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EFFECT OF DIFFERENT STORAGE MEDIA ON THE BOND STRENGTH OF FRACTURED PARTS BEFORE RE-ATTACHMENT: AN IN VITRO STUDY.

Dental Science

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ABSTRACT

AIM: The aim of this study was to examine various storage environments for storing fragments before being bonded to the remaining teeth.
MATERIALS AND METHODS: Forty maxillary incisor teeth were fractured on the incisal one-third and were divided into four groups of 10 each to be stored in normal saline, milk, coconut water and dry environments for 24 hours. All the fractured parts in each group were bonded to their relevant apical parts by an etch and rinse bonding system and a flowable composite resin. The fracture resistance was measured by a universal testing machine, and the results were analyzed using one-way ANOVA and Tukey statistical tests.
RESULTS: The results revealed that the difference among the four groups was statistically significant (P=0.000). Tukey tests showed that the force required for fracturing fragments kept in the milk environments were significantly higher than those for the normal saline, coconut water and dry environments (P>0.05).
CONCLUSIONS: It was concluded that keeping the fractured parts in milk storage environment can increase the required force for fracturing teeth more than the other environments.

KEYWORDS

Fragment, Milk, Coconut Water, Normal Saline.

INTRODUCTION:
Dental trauma is a common occurrence and attending to patients with fractured teeth is an important aspect of clinical dentistry. Coronal fractures of permanent incisors represent 18 – 22% of all traumas to dental hard tissues; of these 96% involve maxillary incisors[1].It has no perspective method for occurring, possesses no significant predictable pattern of intensity or extensiveness. One of the most common anterior tooth fractures are Ellis class I and class II (enamel and enamel-dentin facture without involving pulp). In various situations different techniques have been suggested for restoring the fractured crowns such as stainless steel crowns, pin retained resin restorations, and composite build-ups. However if the crown fragment is retrieved immediately after trauma, reattachment of the crown fragment could be a possible treatment option[2]. This technique of reattachment is preferred due to various reasons. One the major being aesthetics, as enamel's original shape and color, brightness and surface texture are maintained. Apart from superior natural appearance there are additional properties adding to the importance of reattachment such as harmonious wear as most of the composite resin build ups wear out faster while the patient's own incisor edge will wear harmoniously, there is also preservation of pulp vitality. Moreover to the above mentioned importance this technique is very conservative and is a very cost effective approach[3-4].Second injury or non-physiologic use of the tooth is contributing factors to the loss of restorations of fractured teeth[5]. The maxillary incisors face many remarkable forces due to their distinctive position and function[6].

The prognosis of the fragment reattachment depends on the firm attachment of the fragment with impervious margins along with strong bonding between the two segments[1]. Many theories do suggest that even if the reattached fragment can resist the load during mastication, there should be improvement to overcome the traumatic situations. Various studies are done on type of restorations, materials used for restorations, techniques used for attachment[7]. Improving the bond strength is the basic objective of the recent researches done. Keeping the fractured part in a wet environment before reattaching has been proved in supporting the effect of a moist environment[8-9]. For successful reattachment of a fractured fragment the, the fractured part plays an important role. It also depends on patient's awareness as after a period of time the fractured part may variably lose its moisture. Final strength of the restoration has been proved to be affected by factors like dehydration and rehydration of the fragments and the duration of the rehydration phase[2,10]. Very few studies give information about environments like saliva, water, milk and normal saline for storing fragments of fractured teeth. Dentin moisture is essential for achieving high bond strength of composite resins and dentin, this dentin moisture is affected by restoration time. A storage medium has equal importance in preserving its vitality before rebonding[3].There have been various studies accounting for the changes in the bond strength of reattached crown fragments affected by different environments. Awareness of public for dental emergencies and their management can lead to better prognosis. The present study was carried out to determine and evaluate the effect of storing the fractured fragments in different storage media prior to reattachment on the bond strength of the composite resin used for restoring the tooth and to evaluate a better storage media amongst normal saline, milk, coconut water and dry environment.

