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Research Article

Evaluation of Fracture Resistance of Endodontically Treated Teeth with Two Different Post System: An In-Vitro Study

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Abstract

Background: The number of endodontic procedures has increased steadily in the past decade with highly predictable results. Therefore, restoration of teeth after endodontic treatment is becoming an integral part of the restorative practice in dentistry. When restoring an endodontically treated tooth, the first step is to assess the level of predictability involved in the restoration. Proper restoration of ET teeth begins with a good understanding of their physical and biomechanical properties, anatomy, and a sound knowledge of the endodontic, periodontal, restorative and occlusal principles. A thorough understanding of posts is necessary to make the right selection, as there are so many choices available. Finally, the choice of core material and the final restoration are important in achieving long-term clinical success.

Aim: To compare the fracture resistance of endodontically treated teeth restored with two different post-core systems.

Material and Method: The samples were split into two groups of 15 each and given root canal therapy on 30 maxillary incisors. For two experimental groups, post space preparation and tooth restoration utilizing glass fibre posts with composite cores and adhesive resin cement (Group A) and zirconia posts (Group B) respectively were carried out.. Using the universal testing apparatus, 0.5 mm/min of force was applied to each sample at 130 degrees until fracture was experienced. A statistical analysis of the data was done after measuring the fracture resistance.

Result: The least fracture resistance was found in Group A (Glass Fibre Post). Additionally statistically more significant than groups A and B was group B (Zirconia Post). According to the statistics that were found, the p value is significant ($p < 0.05$).

Conclusion: The load needed to fracture the custom-made zirconia post was higher than that of the glass fibre post, according to the study's limitations.

Keywords: *Endodontic treatment, Post and core, Fracture resistance, Zirconia post, Glass fiber post, Maxillary incisor*

Introduction

Restoration of teeth with filled roots is a crucial and concluding phase in effective root canal therapy, and it has undergone significant modification in recent years. Different techniques for repairing pulpless teeth have been used historically. However, the post and core system has been crucial in enhancing biomechanical performance to achieve the highest levels of strength, esthetic, and functionality.[1,2]

When restoring an endodontically treated (ET) tooth, the first step is to assess the level of predictability involved in the restoration. Proper restoration of ET teeth begins with a good understanding of their physical and biomechanical properties, anatomy, and a sound knowledge of the endodontic, periodontal, restorative and occlusal principles.

A thorough understanding of posts is necessary to make the right selection, as there are so many choices available. Finally, the choice of core material and the final restoration are important in achieving long-term clinical success. Posts do not strengthen ET teeth and should not be used in them routinely. The main function of a post is for the retention of a core if there is insufficient tooth substance left to support the coronal final restoration. The reason that many different types of posts with different designs and materials are available is because they all have certain strengths and weaknesses.[1-3]

The materials used to fabricate post and core systems should have physical qualities that are similar to those of dentin and should be biocompatible in the oral environment in order to produce the best and most favorable results. Custom cast posts and prefabricated posts have both been used in the fabrication of post and core systems, each of which has advantages and disadvantages of its own.[3]

The quantity of surviving dental structure, the anatomic position of the tooth, the functional load on the teeth, and the tooth's aesthetic requirements should all be taken into consideration when deciding where to place the post. Endodontic posts can be prefabricated or constructed to order, metallic or nonmetallic, stiff or flexible, and aesthetically pleasing or unappealing. A fractured tooth that had undergone endodontic treatment was traditionally rebuilt with a cast metal post and core until 1980. There are many tooth-colored posts available today, including carbon fibre posts with zirconium coating, posts made entirely of zirconium, Cerapost, fiber-reinforced light posts, and glass fibre posts.4-6

Due to its high mechanical strength, high toughness, and a Young's modulus that is comparable to stainless steel alloy, zirconia is a material that is widely employed. Zirconia that has undergone partial stabilization exhibits transformation toughening, a physical characteristic that increases the material's fracture toughness and initial strength. Zirconia has advantageous chemical and physical characteristics, but it also has the aesthetic benefit of looking like natural teeth in color.[7-9] This study compares the fracture resistance of anterior teeth that have had endodontic treatment and have been repaired using glass fibre posts and zirconia posts.

Material and Method

A stereomicroscope was used to examine 30 freshly extracted maxillary central incisors that were free of fracture, caries, and cervical abrasion. Vernier calipers were used to measure each tooth's maximal buccolingual and mesiodistal dimensions at the cementoenamel junction. Prior to and throughout the experimental procedures, the teeth were cleaned and kept in normal saline solution at room temperature (24 to 28°C) to avoid dehydration. All specimens underwent root canal therapy, and lateral condensation obturation was performed using 40-size gutta-percha (Dentsply, Addlestone, Surrey, UK) as a master cone. The chosen teeth were divided into two experimental groups at random.

Group A: 15 teeth restored with glass fiber post and composite core

Group B: 15 teeth restored with Zirconia post.

