

Evaluation Of Bond Strength Of Wire Splinting Material To The Teeth After Brushing Simulation Using Fluoridated And Herbal Toothpaste - An In Vitro Study

Research Article

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Abstract

Introduction: There are numerous procedures to stabilize the traumatized teeth with different splinting materials. Bond strength is defined as the amount of adhesion between bonded surfaces. It is measured by the stress needed to separate the bonded layers from each other. Brushing simulator machines are capable of running programmable three-dimensional brushing patterns. The aim of the study is to evaluate the bond strength of wire splinting material to the teeth after brushing simulation using fluoridated and herbal toothpaste.

Materials And Methods: In this study the bond strength was evaluated of the wire splinting material after introducing them to the brushing simulator machine. The materials used were, 10 pairs of maxillary central incisors, ligature wire, composite, etchant, bonding agent. The splinted samples were subjected to the brushing simulator machine after the splinting process and the bond strength of wire splinting material was evaluated post brushing simulation using Instron E 3000 universal testing machine.

Results: Colgate toothpaste group had mean value of 161.25 followed by herbal toothpaste group with mean value 52.53. The standard deviation for colgate group was 187.67 followed by herbal toothpaste group with 57.14. Independent sample t test was done and p value was 0.12, which is more than 0.05, hence statistically insignificant.

Conclusion: Within the limitations of the study, it can be concluded that the wire splinting material exposed to brushing simulation with fluoridated toothpaste showed higher bond strength than that of herbal toothpaste.

Keywords: Bond Strength; Splinting; Brushing Simulator; Composite; Innovative Measurement.

Introduction

Dentoalveolar trauma is considered to be an emergency condition as well as challenging for every dentist [1]. Periodontitis is the bacterial infection that most often arises from dental plaque, if untreated it leads to tooth mobility [2]. Dental splinting is the most widely accepted and executed treatment option in case of trauma like that of subluxated, luxated, avulsed and root fractured teeth. There are numerous procedures to stabilize the traumatized teeth with different splinting materials. This generally involves the process of using a conventional orthodontic wire, which is attached to the teeth using dental composite. Alternatively it can be realigned using acrylic cap splint, porcelain veneers, acid etched splints, complicated procedures like trans-alveolar sutures and fi-

bre reinforced composite splints [3]. In an overview, it can be seen that dental splints require a quick setting material without any aid for special preparation of the involved tooth structure [4].

A dental splint is defined as a rigid or flexible device with a prior function of supporting the involved tooth structure followed by supporting, protecting, immobilizing teeth that have been weakened because of endodontic or periodontal etiology, traumatically injured, replanted, or fractured cases. In general, the use of a splinting process is not recommended for injuries that occur to the primary dentition (like that of avulsion or luxation [5]). Luxated milk teeth mostly undergo the process of extraction. During this scenario the process of repositioning is not recommended as there is a high chance of infection which could endanger the tooth bud of permanent dentition. Splints are categorised as rigid

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and non-rigid/semi rigid/ flexible splints based on their possibility of the physiological mobility of the teeth. In case of ankylosis or external resorption the rigid splints are employed which does not permit any physiological mobility of the tooth. On the other hand, in a non-rigid splint the physiological functional mobility is possible for a traumatised tooth, thereby healing the periodontal ligament.

Cyanoacrylate ester adhesives are used as a better alternative for splinting of replanted teeth. The material comes with numerous pros enabling its wide usage in the society, by drying up quickly thereby easy facilitation of procedure in the dental clinic. There is no carcinogenic approach by the material, but on its darker side it can lead to neurological and respiratory problems leading to contact dermatitis and urticaria. With the field of advantages encircled by various splinting materials, Ribbond is the most preferred reinforced ribbon made up of high ultrahigh molecular weight polyethylene fibre with an ultrahigh modulus. In the clinical setup it can be used as an application to periodontal splinting, direct bonding of endodontic post and core, trauma stabilization [6].

Bond strength is defined as the amount of adhesion between bonded surfaces. It is measured by the stress needed to separate the bonded layers from each other [7]. This property exhibited by various splinting materials is not the same for all. The bond between the teeth structures to be intact in the same position there curing the periodontal ailment gradually [8]. Brushing simulator machines are capable of running programmable three-dimensional brushing patterns. Programmable mechanical brushing simulators are now a well-established method for the analyses of toothbrush efficacy. The machine works as an alternative to the normal brushing pattern. It allows proper brushing patterns rendered by the toothbrush for the desirable amount of year [9]. For the process of splinting, etching, bonding and composite application on the orthodontic wire is done followed by curing. Evaluation of these wire splinting materials after brushing simulation are not widely reported. Hence, the aim of the study is to evaluate the bond strength of wire splinting material to the teeth after brushing simulation using fluoridated and herbal toothpaste.

Materials and Methods

Preparation of the specimens

The original study was done in White Lab, Saveetha Dental College and Hospital. Maxillary central incisors, in pairs, were used as samples. A total of 10 pairs of maxillary central incisors free of any carious lesions (extracted due to periodontal problem), with a total of 20 teeth in number were used in the study. They were mounted on top of the single 6X4cm acrylic block by the help of beading wax which inturn was kept on top of each die stone for

a stable base, as seen in figure 1. They were divided into 2 groups based on the usage of toothpaste as colgate and herbal; A being fluoridated (Colgate) and B being herbal (Dabur).

