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Comparison of Fracture Resistance of the Three Different Core Build UP Materials Using Nayyar Core Build UP Technique- An In Vitro Study

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Abstract

Background and objectives: The present study was undertaken to evaluate the fracture resistance of three different core materials by using nayyar core build up technique.

Methodology: 45 carious molars were selected in this study. The study includes carious molars involving pulp with minimum of 2 wall intact and were assigned into three groups, comprising 15 teeth each as follows. Group 1: AMALGAM CORE, Group 2: GC ever x posterior Fiber reinforced composite core and Group 3: Filtek Z 350 Nano composite core. Tooth were made caries free followed by Root canal treatment with crown down technique and irrigated with NAOCL & Saline, canals were then dried with absorbent paper points, followed by AH PLUS sealer application and obturated with lateral condensation technique. Post space preparation was done after 24 hours, Undercuts present in the pulp chamber were retained and the core build up was done

Results: The 15 teeth were assessed in each group using ANOVA and Post hoc Tukey statistically test. The Group 2 showed the highest mean fracture resistance (520.3) followed by Filtek Z350(466) and Amalgam core (284). ANOVA test also revealed a statistically significant difference between all the groups. Post hoc Tukey test showed a significant

Conclusion: This study revealed that GC Ever X posterior has the best fracture resistance compared to amalgam and composite.

Keywords: Fracture resistance, GC Ever X posterior, Post Hoc Tukey, Core material

Introduction

Success of endodontic treatment is dependent on post endodontic restorations. Many in vivo and in vitro studies have concluded that endodontic therapy is the major etiological factor for the fracture of the teeth. Endodontically treated teeth are more prone to fracture than compared to vital teeth, particularly in the posteriors tooth where the stress initiated by normal functional forces can lead to fracture of remaining/undermined tooth structure. Restoring endodontically treated/non vital teeth presents a major challenge for clinicians.[1,2]

Many factors have been attributed for the decrease in fracture resistance of endodontically treated teeth namely tooth structure loss, loss of free unbound water from the lumen and dentinal tubules, age induced changes in dentine, reduced level of proprioception, effect of endodontic irrigant and medicament on dentine, effect of bacterial interaction with dentine substrate.[3,4,5]Coronal destruction from dental caries, previous restorations/fracture, and endodontic access preparations are considered to be the main cause. But finally, the ultimate challenge is how to reconstruct the compromised teeth to regain the original fracture resistance. Although studies have indicated the use of various type of post and core materials that helps to improve the fracture resistance of the remaining tooth structure. Different clinical techniques have been proposed to solve these problems, and one such technique is the post and core.[6,7]

Dental **amalgam** is a liquid mercury and metal alloy mixture used to fill cavities caused by tooth decay, In the 1800s, amalgam became the dental restorative material of choice due to its low cost, ease of application, strength, and durability, and used as core build up material.[2]Apart from the prefabricated post system and fiber post technique, Nayyar core build up technique has been done to restore the tooth structure by enlarging the root canal orifices by peso reamers n.o 1,2,3,4. followed by restoring the tooth with core build up material. Recently, a short fibre reinforced composite (SFRC) (EverX Posterior, GC Europe,Leuven) has been introduced to the market with the goal not only to change restorative indications of large class II posterior cavities towards direct restorations, but also for the core build up. This composite resin is intended to be used in high stress bearing areas especially in molars.[1,8]Filtek Z350 XT 3M ESPE builds its nanocomposite using a patented process that creates unique clusters of nanometer -sized particles. Used as a core build up material in high stress bearing areas.[6]With this background the present study was carried was to assess the fracture resistance of three different core materials by using nayyar core build up technique.

