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FRACTURE RESISTANCE OF MANDIBULAR FIRST MOLAR REINFORCED WITH DIFFERENT POST DESIGNS AND CORE PREPARATION AFTER OBTURATION –AN IN VITRO STUDY

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Abstract

Aim: This study aim to compare fracture resistance of mandibular first molar reinforced with horizontal diagonal fibre post and vertical metal post and core preparation after obturation

Materials and methods: Twenty –four extracted mandibular first molar teeth were selected, divided into four groups (GP) - GP I (endodontically treated-no post)), GP II (horizontal diagonal post design –fibre post), GP III (vertical post – metal). The individual teeth were mounted on acrylic bases and tested under universal testing machine for fracture resistance.

Results : Group II (horizontal diagonal fibre post) design had higher fracture resistance as compared to the vertical metal post design and no post design and core preparation .

Conclusion : Within the limitations of this study, it can be concluded that horizontal diagonal fibre post design has better fracture resistance as compared to vertical metal post

Keywords: horizontal diagonal post, post design, fracture resistance, mandibular molar, vertical metal post

INTRODUCTION: The ultimate goal of endodontic treatment is to maintain a functional pulpless tooth through adequate restoration. The initial clinical situation is the primary factor to be taken into account for a successful outcome [13].

One of the more researched and debatable dental problems is the restoration of teeth that have undergone endodontic treatment. Concerning the therapeutic techniques and materials that should be employed to replace these teeth, given that fractures are frequently connected, questions and divergent views still exist [10]. After endodontic therapy is complete, excessive tooth structure loss or removal reduces the restorations' ability to resist fracture[2].

The most effective method of preventing fracture is immediate full coverage restoration and prosthesis. Unfortunately, in many urban locations, this restoration is frequently delayed, which results in fracture, primarily because of cost.

The results of endodontic treatments have been analyzed, and it has been found that tooth breakage may be more problematic than reinfection[2]. Different post designs and core preparation play a crucial role in preventing this post endodontic restoration of the tooth.
An indication of a post is a tooth that has lost its crown or has significant damage, has had RCT, is being used as a bridge abutment, or requires a shift in axial position of more than 1mm.
Custom-cast posts, prefabricated posts, metallic posts, non-metallic posts, and so forth are among the several types of posts.
Endodontically treated teeth typically suffer significant structural loss, necessitating multiple techniques of reinforcement for their regeneration. They could need a post to hold the core restoration in place, and prefabricated posts are one of the most popular options because of how simple and inexpensive they are to handle. These prefabricated posts are typically constructed of metals like stainless steel and titanium, but they can also be made of ceramic or fiber reinforced with glass. Although the metal posts are more resilient to breaking, their higher elastic modulus than dentin might cause strains in the dentin.

To repair damaged endodontically treated teeth, glass-fiber-reinforced endodontic posts (GFRPs) are frequently combined with composite resin core materials.[12] In this study, prefabricated metal posts and glass fiber posts have been used using two distinct design strategies, namely vertical metal post design and horizontal diagonal fiber post design.

MATERIAL AND METHODOLOGY: Twenty-four extracted mandibular permanent molar teeth with fully developed, unharmed root apices were collected, prepared, radio-visiographically evaluated for calcification, curvature . Each experimental group received an equal number of samples.

