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Effect of building-up core material's kind on location of fracture for endodontically treated teeth and restored using glass Fiber post (*in-vitro* study)

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Abstract
Introduction: The quality of the material used to build-up the cores of the treated and restored teeth with fiberglass posts affect the location of fracture, as it plays an important role in the durability and durability of the coronary root restoration under different oral environment conditions.
The aim of the study: Study of the effect of the core building-up material quality of three different materials on the location of fracture for a group of lower premolars after treating the core and restoring them with fiberglass posts.
Research materials and methods: The research sample consisted of (30) lower first laughs, as these teeth were extracted in the course of orthodontic treatment (free from any defects) and stored with distilled water. The clinical crowns of these teeth were cut so that a coronary tissue was kept 2mm high above the enamel-cemento junction. These teeth were treated with pulp and restored with fiberglass posts. The research sample was divided into three groups, each consisting of (10) premolars, according to the type of core building-up material.

1. Composite Resin (IVOCLAR, T-Econom, Liechtenstein) Group T.
2. Flow composite resin (IVOCLAR, Titric N-Flow, Liechtenstein) Group F.
3. Resin Reinforced Glass Ionomer Cement (3M ESPE, Vitermer, USA) Group G.

The teeth were crowned with Nickel-Chrome crowns and then an oblique force was applied at an angle of 45 to the tooth axis using a general mechanical testing device at a speed of 1mm / min until failure occur.
Results: It was found that group T premolars restored with composite resin had nine Cervical Fracture states and once in middle while the locations of fracture fore premolars restored with Flow resin had eight Cervical Fracture states and twice in Middle, and locations of fracture for premolars Restored with Glass ionomer cement had ten Cervical Fracture, and significant differences were observed between groups (P =1).
Conclusion: As it turns out, there is no correlation to the core building-up material in the failure model.

Keywords: Location of fracture, core build-up, Fiber posts, treated teeth

Introduction

The use of fiber reinforced composite (FRC) posts has tremendously increased the restoration of endodontically treated teeth due to their favorable physical properties, such as high tensile strength and good fatigue resistance. Also, their modulus of elasticity is similar to that of dentin. In combination with FRC post, the composite core build-up material is often used to restore the coronal portion of the teeth and to achieve retention and resistance form for the crown [1, 2].

Resin composite is a popular core build-up material to be used with FRC post due to similarity to tooth structure in hardness and fracture toughness, giving the ability to perform the preparation after curing [1].

Characteristics of an ideal restorative material [5]: The forces of compression and twisting are suitable for resisting intraoral forces, Bio-acceptance, High catalytic leakage resistance., Non-dissolving and dimensionally stable when exposed to oral fluids, Linkage with dental tissues., Ease of application.

Low potential for water absorption, Inhibition of dental caries and The coefficients of thermal expansion and contraction similar to dental tissues.

- **Factors Affecting the Fracture Resistance of Endodontically Treated Teeth**
  - Endodontic Access Cavity Preparation [3].
  - Root Canal Preparation [4].
  - Root Canal Irrigation [4].
  - Root Canal Obturation [4].

- **Factors related to coronary radical repair**
  - Post Space Preparation [4].
  - Coronal Restoration [5].
  - Endodontically Treated Teeth as Abutments [4].

- **Classification of Posts**
  - According to the nature of the surface [6].
  - Passive Posts, as smooth posts.
  - Active Posts, as Splice posts.

- According to the Shape of the posts [7].
  - Parallel Posts.
  - Tapered Posts.
  - Parallel-Tapered Posts.

- According to material [8].
  - Reinforced with fiber
  - Carbon fiber posts
  - Glass fiber posts
  - Polyethene fiber-reinforced Posts
  - Zirconium
    - Material
  - Prefabricated metal posts
  - Cast post & core

Material and Methods

Thirty extracted human lower first premolars, due to orthodontics treatment protocol, with similar form and size of roots, were selected. Each tooth was visually inspected to be free of cracks, dental caries, restorations, or other defects figure 1. The dimensions of the teeth were measured mesiodistally, labiolingually, and in root length, using a digital vernier caliper (Insize, China) figure 2. Teeth size with 4.5+0.5 mm mesiodistally, 7.0+0.5 mm labiolingually, and 14.5+0.5 mm in root length were chosen. All teeth were cleaned and debrided of soft tissues and stored in 0.9% normal saline until used.

Fig 1: thooth that used in study after Clean

Fig 2: digital vernier caliper (Insize, China)

The clinical crowns were decoronated perpendicularly to the root axis 1 mm above the cementoenamel junction (CEJ) by a low speed cutting machine the pulpal tissue was removed with a barbed broach and a stainless-steel K-file size 15.

All teeth were endodontically treated using a step-back technique with master apical file size 40 and coronal flaring size 70. The canals were dried and then obturated using a lateral condensation technique with gutta-percha cones. After endodontic treatment, a universal drill was used to prepare a post space to a depth of 10 mm, leaving 4 mm of intact gutta-percha as the apical seal. Each root was dipped into melted modeling wax at 2 mm below the CEJ, which allowed the thickness of approximately 0.2 mm. The tooth was then attached to a surveyor (Dentalfarm, Torino, Italy) with the Light drill in the canal and placed in a plastic mold (22 mm in diameter and 20 mm in height) 2 mm coronally above the upper edge. The autopolymerizing acrylic resin was poured in the mold, resulting in root embedded in acrylic resin base.