Materials and Methodology

45 carious molars which were extracted for periodontal reasons were collected in this study and stored in distilled water. The study includes carious molars involving pulp with minimum of 2 wall intact. And they were randomly divided into three groups, comprising 15 teeth each as Group 1 consisting of Amalgam Core, Group 2 as GC ever x posterior Fiber reinforced composite coreand Group 3 as Filtek Z 350 Nano composite core. Tooth were made caries free using a tapered diamond bur with high-speed handpiece, and tooth were optimized under the stereo microscope for detection of any dentinal micro cracks and fractures were eliminated from the study. Followed by Root canal treatment cleaning and shaping done with crown down technique and irrigated with NAOCL & Saline, canals were then dried with absorbent

paper points, followed by AH PLUS sealer application and then obturated with lateral condensation technique. (**Figure 1**)

Post space preparation was done after 24 hours upto 3mm from the canal orifice (nayyar post technique) and the post space was prepared with pees B) Post space preparations were filled prior to core build up C) Core build up was done using Nayyar Core technique o reamers no. 1,2,3,4 (**Figure 2**). Undercuts present in the pulp chamber were retained in order to assist with core retention a stainless steel ivory matrix band with tofflemire retainer was custom fitted to each prepared tooth prior to core build up. and the core build up was done. Teeth were again divided into 3 groups comprising of Group A of post space preparation and core build up done with amalgam, Group B: post space preparation & core build up done with filtek Z350 3M and Group C: post space preparation & core build up done with GC Ever X posterior.(**Figure 3**)

Preparation of The Samples

Group A :**Amalgam corono-radicular core technique**

The amalgam was triturated according to manufacturer's instructions using an amalgamator. condensation of the amalgam was incorporated immediately, with the amalgam first packed into the root canal space, and core build up was done with proper condensation then built to a height of 4mm. following the procedure matrix band was carefully removed. Tooth preparation was done for the samples keeping the finish line 1.5 mm & coronal height was maintained at 4mm.Teeth were mounted in autopolymerising acrylic resin. (**Figure 4a**)

Group B: **Nano Composite corono-radicular core technique**

Both the enamel and dentin were etched with 37% Ortho-phosphoric acid for 30 and 15 seconds, respectively, then a bonding agent was applied according to the manufacturer's instructions. The composite was initially condensed into the root canal space, and followed by core build up with incremental placement of subsequent material. And light cured after each layer of application, two minutes after placement, then matrix band was carefully removed and countering commenced. Tooth preparation was done for the samples keeping the finish line 1.5mm & coronal height was maintained at 4mm. Teeth were mounted in autopolymerising acrylic resin. (**Figure 4b**)

Group C: **Fiber reinforced composite corono-radicular core technique**

Both the enamel and dentin were etched with 37% Ortho-phosphoric acid for 30 and 15 seconds, respectively, then a bonding agent was applied according to the manufacturers instructions. The composite was initially condensed into the root canal space, and followed by core build up with incremental placement of subsequent material followed by the application of traditional composite. And light cured after each layer of application. (**Figure 4c**)

Tooth preparation was done for the samples keeping the finish line 1.5mm & coronal height was maintained at 4mm. Teeth were mounted in autopolymerising acrylic resin. The teeth were mounted perpendicular to the base of the mould and embedded in the autopolymerising acrylic resin. Care was taken so that the cervical finish line was just above the auto-polymerizing acrylic resin. (**Figure 5**) All the teeth were mounted in a similar manner. The acrylic block with the samples was placed on the base of Universal testing machine for testing of the fracture resistance. For positioning the samples on the Universal testing machine a customized mounting fixture was fabricated into which the acrylic blocks fitted perfectly. The fixture also helps to position the samples in such a way that the load could be directed at 90◦ to the long axis of the tooth.

Each of the sample blocks were fixed to the base of the Universal testing machine using the fixture and the tip of the plunger was made to contact the notch on the CEJ of the tooth. The samples were loaded at a crosshead speed of 1mm/min until there was a visible or audible sign of failure in the core. (**Figure 6**). The site at which the fracture took place(**Figure 7**) was evaluated and the results tabulated. Observations thus obtained were statistically analysis using ANOVA & POST HOC TUKEY TEST.