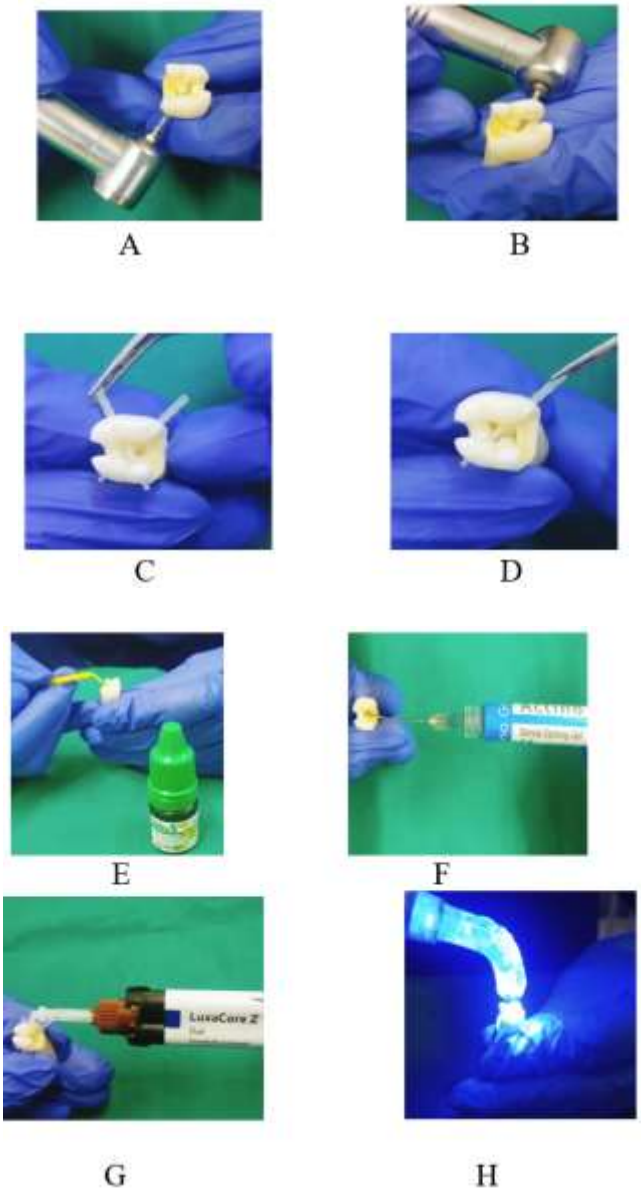
Sample groups

Groups (*n*=8)	**Post design**
I	RC treated - No post
II	Horizontal diagonal post –fibre post
III	Vertical post – metal post

Endoaccess and endo Z burs were used to prepare the access cavity. For samples of Gps I, II, and III, the working length was assessed by passively inserting a 10 K file (made by Dentsply Maillefer, Ballaigues, Switzerland) through the canal until the tip could be seen and adjusted to the apical foramen. Working length is estimated by taking 0.5 mm from the measured value and doing canal preparation. According to the manufacturer's instructions, the instrumentation was started with manual files (Dentsply, Maillefer, Ballaigues, Switzerland) up to size 20, then rotary files (Hyflex CM) up to size 20(o6%) with an e-connect endomotor (Orikam). Using a 27 gage needle, 5.25% of sodium hypochloride as a irrigant was administered. AH + sealer and gutta percha cones were used for obturation, which was carried out using a cold lateral condensation approach. After the samples were incubated and kept for 24 hours, the coronal section was standardized.
The cavity were then etched, a bonding agent was used, and core buildup for the non-postgroup was completed using a dual cure core buildup material.

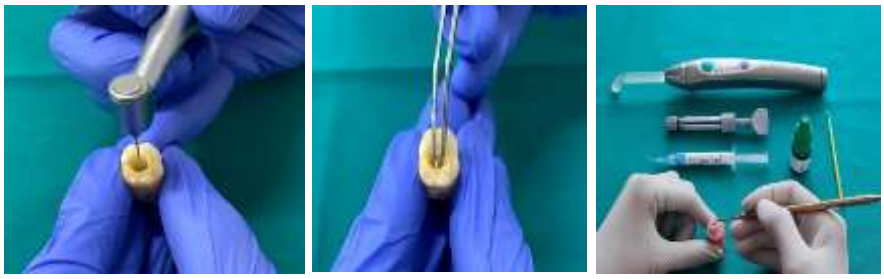
For a horizontal post with a diagonal pattern On the mesiobuccal wall, there was one slot prepared. another on the other diagonal wall.The same process was used to prepare a second slot somewhat higher in the distobuccal to mesiolingual direction than the first. The first fiber post, coltene, was put

in the first slot, and the second fiber post, coltene, was put in the second slot. dual-cure composite resin (luxacore)-cemented



A.Slot prepation on buccal wall B. Slot prepation on lingual wall C. 1st Fibre post no.1(coltene) placed in slot
D. 2nd Fibre post no.1(coltene) placed in slot E. Acid etching F. Application of bonding agent
G. Cemented with dual cure composite resin (luxacore). H. Light curing with curing gun

With the use of the Pesso Reamer No. 2, the post space for the vertical metal post was prepared, with the remaining 4-5 mm of gutta percha being kept in the distal canal's apical third. Dual cure composite resin (luxacore) was used to cement a metal post (3M MANI). Using dual cure composite resin (luxacore), cavities were repaired.



A B C

A. Using a Pesso reamer No. 2, prepare the post-space B. A metal post (3M MANI) that was luxacore dual cure composite resin-cemented. C. Dual-cure composite resin (luxacore) was used to restore cavities.

Each group's samples were put on silicone formers. The tooth was inserted vertically, with the occlusal surface parallel to the mounting surface and the tooth's crown completely visible. Next, the autopolymerizing resin was poured and given time to dry. Following that, the test blocks were encoded and saved.