All specimens were randomly divided into three groups of ten samples according to different core materials to build-up. The core materials used are shown in table1. Each fiber post was cut at 14 mm length with a high-speed diamond rotary cutting instrument. At this length, 10 mm of the post would be in the root, leaving 4 mm projecting above the prepared tooth.

Table 1: Material that used for core Building-up

No.	Material	Company	Group Name
1	Composite Resin	. (IVOCLAR, T-Econom, Liechtenstein)	Group T.
2	Flow composite resin	(IVOCLAR, Titric N-Flow, Liechtenstein)	Group F.
3	Resin Reinforced Glass Ionomer Cement	(3M ESPE, Vitermer, USA)	Group G.

The post was cemented with dual-polymerizing resin cement according to the manufacturer's instruction. After finished, the core was prepared for full metal crown with a circumferential 0.5 mm chamfer finishing line at CEJ level. The height of the core was 6 mm facially and 3 mm lingually above the CEJ. All measurements were done by digital caliper.

The crown was finished, polished and the fit to the specimen was evaluated by visual inspection and checked with vinyl polyether silicone. The crown was then cemented with zinc phosphate cement figure 3. All specimens were stored at 37C during 24 h for complete setting of cement [9].

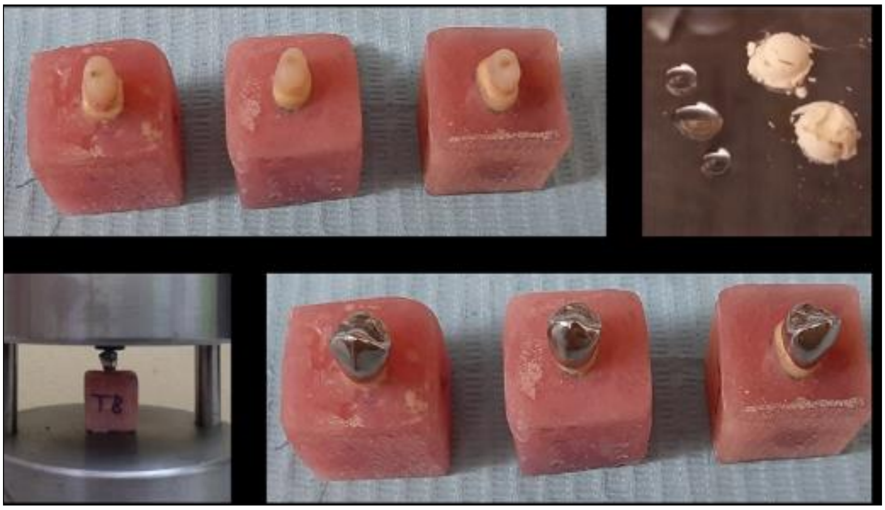

Fig 3: Crown after Cemented

The fracture resistance test was performed by a universal testing machine at 135 degree to the long axis of the tooth. The load tip was placed on the prepared occlusal notch. A continuous compressive force was applied at a crosshead speed of 1 mm/min until failure figure 4.

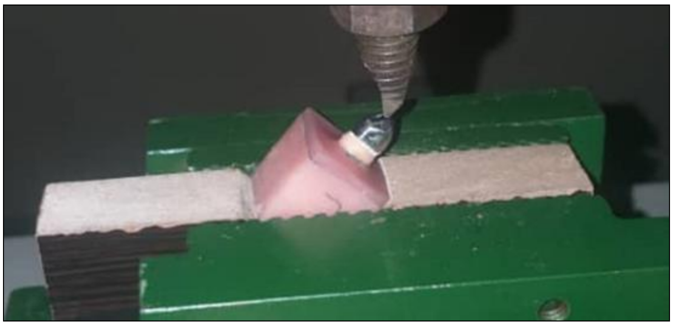

Fig 4: Applying force by a universal testing machine at 135 degree

Results

Table 2: Type and location of fracture [16].

Group		Location of Fracture			Total
		Reparable	Catastrophic		
		Cervical	Middle	Apical	
Group T	Count	9	1	0	10
	Percent	90%	10%	0%	100%
Group G	Count	8	2	0	10
	Percent	80%	20%	0%	100%
Group F	Count	10	0	0	10
	Percent	100%	0%	0%	100%

Discussion

This study was performed on freshly resected human teeth, being the most reliable procedure as a methodology for fracture tests. It is approved by many researchers for studies similar to the nature of this study [10, 11].

The remaining coronary height was prepared in a manner consistent with the cemento enamel junction, that is, its length is equal and the amount of 2mm over the entire circumference of the tooth as this preparation is more supportive of the endodontically treated teeth compared to the nonuniform Ferrule [12].

- The angle of application of the pressure force used in the study simulates the lateral forces that the lower premolars can experience during the lateral movement of the mandible, where the lateral forces cause more damage than vertical forces [13].

When POSTS reinforced with fiberglass with a modulus of elasticity similar to dental tissue are subjected to stresses, they absorb and distribute mainly around the post in the cervical region, making most of the fractures repairable [14].

While irreparable fractures are often located in the middle third of the root, this can be attributed to the use of resin adhesives that allow stress to be distributed along the attachment surface and thus the root wedge can absorb the functional stress and then direct it towards the longitudinal axis of the root and thus the stress becomes more appropriate [15].

Conclusion

As it turns out, there is no correlation to the core building-up material in the failure model.

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