Each specimen was placed in an acrylic resin-coated 19 x 19 x 20 mm stainless steel block, and the socket was lined with a silicone rubber impression substance that was roughly 0.25 mm thick. Before the testing procedure, all finished specimens were kept in normal saline at room temperature for a duration of 30 days. The tooth was mounted in a customized fixture with its long axis at a 1300-degree angle to the force application point. A computer controlled Instron Universal Testing Machine has a specific fixture on which the specimen with the stainless steel block was attached. The compressive load was applied with 1 mm diameter, ball ended steel compressive head at an angle of 130° to the long axis of the tooth. The force was applied by measuring in the midline of the palatal slope from a point 4 mm from the start of palatal surface, at a rate of 0.5 mm/min until visible or audible evidence of fracture or indication of inability of the specimen to withstand a greater load was shown. Descriptive data were collected and analyzed. The comparative evaluation of mean fracture resistance between the experimental groups was carried out with t-test.

Result

According to the acquired statistical results, Group A had lower fracture resistance (430.88 7.2) than Group B did (611.54 5.4), which is statistically significant (p 0.05). **(Table 1)**

Table 1: Mean score of Fracture Resistance Group A Vs Group B.

Groups	N	Mean ± SD	p-value
Groups A	15	430.88 ± 7.2	0.05*
Groups B	15	611.54 ± 5.4	

Discussion

Strength and aesthetics are the driving forces behind various restoration techniques for endodontically treated teeth. When the tooth's remaining coronal structure can no longer adequately retain and support the restoration, a post is suggested.[10,11] Cast gold posts and cores have been the gold standard for decades due to their favorable long-term prognosis; however, when used with all-ceramic crowns, particularly with high-translucency ceramics or when the available thickness is less than 1.5 mm, they may compromise the aesthetic result.[12,13]

This study compared the fracture resistance of maxillary central incisor teeth that had undergone endodontic treatment and were repaired with glass fiber posts and zirconia posts. In this study, the fracture resistance of posts made of zirconia and glass fiber was compared. The fiber posts were chosen because they have flexural strength and an elastic modulus that are comparable to that of dentin.[14-16] The ability of glass particles to conduct light, which may enhance the polymerization of resin luting cement, is another benefit of fiber post. Numerous investigations show that these posts and the resin luting cements had a greater adhesive bond.[17-19]

This study revealed that the teeth restored with zirconia posts showed high fracture resistance compared to the glass fiber post groups.

Group A showed the lowest fracture resistance. The cement coating surrounding the post was thicker than in the other groups, which may have contributed to the lower fracture strength and retention values than in the other groups. Due to its exceptional mechanical qualities, zirconia occupies a special position and is a potential material for endodontic posts. In order to be used as a restorative material, zirconia must be compared to a substance that is both aesthetically pleasing and has good mechanical qualities.

In their short-term clinical investigation, Kakehashi Y et al. showed a good success rate for zirconia post and core. While Sareh Habibzadeh et al. came to the opposite conclusion in their investigation from ours, they observed that the fracture resistance of zirconia post-and-core systems was much lower than that of glass fiber post and cast Ni-Cr post systems.[17] In their work, Begüm Akkayan et al. found that glass fiber and zirconia posts repaired teeth had statistically equal fracture resistance.[16]

Since zirconia posts are more expensive than metal alloy, glass fiber, and carbon fiber posts, it is necessary to make zirconia posts affordable for doctors to utilize on a regular basis. To examine the fracture resistance and retention of these posts in clinical settings, more research is needed. Additionally, research can be done to determine how well these posts' push out bonds hold at every level of root. The fracture resistance of restorations in anterior teeth must be taken into account in light of the need for cosmetic procedures and the growing usage of ceramic restorations. We advise future research on an adequate number of anterior teeth should be conducted in a manner similar to ours.

The multidirectional nature of masticatory pressures, which cannot be replicated in a Universal Testing Machine, where only a single unidirectional load is administered, is a significant drawback of our in vitro test model. It is clear that this kind of in vitro loading may not always accurately reflect a situation that would occur in vivo. The post diameter, length, design, adaptability, amount of remaining root dentin, cement, method of cementation, core material and design, crown design, and biocompatibility of post material are additional parameters that affect the fracture resistance of post restored endodontically treated teeth. Therefore, caution should be used when translating the results of our current investigation directly into clinical practice. Before they can be employed as practical substitutes for the currently accessible commercial post systems, we advise further in vitro research testing the aforementioned criteria utilizing zirconia posts.[18-23]

Conclusion

The endodontically treated teeth without post core system showed the least fracture resistance demonstrating the need to reinforce the tooth. The teeth restored with Zirconia post/composite core demonstrated the highest fracture resistance compared to the glass fiber post systems. However, further research on a large scale in this field is required before anything can be deemed ultimate for the clinical use. Additional *in vitro* and *in vivo* studies are required for the long-term results.

Conflict of interest

The authors declare no conflict of interest.

Source of Support

Nil

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