Splinting technique

The splinting with wire splint was carried out in a dry field at room temperature. The clinically used ligature wire was incorporated for the study. The middle third of the labial surface of the teeth were initially acid etch by the usage of 37% orthophosphoric acid gel for 20 seconds, after which it was rinsed for 20 seconds and air dried completely. A fifth generation bonding agent was then properly applied on to the top of the etched surface of the teeth. This was followed by the 20 seconds of light cure process using a LED light curing unit. Further ligature wire was placed on the crown surface which was etched and bonded using composite resin. The flowable composite was light cured for 20 seconds using a LED light curing unit.

Brushing simulation technique

The samples were subjected to the brushing simulator machine (ZM3.8 SD Mechatronik), by the application of herbal toothpaste for the 5 pairs and the rest 5 pairs being applied by colgate toothpaste. 10,000 cycles with linear x-axis and y-axis, 2,500 cycles by clockwise and 2500 cycles by anti-clockwise motions were followed (figure 2).

Measurement of bond strength

For the proper measurement of bond strength the ligature wire was passed through the interdental space between the two teeth towards the crown aspect and a 2cm diameter loop was formed. This was done to ensure that the loop of the Instron E 3000 universal testing machine would loop around properly when the maximum force was applied. The samples were subjected to the machine one by one and the graph was formulated based on the outcome. This is demonstrated in figure 3.

Results

The bar graph values in the study signifies the maximum force at which the bond of each group got weak for these composite splints and was broken. This is represented in Figure 4. Table 1 demonstrates the colgate toothpaste having mean value of 161.25 followed by herbal toothpastes with mean value 52.53. The standard deviation for colgate was 187.67 followed by herbal toothpaste with 57.14. Independent sample t test was done and p value was 0.12, which is more than 0.05, hence statistically insignificant.

Figure 1. Sample Preparation.



Figure 2. Brushing Simulation.

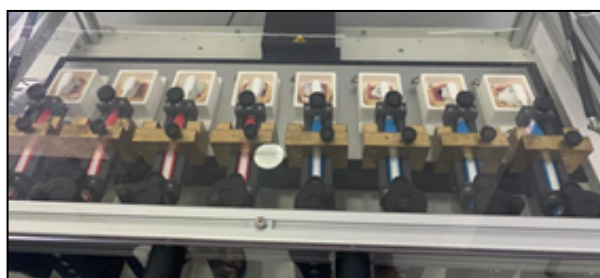


Figure 3. Evaluation of bond strength using Instron E 3000 universal testing machine.



Figure 4. The bar graph shows the average mean of the bond strength of the Colgate and herbal toothpaste along with the standard deviation. X axis represents the type of toothpastes and the y axis represents the mean bond strength. Blue colour represents the herbal dabur toothpaste and red colour represents the colgate fluoridated toothpaste. The bond strength of the splinting material was more in samples of brushing simulation with colgate toothpaste.

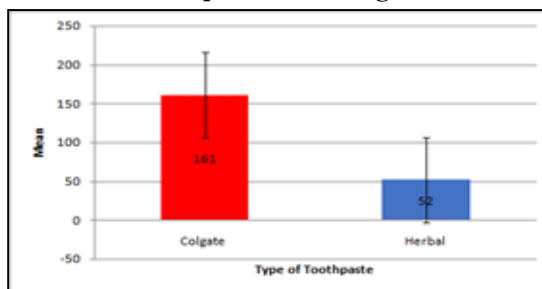


Table 1. Mean, standard deviation and test of significance of bond strength values between groups.

Groups	N	Mean	Std. Deviation	Significance
Colgate (Group A)	5	161.25	187.67	0.12
Herbal (Group B)	5	52.53	57.14	

Discussion

The present study compares the effect of two different types of toothpaste, herbal and colgate after which bond strength of splinting material was being evaluated. Our team has extensive knowledge and research experience that has translated into high quality publications [10-29]. Numerous techniques are practiced in the dental clinical setup to stabilize and repair the dentoalveolar injuries. Due to the advancement in the technologies, various feasible and new techniques have been adopted to treat the periodontal traumatic injuries [30].

Modern tooth splinting should be easy in application, cost effective and easy to remove without involving damage into the dental hard tissues. It should not involve the normal occlusion, dental hy-

giene or various endodontic treatment if necessary. There should not be any bit of trauma caused by the splint to the surrounding tissue or traumatized any other teeth in the oral cavity. Minimally, they should ensure to restore the original anatomical tooth position as well as ensure proper adequate fixation that occurred due to immobilization [31]. As seen in the previous literature, most of the splinting materials previously employed were time-consuming and attributable to injury to the soft and hard supporting tissues. The adhesives used for splint were dental composite in a study, when compared to CA esters it will be a feasible option, in making a rapid, simple and efficient contention of replanted teeth.

From the previous literature, the Versatile flow and the conventional flowable composite showed comparable results, Versatile flow opt to bind to the tooth structure by enabling two different ways: chemical bond formation between the phosphate function-

al groups of a glycerol phosphate dimethacrylate monomer and along with calcium ions as the primarily option and secondarily, through the process of micro-mechanical bond rendered by polymerised monomers of self-adhering flowable composite and the collagen fibers of dentin [32]. It was found in a study that metal splints were better than the other periodontal splinting materials at distributing the stresses [33]. The composite material represents an attractive approach to the clinicians. However, long-term success is not yet validated, as these materials need to be more advanced to increase the longevity of the material. The study that is conducted includes a very small sample size which was a limitation. There is a need for further research in this avenue with the larger sample size and comparing the efficacy of different types of toothpaste and splinting material.

Conclusion

Within the limitations of the study, it can be concluded that the wire splinting material exposed to brushing simulation with fluoridated toothpaste showed higher bond strength than that of herbal toothpaste.

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