the re attached fragments, 50% dextrose revealed highest mean values of 380N.

**Discussion**

Management of traumatized teeth includes direct and indirect restorative procedures, and even complete coronal coverage. (9)

Reattachment technique more effectively matches the natural shape and colour of the tooth. (10)

50% Dextrose gave better results than egg white, and saline media when fracture resistance of re attached fragment was evaluated.

Higher fracture resistance of 50% Dextrose is related to its High osmolality. (11)

Shirani *et al.* concluded preservation of the fractured tooth fragment in egg white or hypertonic solution results in a higher fracture resistance of the bond between the restored fragment and the tooth as compared to storage in water or dried conditions.

Khademi et al compared milk and egg white solution as storage Medias and found that fragments stored in egg

white solution for 6 hours had a better incidence of repair than the ones stored in milk for the same time duration (12)

Egg white was considered as a good storage media owing to its high content of proteins, vitamins and water, absence of microbial contamination and ease of availability.

Gatorade is a brand of sports themed food and beverage products manufactured by Pepsico and distributed over 80 countries. It consists of a mix of water, sodium, sugar, potassium, phosphate and lemon juice. (13)

Sigalas et al also reported Gatorade to be an effective media as an alternative for HBSS and Coconut water, when used at a low temperature, and as immediately as possible.

Although it is a highly hypertonic solution with harmful osmolality it has been found to be a better storage media than tap water and normal saline. (13)

**Conclusion**

Within the limitations of this study, it can be concluded that:

- Hydration of the fragment does improve its fracture resistance significantly.
- 50% Dextrose offers the highest fracture resistance values among the tested media and Egg white was the second best found.

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