METHODOLOGY:
40 maxillary incisors were selected for this study from the Department of Oral and Maxillofacial Surgery, School of Dental Sciences, KIMSDU, Karad. These 40 teeth were then randomly divided in 4 equal groups (n=10). Each tooth was marked at 3mm from the incisal edge and was cut on the marked line using saline as coolant with a low speed diamond disk, then on lingual side of each tooth, an enamel-deep

fracture line was made using a diamond disk. On the labial side, a small notch was made in the middle. They were then fractured by a perpendicular force applied labio-lingually. The force was applied on the enamel cut by a blade on the lingual surface of the tooth and by another blade positioned on the labial surface. Then, the apical parts were kept in distilled water and at an ambient temperature .The fractured fragments were stored in separate containers with suitable storage media which were milk, saline and coconut water for 24hrs. After 24 hours fragments were reattached using bonding agent and composite, without any additional preparation. The fractured surfaces were etched with 35% phosphoric acid for 15 seconds, rinsed for 15 seconds and dried. Layer of the bonding agent(single bond (3M)) was applied on the etched surfaces and then thinned gently by air blow for 3 seconds. Bonding agent was cured using light cure unit at a wavelength of 480nm. For reattachment a flowable composite (3M, ESPE Filtek Z 350xt) was used on both fractured surfaces and both the parts of the tooth were aligned together applying light pressure and light cured (Blue Phase, Ivoclar Vivadent, Liechtenstein) for 40 seconds from labial and lingual directions and 30 seconds from the mesial and distal sides. Reattached samples were kept in saline. Samples were mounted in acrylic blocks such that the roots were embedded in acrylic resin up to the cingulum, the line of axis of acrylic block being parallel to the long axis of the tooth. The specimen was loaded on a universal testing machine (Instron, H Humboldt universal machine, USA) (figure.1) and a load was applied using a stainless steel point or device of approximately 3mm diameter. The force application tip was positioned exactly on the material surface, perpendicular to the facial surface of crowns. The machine was activated at a speed of 3mm/min until specimens fracture. The force required to fracture each specimens was recorded in Newtons.

Figure.1

RESULT:-

The forces required for fracture in each group are shown in Table 1. The highest force required for fracture is seen for Group 3 and lowest required force for fracture is seen for group 2. One-way ANOVA indicated differences in the amount of force required for making fractures in different groups (F= 19.743, P = 0.000).

There was significant difference between groups 1, 2, 4 compared with group 3 (p=0.000). The required force for fracture is less in Group 2 compared with Groups 1, 3 and 4. Group 2 has the lowest required force for fracture, though not significantly different from Groups 1 and 4 (P > 0.05).

Table 1: Required force (N) to fracture specimens according to the storage environment for each experimental group

Group	ENVIRONMENT	Shear Force In Newtons			
		Mean (n)	Standard Deviation	Minimum Force (n)	Maximum Force (n)
1	Normal saline	191.243	45.046	135.530	264.500
2	Dryenvironment	118.547	68.158	40.860	274.590
3	Milk	338.618	14.258	325.440	366.590
4	Coconut water	192.693	37.920	37.920	390.620

Table 2: Level of significance according to Tukey's test

Group	Environment	Group 1	Group 2	Group 3	Group 4
1	Normal saline		0.081	0.000	1.000
2	Dry environment	0.081		0.000	0.073
3	Milk	0.000	0.000		0.000
4	Coconut water	1.000	0.073	0.000	

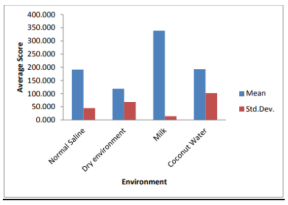

Fig 2. Graph representing the value of shear bond strength.

DISCUSSION:

The effect of reattachment techniques has been earlier studied with the amount of time affecting the rehydration of the fractured fragment. Maintenance of adequate hydration of the fracture fragment when it is outside the mouth is another important factor to ensure adequate bond strength[12].With technique and time, the storage medium also has an important part to play in prognosis of reattachment. The storage medium has a deep impact on the bond strength of the reattached fragment[13]. In this study maxillary central incisors were chosen because they are more prone to fractures. Uncomplicated fractures or Ellis class II fracture is the fracture of dentin. This fracture causes exposure of the dentinal tubules. In this study, comparison in between the four media normal saline, dry environment, milk and coconut water has done. The results proved milk to be the best storage medium. And dry environment proved as not to be a suitable medium. Dry environment causes desiccation of tooth fragments. As the fragments are dry there is loss of moisture. Again acid etching causes excessive loss of moisture, which affects the bonding[12]. Hydration is important to maintain original esthetic appearance of the tooth[14]. Many operative procedures have been suggested by literature, from no additional tooth preparation to various preparation options such as: circumferential bevel, internal groove, external chamfer and superficial over contour of composite on the fracture line[15-18].