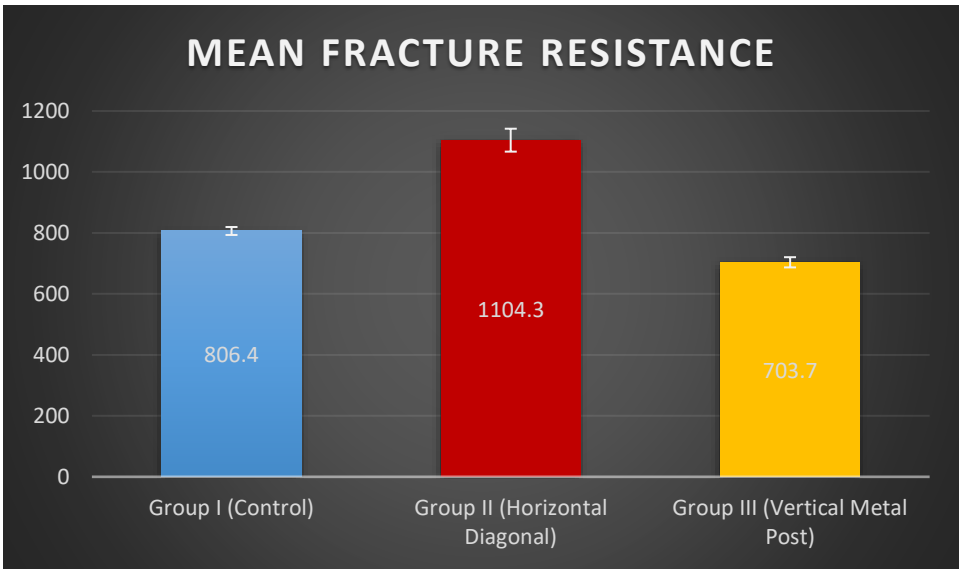
The teeth were mounted in acrylic block

A special metal indenter measuring 3 mm was used to test the samples of each group under a universal testing machine. The load was delivered on the surface of the tooth from above, vertically parallel to the occlusal surface, at a crosshead speed of 1 mm/min. The highest force at which the tooth fractured was noted.

RESULTS

Table 1 shows descriptive statistics for the mandibular molar's fracture resistance after it has been obturated and reinforced with various post designs.

	Mean	SD	SE	Minimum	Maximum
Group I (Control)	806.4	**13.02**	**4.6**	**785.7**	**821.4**
Group II (Horizontal Diagonal Fibre Post)	**1104.3**	**37.55**	**13.27**	**1041.6**	**1156.3**
Group III (Vertical Metal Post)	**703.7**	**16.72**	**5.91**	**681.15**	**722.4**



There was a statistically significant difference between the three groups, with the horizontal diagonal post (GRP ll) having the highest fracture resistance, followed by the control group (GRP l), and the vertical metal post (GRP LL), respectively.
Further research using the Tukey Post-hoc Test revealed that the horizontal diagonal fibre post had stronger fracture resistance than the control and the vertical metal post. The difference was highly significant statistically. In comparison to the control, vertical metal posts exhibit lower fracture resistance, and this difference is highly statistically significant.

DISCUSSION – Because endodontic treatment causes the loss of dentin, fractures in endodontically treated teeth have a worse long-term survival rate. The residual tooth structure should be strengthened by post Endodontic restorations so that the therapy is successful and the tooth retains its longevity. .Glass fibre posts are used to reconstruct endodontically treated teeth because they are aesthetically pleasing, quicker to install, and have an elastic modulus that is similar to that of tooth structure (30–50GPa). While in the case of a metal post, metallic corrosion by-products weaken the dentin and the junction between the post and the prepared canal. In addition, wedging forces work at the junction of the metal post and any leftover gutta percha inside the canal, increasing the likelihood of fracture.

Modern fibre -reinforced post systems protect dental structures, are noncorroding, have an elastic modulus similar to dentin, and are more aesthetically pleasing than metal alternatives. Corrosion, decementation, concentration of the wedging stresses at the junction, and dentin loss are the causes of metal post tooth fractures.
Without postendodontic restoration, the failure rates of endodontically treated teeth practically treble. The more recent method of utilizing posts that are horizontally and diagonally oriented fibre posts distributes the stresses operating on the tooth as two posts in this way occupy a significant portion of the tooth. As a result, forces are dispersed transversely rather than longitudinally, which reduces the risk of tooth fracture.
Aravindhan, V (2022) concluded that horizontal diagonal fibre post had a higher fracture resistance when compared to other experimental groups

Venkataraman KJ et.al 2021 concluded that diagonally placed horizontal post design has a higher resistance to facture when compared to buccolingually place horizontal post design and root canal treated non post group

Additionally, reviews of numerous research indicate that a composite restoration reinforced with glass fibers, particularly with fiberglass posts laid horizontally in a buccolingual orientation, particularly horizontal diagonal fiber posts, considerably increased fracture resistance.

CONCLUSION - Based on preoperative analysis, it is important to tailor the selection of biomechanical instruments, obturation technique, and post endodontic restoration options, including core buildup approaches, to specific cases in order to improve long-term outcomes[2]. A conservative post-endodontic treatment strategy, the use of diagonal horizontal posts appears promising[2]. The study's findings indicate that horizontal diagonal fibre posts have better fracture resistance than vertical metal posts. It is advised to conduct additional research on these diagonal horizontal post designs and assessments in a clinical context.

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