Results

The present study revealed that mean fracture resistance was highest in GC Everx Posterior as compared Filtek Z 350 3M and Amalgam(Table No.1). As per ANOVA statistical test the fracture resistance between these groups were statistically significant (p value <0.001, Table No.2). Post Hoc Tu key test was also used to compare the fracture resistance of different materials the results revealed that Filtek Z 350 3M and GC Everx Posterior was statistically stronger than amalgam.(Table No.2)

Discussion

The restoration of endodontically treated teeth has been a long concern of dentistry. These pulpally-involved teeth, which were formally considered for extraction, are now being retained with the advances in the field of endododontics and restorative dentistry. Due to loss of tooth structure and altered physical characteristics following endodontic therapy, all teeth require some form of restorative treatment. The longevity and the success of the endodontically treated teeth depend on the procedure with which it is restored. It has been observed that pulpless teeth are more brittle than vital teeth When there is excessive loss of tooth structure, retention for the artificial crown is required. This can be achieved by using a postcore.

The core build-ups were modified with an airotor to give the shape of a prepared tooth so as to simulate clinical conditions. However, it should not adversely affect the load bearing capacity of the tooth. It has been indicated that the structural integrity of the tooth depends on the quality and quantity of dentin and its anatomic form (Gutmann,1992).Thus, an extra-coronal restoration would be required to restore the weakened tooth. The remaining tooth structure might not be adequate enough to retain a crown, and thus a post and core is indicated. A large number of post and core systems are available with their advantages and disadvantages. There are various core materials used in the past, such as amalgam, glass ionomer cement, modified glass ionomer and composite resin.[9]

The function of bulk short fiber composite substructure is based on supporting the surface particulate filler composite layer and working as crack stopper layer. Reinforcing effect of the fiber fillers is based on stress transfer from polymer matrix to fibers but also behavior of individual fiber as a crack stopper. Random fiber orientation had a significant role in mechanical properties. The differences in the fracture resistance of various materials can be attributed to composition of the matrix, filler size, content as well as distribution. Hence the size reduction and increase in volume attributes to increase in comprehensive strength and hardness.[10,11,12]

Figures and Tables

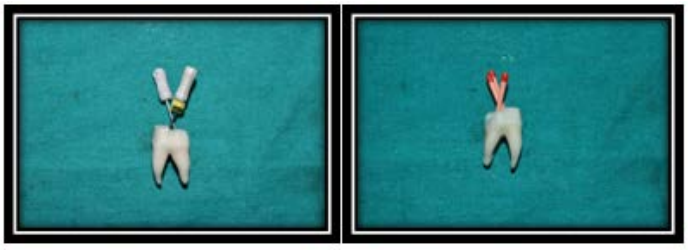


Figure 1: Access Opening, working length, master cone and obturation.

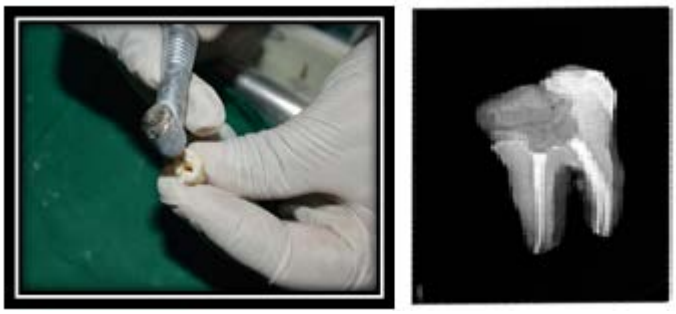


Figure 2: Post space preparation done 3mm from the canal orifice.