In this study these techniques are not used as the main focus is on preservation of fractured fragments and bond strength. It is said bonding agent also influence the strength of bond between enamel and dentin and studies have shown better results for single bond than self etch adhesive system which are said to have weaker enamel bond[19]. The storage conditions of the fractured segments have gained much concern in predicting the prognosis of reattached teeth. Proper storage medium helps to prevent dehydration and collapse of the collagen in the fractured segment and any dimensional change. Sterile saline at 37 °C has been recommended as a suitable medium[20].It has been shown that differences in the bond strengths are evident after preservation in different media. There are few studies comparing the storage medium for fractured fragment as well on its bond strength of reattachment of crown fragments to fractured teeth. Mainly the selection of the storage conditions in this study is based on easily available materials to the patients like normal saline, milk and coconut water. Milk is proved to be best storage media for fractured fragment in our study. These results are in accordance with findings of FarzanehShirani[3,11] and Mohammad Reza Malekipour[13] , Sharmin DD[21]where they concluded that keeping the fractured parts in milk and saliva environments can increase the required force for fracturing teeth more than the other environments. Storing the fragment in milk resulted in higher fracture forces compared to coconut water, normal saline and dry conditions. Milk is isotonic and has physiological pH, osmolality and contains small bacterial contents, growth factors and nutrients and is proved to have excellent efficacy for storage of avulsed teeth also.[22]. In our study, dry environment group has shown lowest required force value for fracture which may be due to collapse of collagen because of loss of moisture, though not significantly different from significantly different from normal saline and coconut water. This may be due rinsing which enhances bond strength due to rehydration as stated by one of the study that rinsing which was done in the dry environment group let to produce the similar results to that of the groups with normal saline and coconut water storage environments[3].

Fracturing teeth rather than using disc for sectioning would result in preservation of natural enamel prism alignment along the surface and a closer match to the clinical condition[23]. This also helps to simulate the tooth tissue in trauma situations[11]. Best storage media, as observed in our study, milk. It seems that osmotic and isotonic therefore it has said dimensional changes happen in the dentin surface and stronger bond strength is achieved[3]. It has been proved that milk contains calcium and phosphate which can harden and stiffen both demineralized and

healthy dentin by permeating the surface. Surface topography of dentin is affected by Calcium and phosphate sedimentation and the degree of its dissolution during acid etching, which contributes to better bond strength in the milk. Further studies are required to investigate the advantage of storage environment on the bond strength of reattachment of crown fragments to fractured teeth[23-24].

CONCLUSION:

This study shows milk to be the best environment for storage of fractured fragment as compared to normal saline, coconut water and dry storage media which is easily available. Also the storage media has impact on force required to fracture the restored teeth.

REFERENCES:

