

Comparative Evaluation of Fracture Resistance of Teeth with Different Intraorifice Barriers after Bleaching

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Abstract: *The aim and objective of this study is to compare and evaluate the fracture resistance of roots obturated with guttapercha different Intra orifice barriers after bleaching. Forty Human single canal extracted Maxillary Central Incisor, root canal preparation and obturation are done. Except for control group specimens, the coronal 3 mm of root fillings of all other group specimens will be removed with the aid of heated finger plugger and verified with the help of William's periodontal probe. Obturated specimens will be divided with respect to the intra orifice barrier material- using Universal restorative composite (Filtek Z 350 XT), Light cure GIC (Fuji II LC, GC America) and Flowable hybrid (Filtek Z350 XT flowable composite) composite placed over the root canal fillings. (n=10). Groups will be submitted to internal bleaching with Sodium perborate- powder mixed with Hydrogen peroxide 6% w/v. Axial compressive fracture strength testing was performed in a universal testing machine at a crosshead speed of 1mm/min and values recorded in Newton. According to the present study, the presence of intra orifice barriers strengthen the fracture resistance of endodontically treated teeth as compared to endodontically treated teeth without intra orifice barriers. RMGIC and Flowable composite proved to provide better fracture resistance than universal restorative composites. Intra orifice barriers provide not only the fracture resistance but also the coronal sealing, so it will definitely boost the treatment outcome of the root canal treated teeth.*

Keywords: intraorifice barrier, bleaching, fracture resistance

1. Introduction

Endodontically treated teeth are considered to be more susceptible to fracture than vital teeth. After the completion of endodontic treatment, restoration and protection of the remaining tooth structure is compulsory. ¹ One of the major goal of endodontic therapy should be reinforcement of the residual tooth structure after treatment. ^{1,2} There is a need for different materials and/or techniques to overcome the shortcomings of current endodontic filling materials such as guttapercha or resilon to reinforce roots that is known as intra-orifice barriers. Intra-orifice barrier is an efficient alternative method to decrease coronal leakage and strengthen endodontically treated teeth. ^{2,3} Composite resins, hybrid flowable composites, Glass ionomer cements, Resin modified GIC, MTA etc are widely used as intraorifice barriers. ²

Nearly 10% of endodontically treated teeth presented shade alterations, due to different causes: pulp hemorrhage, insufficient coronal opening, drugs employed in root canal treatment, filling materials and pulp calcification, causing distress to the patients when speaking or smiling. ⁴ The Sodium perborate, according to its concentration, is effective for bleaching of non-vital teeth at the dental office. Several studies revealed strength reduction of tooth when sodium perborate was used, associated with superoxol formation, ⁵

Alterations in the tooth structure (porosity, demineralization, reduction in microhardness) and reduced adhesion of composites to the dentin have been associated with oxidizing agents. It is generally agreed that endodontic

treatment reduces the fracture strength, yet it is not known the extent to which bleaching causes additional strength reduction. ^{5,6}

Aim & Objectives of Study

The aim and objective of this study is to compare and evaluate the fracture resistance of roots obturated with guttapercha using Universal restorative composite (Filtek Z 350 XT), Light cure GIC (Fuji II LC, GC America) and Flowable hybrid (Filtek Z350 XT flowable composite), composite as different Intra orifice barriers after bleaching. Mean strength of Group 1 was 196.1, Group 2 was 498.7, Group 3 was 571.5 and that of Group 4 it was 573.4 respectively.

2. Materials and Methods

Selection of Specimens

Forty Human single canal Maxillary Central Incisor extracted for purposes other than for the study were collected from the Department of Oral & Maxillofacial Surgery, KVG Dental College and other private clinics in Sullia.

Inclusion Criteria: Freshly extracted single canal Maxillary Central Incisor selected on the basis of their macroscopically similar size and straight roots reduce to 14 mm from the coronal aspect.

Exclusion Criteria: Teeth with fracture, craze lines, caries and curved roots

Specimen Preparation

Soft tissue & calculus was mechanically removed from the root surface of selected specimens. The teeth will be reduced to 14 mm from the coronal aspect to standardize the specimens. All specimens were examined under a dental operating microscope to ensure the absence of cracks. A size 10 K-type file will be placed into the canal until it was visible at the apical foramen. The working length was established 1 mm short of this length.

Canal Preparation

The root canals instrumentation was done with 0.06 taper Pro Taper rotary files in conjunction with RC-Prep lubrication and 2ml of 3% sodium hypochlorite irrigation between each files. All canals was enlarged to ISO size 25 to the working length . The root canals had a final irrigation of 5 ml 17 % EDTA and 5 ml 2.5% NaOCl, after which the canals were flushed with distilled water to avoid the prolonged effect of EDTA (RC- Prep) and NaOCl. The canals are subsequently dried with paper points.