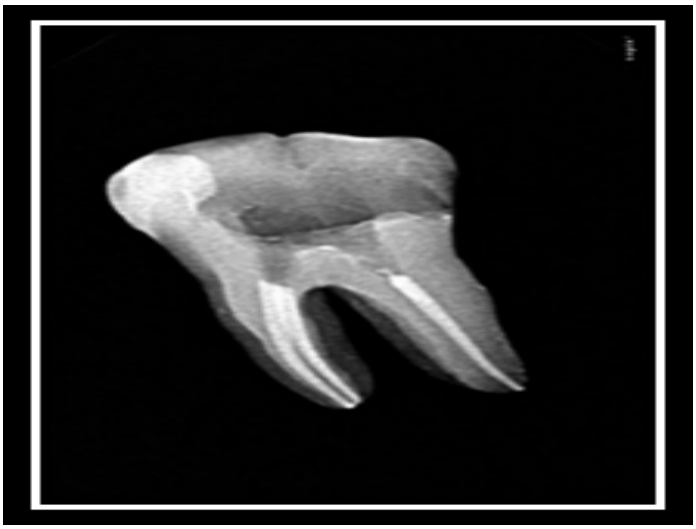


Figure 3A): Post space preparation.

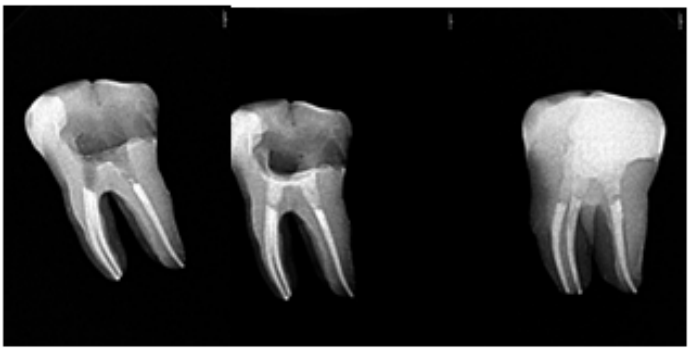
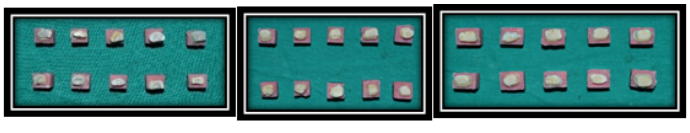


Figure 3B) Post space preparations were filled prior to core build up.

Figure 3C) Core build up was done using Nayyar Core technique



a b c

Table 1: Mean and SD of fracture resistance of various materials

Figure 4a): Amalgam corono-radicular core technique. 4b) Nano Composite corono-radicular core technique. 4c) Fiber reinforced composite corono-radicular core technique

Figure 5: Mounted tooth with cervical finish line above the auto-polymerizing acrylic resin.

Figure 6: Load testing at Universal testing machine.

Figure 7: Fracture of the core material

Material	N	Minimum	Maximum	Mean	Std. Deviation
FILTEK Z 350 3M	15	223.52	644.16	465.9767	120.65430
GC Everx Posterior	15	277.74	855.41	520.3927	131.38253
Amalgam	15	179.75	437.45	283.7233	75.29083

Table 2: Comparison of mean fracture resistance of various materials using One-way ANOVA and Post Hoc Tukey HSD.

Characteristics	Sum of Squares	df	Mean Square	F
Between Groups	460948.760	2	230474.380	18.444
Within Groups	524825.542	42	12495.846	
Post Hoc Tukey HSD				
Comparisons		Mean Difference (I-J)	Std. Error	Sig.
FILTEK Z 350 3M	Gc Everx Posterior	-54.41600	40.81805	.385
	Amalgam	182.25333	40.81805	.000**
GC EVERX POSTERIOR	Filtek Z 350 3m	54.41600	40.81805	.385
	Amalgam	236.66933	40.81805	.000**
AMALGAM	Filtek Z 350 3m	-182.25333	40.81805	.000**
	GC Everx Posterior	-236.66933	40.81805	.000**

Conclusion

The study conducted evaluated the fracture resistance of three different core materials by using nayyar core build up technique in extracted endodontically treated teeth. within the limitation of the in-vitro study, the following conclusions were drawn. GC EverX posterior has the best fracture resistance compared to amalgam and composite (Filtek Z350) Fracture resistance of amalgam was found to be very much inferior to that of composite and GC EverX posterior.

ABBREVATIONS

CRCT- Corono radicular core technique

CEJ – Cemento enamel junction

FRC- Fiber reinforced composite

PR- Peeso reamers

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