1. David Ditto Sharmin, Eapen Thomas. Evaluation of the effect of storage medium on fragment reattachment. Dent Traumatol. 2013; 29: 99-102.
2. Claudia Ines Capp, Maria Inez Roda, Regina Tamaki, Gisela MuassabCastanho, Maite Andre Camargo, Antonio Alberto de Cara. Reattachment of rehydrated dental fragment using two techniques. Dent Traumatol. 2009; 25: 95-9.
3. FarzanehShirani, Mohammad Reza Malekipour, Dana Tahririan, VahidSakhaeiManesh. Effect of storage environment on the bond strength of reattachment of crown fragments to fractured teeth.J Conserv Dent. 2013;14: 269-72.
4. YucelYilmaz, CigdemZehir, OzgeEyuboglu, NihalBelduz. Evaluation of success in the reattachment of coronal fractures. Dent Traumatol. 2008; 24: 151-8.
5. Andreasen FM, Noren JG, Andreasen JO, Engelhardtsen S, Lindh-Stromberg U. Longterm survival of fragment bonding in the treatment of fractured crowns: a multicenter clinical study.Quint Int. 1995;26:669–681.
6. Macedo GV, Diaz PI, De O, Fernandes CA, Ritter AV. Reattachment of anterior teeth fragments: a conservative approach. J Esthet Restor Dent. 2008;20:5–18; discussion 19-20.
7. Reis A, Kraul A, Francci C, et al. Re-attachment of anterior fractured teeth: fracture strength using different materials. Oper Dent. 2002;27:621–627.
8. Marino TG, West LA, Liewehr FR, et al. Determination of periodontal ligament cell viability in long shelf-life milk. J Endod. 2000;26:699–702.
9. Harkacz OM Sr, Carnes DL Jr, Walker WA 3rd. Determination of periodontal ligament cell viability in the oral rehydration fluid gatorade and milks of varying fat content. J Endod. 1997;23:687–690.
10. Farik B, Munksgaard EC, Andreasen JO, Kreiborg S. Drying and rewetting anterior crown fragments prior to bonding. Endod DentTraumatol. 1999;15:113–116.
11. F.Shirani, V SakheiManesh, MR Malekipour. Preservation of coronal tooth fragments prior to reattachment. Aust Dent J. 2013;58:321-5.
12. Capp CI, Roda MI, Tamaki R, Castanho GM, Camargo MA, deCara AA. Reattachment of rehydrated dental fragment using two techniques. Dent Traumatol. 2009;25:95-9.
13. Mohammad Reza Malekipour, FarzanehShirani, ParvanehBahrami.The effect of different preservation environments on shear bond strength of fractured parts before re-attachment. Journal of Isfahan Dental School. 2009; 4:179-84.
14. AndreasenF,&Andreasen J (2007) Crown fractures In: Andreasen J, Andreasen F, &Andersson L (eds) Textbook and Color Atlas of Traumatic Injuries to the Teeth Blackwell Munksgaard, Oxford, UK 280-313. .
15. Badami AA, Dunne SM, Scheer B. An in vitro investigation into the shear bond strengths of two dentin bonding agents used in the reattachment of incisal edge fragments. Endod Dent Traumatol. 1995;11:129-35.
16. Reis A, Francci C, Loguercio AD, Carrilho MR, Rodriguez Filho LE. Reattachment of anterior teeth: fracture strength using different techniques. Oper Dent. 2001;26:287-94.
17. Reis A, Loguercio AD, Kraul A, Matson E. Reattachment of fractured teeth: A review of literature regarding techniques and materials. Oper Dent. 2004;29:226-33.
18. Giriyappa RH, Chandra BS. Comparative evaluation of self-etching primers with fourth and fifth generation dentin-bonding systems on carious and normal dentin substrates: An in vitro shear bond strength analysis. J Conserv Dent. 2008;11:154-8.
19. Chu FCS, Yim TM, Wei SHY. Clinical considerations for reattachment of tooth fragments. Quint Int. 2000; 31:385-391.
20. Sharmin DD, Thomas E.Evaluation of the effect of storage medium on fragment reattachment. Dental Traumatol. 2012; 29:99-102.
21. Wilson Roberto Poi, CelsoKoogiSonoda, Christine Men Martins, Moriel Evangelista Melo, Eduardo Pizza Pellizzer, Marcos Rogerio de Mendonca, Sonia Regina Panzarini. Storage Media For Av u l s e d Te e t h : A L i t e r a t u r e Review. Braz Dent J. 2013; 24: 437-45.
22. Pusman E, Cehreli ZC, Altay N, Unver B, Saracbasi O, Ozgun G. Fracture resistance of tooth fragment reattachment: effects of different preparation techniques and adhesive materials. Dent Traumatol. 2010; 26: 9–15.
23. O'Donnell JN, Schumacher GE, Antonucci JM, Skrtic D. Adhesion of amorphous calcium phosphate composites bonded to dentin: A study in failure modality. J Biomed Mater Res B Appl Biomater. 2009;90:238-49.
24. Arhun N, Ungor M. Re-attachment of a fractured tooth: A case report. Dent Traumatol. 2007; 23: 322-6.