Canal Obturation

Root canal was coated with sealer and obturated with guttapercha cones of 0.06 taper.

Placement of Intra Orifice Barriers

Except for control group specimens, the coronal 3 mm of root fillings of all other group specimens were removed with the aid of heated finger plugger and verified with the help of William's periodontal probe. Obturated specimens was divided with respect to the intra orifice barrier material placed over the root canal fillings into the following groups (n=10).

Group 1: Control

In this group, there were no removal of gutta-percha and no placement of intra-orifice barriers.

Group 2: Universal restorative composite

Prior to the restoration with composite, the root canal orifices were etched with 37% phosphoric acid for 15-20 sec. Then the surface was rinsed with water and the excess water was removed with an air syringe. Then the Adper Single bond 2(3M) adhesive was applied to enamel and dentine and was light cured for 10 sec. Finally placed Universal restorative composite (Filtek Z 350 XT, 3M ESPE)and cured for 20 sec.

Group 3: RMGIC

The specified amounts of powder and liquid dispensed onto the paper pad in the ratio of 3:1, then divided the powder into two equal parts. Mixed the first portion into the liquid with agate spatula and added the second portion into the remaining liquid. Mixed GIC (FUJI GC RESIN MODIFIED GIC) was placed into the canal orifices and it was cured for 20 seconds.

Group 4: Flowable composite

Prior to the restoration with composite, the root canal orifices were etched with 37% phosphoric acid for 15-20 sec. Then the surface was rinsed with water and the excess

water was removed with an air syringe. Then the Adper Single bond 2(3M) adhesive was applied to enamel and dentine and was light cured for 10 sec. Finally placed the flowable composite (Filtek Z 350 XT, 3M ESPE) and cured for 20 sec.

Internal Bleaching of teeth

Groups were submitted to internal bleaching with Sodium perborate- powder mixed with Hydrogen peroxide 6% w/v, which will be covered with a cotton pellet and glass ionomer cement as a provisional sealing.

The apical root ends was embedded along their long axis in self-curing acrylic blocks, pre leaving 9 mm of each root exposed.

The specimens are kept in distilled water at 37°C for 7 days, following which Glass ionomer restoration will be removed, cavity cleaned, dried and a composite resin post endodontic restoration of access cavity is placed.

Testing of fracture resistance

Axial compressive fracture strength testing will be performed in a universal testing machine at a crosshead speed of 1mm/min and values recorded in Newton.

3. Results

Mean strength of Group 1 was 196.1, Group 2 was 498.7, Group 3 was 571.5 and that of Group 4 it was 573.4 respectively. Mean of Group 1 is least followed by Group 2, Group 4 & Group 3. ANOVA tests shows that there is significant difference as $p=0.000<0.01$. Further post hoc test was performed by Bonferroni tests, showed that Group I is significantly less as compared to Group II, Group III & Group IV. ($p<0.01$).Whereas Group III and Group IV, there is no significant difference ($p>0.05$), but comparing between group II to group III & IV there was statistically significant difference ($p<0.05$). (Table 1,2 & Figure 1)

Table 1: Mean fracture strength in Newtons and standard deviation

	N	Mean	Std. Deviation	Significance
Control	10	196.1	34.92	<0.01
Universal restorative composite	10	490.52	43.54	
RMGIC	10	571.5	55.32	
Flowable composite	10	558.32	50.21	

Table 2: intergroup comparison for fracture strength

Group I Vs GroupII , III & IV	$p<0.001$
Group II Vs Group III & I V	$p<0.05$
Group III Vs Group IV	$p>0.05$

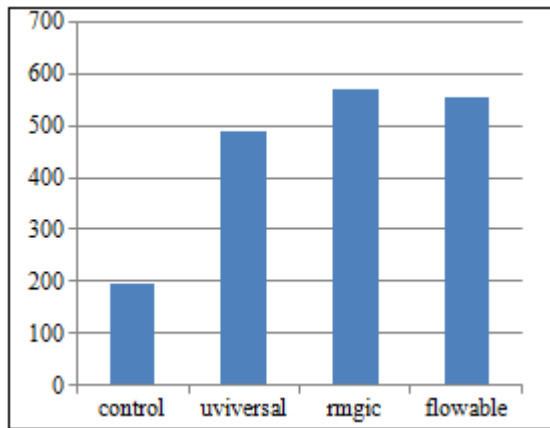


Figure 1: Mean fracture strength in Newtons

4. Discussion

Endodontically treated teeth are more susceptible to fracture than vital teeth because of excessive loss of tooth tissue, dehydration of the dentin, and pressure during obturation procedures. Previous clinical studies have shown that 11-13% of extracted teeth with endodontic treatment are associated with vertical root fractures, rendering it the second most frequent identifiable reason for loss of root-filled teeth.¹

