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Comparison of Fracture Resistance of Endodontically Treated Tooth with Composite and GIC as Entrance Filling-An In Vitro Study

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Abstract:

Aim:

To compare the fracture resistance of endodontically treated tooth with composite and GIC as entrance filling.

Purpose:

The purpose of this study was to evaluate the clinical success rate of endodontically treated premolars restored with composite and with type ix glass ionomer cement on the basis of fracture resistance and mode of failure of endodontically treated teeth and compare it with the normal tooth.

Materials and method:

Sixty extracted, mandibular, permanent premolars were collected. After preparing the access cavity, the teeth were biomechanically prepared and obturated. Samples were divided into three groups based on the type of restorative material used to restore them. Teeth were embedded in acrylic resin and their fracture strength was measured using a Universal Testing machine.

INTRODUCTION:

Restoration of root canal-treated teeth with a permanent, definitive, postendodontic restoration is a final step for successful root canal treatment as these teeth are considered more susceptible to fracture. The reason most often cited for this finding has been the dehydration and loss of dentin after the endodontic procedures and the removal of important anatomic structures such as cusps, ridges, and the arched roof of the pulp chamber, all of which provide much of the necessary support for the natural tooth.[1]

Restoration of root canal-treated teeth is an important step that complements a technically sound endodontic treatment.[2] Thus, root canal treatment should not be considered complete until a coronal restoration has been placed. An optimal final restoration for endodontically treated teeth maintains aesthetics, function, preserves the remaining tooth structure, and prevents microleakage.[3]

Studies suggest that complex amalgam restorations, complete cast coverage, cast restorations, and composite materials can all be used as postendodontic restorations. Although dental amalgam has favorable mechanical properties, it lacks adhesion to the tooth structure. This diminishes the fracture resistance of the remaining tooth structure due to microcrack propagation under fatigue loading.[4] Cast restorations and complete cast coverage procedures involve multiple visits and increased cost, which can lead to increased chances of discontinuation of the treatment.[5,6]

Introduction of new bonding agents has also led to the possibility of restoring root-filled teeth with a bonded restoration instead of a crown or onlay restoration.[2] The ability to predictably restore a root-filled tooth to its original strength and fracture resistance without the placement of a full coverage restoration could provide potential prosthodontic and economic benefits to patients.

Glass-ionomer cements have been used in endodontics for sealing root canals orthogradely and retrogradely, for sealing and restoring the pulp chamber, for repairing perforations, and rarely, for treating vertically fractured teeth. Even after completion of endodontic treatment, teeth are at risk of re infection via ingress of microorganisms from the access cavity into the filled cabals. To prevent bacterial ingress into the filled canal orifices and the floor of the pulp chamber in multi rooted teeth can be sealed with a restorative materials. Glass ionomers with its good sealing properties are best suited for this applications. The aim of the study was to evaluate the in vitro effect of bonded restorations on the fracture resistance of root canal-treated teeth.

MATERIALS AND METHODS:

Sixty freshly extracted, intact, noncarious, human, mandibular,premolar teeth with similar anatomic characteristics were selected. All soft tissue and debris on the teeth were removed using an ultrasonic scaler and the teeth were stored in saline at room temperature. The teeth were randomly divided into three experimental groups of 20 teeth each and subjected to the following procedures:

-class II cavities were prepared either MO or DO with airotor no. 245 straight at the buccolingual width of the occlusal isthmus was one third the intercuspal distance and the buccolingual width of the proximal prepration was one third of the buccolingual width of the crowns. The proximal boxes were prepared straight and limited to 2 mm coronally in the depth from the cemento enamel junction.

Standard endodontic access cavities were prepared with round or straight fissure burs

-the root canals instrumented to a size F2 and filled with 6% 25size gutta-percha using singlecone technique

- Group1(composite restoration):Prior to the restoration with composite the Adper Scotchbond Multi-Purpose plus Adhesive system (3M ESPE) was applied according to the manufacturer's instructions. Etchant (37% Phosphoric acid) was applied to the enamel and dentine for 15 seconds. The cavity was rinsed and excess water removed with a gentle, five-second air blast. One drop each of activator and primer were mixed and applied to the etched enamel and dentine for 15 seconds; the preparations were dried gently for five seconds.The composite material was placed before the bonding material had set; the restorations were then polished.
- Group2(type 9 GIC): Another set of ten teeth were restored with type ix glass ionomer cement, which is high strength used for paediatric restoration and for posterior tooth restoration. Mixed in 1:1 ratio for restorative use.
- Group 3(Control): unaltered tooth was taken as control
- Fracture strength testing was done using a Universal Testing machine. Prepared specimens were then mounted on a holder slot which was fixed to the-lower arm of the universal testing machine. A metal indenter of 6 mm diameter was fixed to the upper arm of the universal testing machine which was set to deliver an increasing load until fracture occurred.

RESULT:

The mean forces at fracture, the minimal and maximum values for each group are presented in Table 1. The mean forces at fracture were: Group 1 (998.00 N), group 2 (875.83). According to the results, significant differences were found between the teeth restored with composite resin(978.00 N) and type 9 GIC(875.83).From above result there is no significant difference between the teeth restored with composite resin and type 9 GIC.

Table 1: Forces at fracture points in root canal-treated teeth restored with different materials

Group	n	Mean	Minimum	Maximum
Group 1	20	998.00 N	534.40	1475.20
Group 2	20	875.83 N	421.00	1362.14
Group 3 (control)	20	1100.50 N	1040	1300

DISCUSSION:

Tooth restoration is the final step in root canal treatment [5]. The success of endodontically treated is determined by final restoration that we provide for patient. Numerous studies have been conducted to determine the ideal method to restore endodontically treated teeth as these teeth have decreased fracture resistance due to the loss of tooth structure during endodontic access and cavity preparation procedures. Cusp separation rarely occurs in noncarious, intact teeth because of the presence of the pulp chamber's roof and marginal ridges, which can be considered to be tooth-reinforcing structures. Many patient do not turn back for crowns after rct so this study evaluated the best entrance filling that is closer to the normal tooth .

Traditionally, root canal-treated teeth have been restored with cast restorations and full/partial coverage crowns which include cusp coverage to improve the fracture resistance.[6] To further increase the fracture resistance, several attempts have been made to restore endodontically treated teeth with different post systems to increase the fracture resistance of the root structure.Numerous materials have been used as substitutes for dental tissues. Amalgam, for instance, is the most common material used for more than 100 years in posterior restorations. Although amalgam has high compressive strength, it does not adhere to the dental structure. Cuspal fractures in amalgam restoration result from the fatigue caused by crack diffusions subjected to repeated loading. Also, the presence of mercury and the types of interactions among its metal components make this material exhibit higher deformation levels when submitted to occlusal load application.[7] In addition to aesthetics, modern composite materials have got high compressive strength for posterior restorations. It has been suggested that the use of resin composite in restorations reinforces dental stiffness as the adhesive nature of the composite binds the cusps and decreases their flexion. Flexion is considered to be the main cause of fracture in conventional, nonbonded amalgam restorations. Due to its low elastic modulus, composite resin can transmit the energy produced by the compressive forces to the adjacent dental structure, thus reinforcing the weakened tooth structure. Although, the tooth restoration interface suffers elastic stresses generated by the contraction of the material during polymerisation, these stresses can be dissipated by cuspal movement.[8,15] In our study, type 9 GIC and composite resin were used to restore endodontically treated mandibular premolars.Several studies have shown that applying the force to the long axis of the tooth transmits the force uniformly.[9-12] In our study, force was also applied vertically at a constant speed using a universal testing machine. The results of our study suggest that adhesion plays an important role in increasing the fracture resistance of endodontically treated teeth.[13,14,16]. In our study fracture resistance of teeth restored with composite was less when compared to that of normal intact tooth but more when compared to that of GIC. The reason for this finding could be the dehydration and loss of dentin after the endodontic procedures and the removal of important anatomic structures such as cusps, ridges, and the arched roof of the pulp chamber, all of which provide much of the necessary support for the natural tooth[1], the difference between GIC and composite may be due to physical and mechanical properties. Type 9 GIC and composite have almost less difference between them therefore they could be used as an entrance filling

CONCLUSION:

1. The teeth restored with type 9 GIC and composite were significantly weaker than the intact normal tooth
2. The differences between the composite resin groups and GIC were minimal, so both could be used as a entrance filling.

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