Some authors have indicated that endodontically treated teeth get desiccated and inelastic while others have suggested that root fractures most often occur in teeth after root canal treatment due to loss of tooth structure, use of irrigants and medicaments, and excessive widening of root canals.²

Renato et al in his study tested the fracture resistance of teeth subjected to internal bleaching and concluded that the internal bleaching protocols provided reduction of the fracture resistance of the teeth, when compared with the unbleached endodontically-treated teeth. The significant fracture resistance of the teeth reduction presented by the experimental groups can be attributed to the presence of hydrogen peroxide in the bleaching agents, independently of the concentration. Peroxides present oxidizing action, which modifies the structure and mechanical properties of the teeth tissues, providing the degradation of collagen fiber and hyaluronic acid. These changes cause dentin microhardness reduction and consequently reduction of crown resistance to fracture.³

Several other factors also affect the fracture resistance of teeth are: amount of tissue lost and its location, magnitude and duration of load, tooth type, direction of applied load and slope of the cuspal inclines.⁴ A study evaluated the relationship between the quality of both the coronal restoration and the root canal filling by examining the radiographs of endodontically treated teeth. They concluded that apical periodontal health depended more on coronal restoration than on the technical quality of endodontic treatment.⁵

For a material to reinforce the tooth structure the elastic properties of a material should approximate those of the tooth structure, so that lesser amount of tensile stresses will

form at the tooth restoration interface and marginal degradation which occurs due the mechanical change in the shape of the restoration will get minimized. The stresses created from occlusal loads will get distributed more evenly along the tooth restoration interface and the whole tooth restoration system will act as a single unit, which will improve fracture strength.⁶

Resin modified GIC (RMGIC) was introduced in the late 1980, it contains some methacrylate components common in resin composites. It showed superior performance as an acceptable coronal seal as reported by Tselnik et al., due to the superior performance of RMGIC explained by water sorption by the material, resulting in setting expansion and consequently a better seal is achieved. RMGIC requires no pre-treatment of dentin and can adhere to it and another useful property of RMGIC is the release of fluoride RMGIC has high flexural strength and modulus of elasticity (10-14 GPa) close to the dentin. Thus, the material can withstand a large amount of stress before transmitting the load to the root. Moreover, it chemically bonds with the dentinal surface, rendering more strength at the dentin cement interface. All these properties might have resulted in RMGIC being the most fracture-resistant material tested in the present study.^{7,8}

Flowable composites are low-viscosity composite resins, making them more fluid than conventional composite resins. They are claimed to offer higher flow, better adaptation to the internal cavity wall, easier insertion and greater elasticity than conventional composites. The universal hybrid composites provided the best general blend of good material properties and clinical performance for routine anterior and posterior restorations.^{9,10}

It could be said that the low stiffness of Flowable Composites Resin(FRC) compensated for the polymerization contraction of the higher-modulus restorative composite materials, hence better flexural properties. Another parameter that describes the flexural property is modulus of resilience. It refers to the amount of energy stored up in a body when one unit volume of material is stressed to its proportional limit. FCRs exhibited relatively higher moduli of resilience than the Conventional Composite Resins (CCR).^{12,13,14} The fracture toughness of FCRs is higher than that of packable composite resins, and the fracture toughness of packable resins is higher than or not significantly different from that of CCRs.^{14,15} In view of these results, it could be said that FCRs are more resistant to crack propagation than CCRs. Hence could be the reason why flowable composites performed better than the universal restorative composite.

5. Limitations

The present study does not exactly replicate the clinical setting and the results may vary. The influence of sealer on the bonding of restorations to the root canal walls was not taken in consideration. Further studies are necessary to precisely correlate the results of this study to clinical success.

6. Conclusion

According to the present study, the presence of intra orifice barriers strengthen the fracture resistance of endodontically treated teeth as compared to endodontically treated teeth without intra orifice barriers. RMGIC and Flowable composite proved to provide better fracture resistance than universal restorative composites. Intra orifice barriers provide not only the fracture resistance but also the coronal sealing, so it will definitely boost the treatment outcome of the root canal treated teeth.

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