



COMPARISON OF FRACTURE RESISTANCE OF ENDODONTICALLY TREATED TEETH RESTORED WITH THREE DIFFERENT COMPOSITE: AN IN-VITRO STUDY

Prajakta Gadge., Vijaykumar Shiraguppi., Bharat Deosarkar and Suraj Malpani

Saraswati Dhanwantari Dental College and Hospital Parbhani

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ABSTRACT

Aim: To evaluate and compare the fracture resistance of endodontically treated premolars restored with Microfill, Nanofill and Supra-nanofill composite in mesio-occluso-distal (MOD) cavities.

Materials and methodology- Eighty orthodontically extracted maxillary premolars were selected for study. Twenty intact teeth served as positive controls (Group 1). Endodontic therapy was done in the remaining 60 teeth. MOD cavities were prepared in all the teeth with standardized dimensions and were randomly divided into three groups (Group 2 - Microfill, Group 3 -Nanofill and Group 4 – Supra-nanofill composite). Restorations were done for all groups. Fracture resistance was measured by Instron universal testing machine.

Statistical Analysis Used: One-way ANOVA test and Tukey's post hoc test.

Results: Highest fracture resistance was shown by intact teeth group followed by supra-nanofill, nanofill and microfill respectively. Statistically Significant difference was revealed by ANOVA test ($P < 0.0001$) and Tukey's post hoc test ($P < 0.0001$).

Conclusions: Among the experimental groups, Supra-nanofill composite showed the highest fracture resistance. Statistically significant difference was observed for all the groups.

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INTRODUCTION

Restoration of endodontically treated teeth is one of the biggest challenges in the field of operative dentistry. Endodontically treated teeth are more prone to fracture than vital teeth, particularly in the posteriors where the stress generated by normal functional forces can lead to fracture of undermined tooth structure.¹

Many factors have been attributed for the decrease in fracture resistance of endodontically treated teeth. They are 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 substrate². Coronal destruction from dental caries, previous restorations/fracture, and endodontic access preparations is considered to be the main cause³.

Crown placement followed by root canal treatment is considered to be the gold standard.⁴ However, there may be cases where the tooth is still erupting, or where the tooth or root canal therapy has a questionable prognosis, or where the clinician wants to wait and evaluate the healing of a periapical lesion before proceeding with full-crown restorations.

There would be situations where both marginal ridges are involved in caries and cannot be restored with amalgam restoration as tooth need to be reinforced using composite. To prevent the failure of root canal treatment, a material with high strength and acceptable clinical performance desirable.⁵

No study has been done comparing Microfill, Nanofill and Supra-nanofill composite so the present study aims to compare the fracture resistance of endodontically treated teeth restored with Microfill, Nanofill and Supra-nanofill composite in maxillary premolars. The objective of the study was to evaluate the fracture resistance of all the three materials and to find out which restorative material will provide maximum fracture resistance.

The null hypothesis tested will be that there will be no difference in the fracture resistance of intact teeth and those restored with different composite materials.

MATERIALS AND METHODS

Eighty human maxillary premolars extracted for orthodontic reason were used in the study. Fully erupted teeth with mature apices, intact enamel, and dentin without any carious lesion, restorations, or developmental disturbances were included in the study.

*Corresponding author: **Prajakta Gadge**

Saraswati Dhanwantari Dental College and Hospital Parbhani

Teeth with open apices or resorption, caries, cracks, root fracture, hypoplastic teeth, and previous restorations or with any anatomical variation were excluded from the study. Specimens were cleaned off calculus and periodontal tissue using an ultrasonic scaler. Then, the teeth were stored in distilled water at 4°C until further processing.⁶

Twenty intact teeth were used as positive controls (Group 1). Endodontic access cavities were prepared in 60 teeth using a water-cooled diamond bur with an airtor handpiece. A size 10 K-file (Mani Prime Dental Pvt. Ltd.) was introduced into each canal until it could be seen at the apical foramen. The working length was determined by subtracting 1 mm from this length cleaning and shaping was completed using Protaper rotary files, till size F1 and obturated with gutta-percha using AH plus sealer with cold lateral condensation technique.

Mesio-occluso-distal (MOD) cavities were prepared in all the specimens using an airtor handpiece with a long straight fissure diamond point. Dimensions of the MOD cavities were standardized by keeping the buccal and lingual wall thickness 2.5 ± 0.2 mm from height of contour of each surface, and the gingival cavosurface margin was kept 1.5 mm coronal to the cements/enamel junction.^{7,8} Dimensions of the cavity were measured with the help of Vernier calipers. Subsequently, teeth were randomly divided into three groups

Group 2: Teeth restored with microfilled (Voco polofil supra) composite

Teeth is restore with voco polofil supra according to manufacture instruction. Restoration was done using incremental layering technique.

Group 3: Teeth restored with nanofill (Tetric N Ceram) composite.

Teeth restored with Tetric N Ceram composite according to manufactures instruction. Restoration was done using Bulk filling upto 4mm.

Group 4: Teeth restored with supra-nanofill (Estelite Sigma Quick) composite.

Restoration was done according to manufactures instructions. Increment layering technique was used. Curing was done for 10 seconds. Finishing and polishing of restored teeth were done. and Samples were mounted on cold acrylic resin. A compressive force at a strain rate of 1 mm/min was applied using Instron universal testing machine by a 0.5 mm diameter round bar, which was parallel to the long axis of the teeth and centered over the teeth until it just contacted the occlusal surface of the restoration.⁹ Forces necessary to fracture each tooth were measured in Newtons (N). The data obtained were tabulated and subjected to statistical analysis.



Group 2- Microfill composite (Voco polofil Supra)



Group 3- Nanofill composite (Tetric N Ceram)



Group 4- Supra-nanofill composite (Estelite sigma Quick)

RESULTS

Highest mean fracture resistance was observed with intact teeth followed by Estelite sigma quick, Tertric N ceram, Voco polofil supra. One-way ANOVA test [Table 1] revealed

statistically Highly significant difference ($P < 0.0001$) between all the groups. Intergroup multiple comparisons were done by Tukey’s post hoc test [Table 2] which also revealed statistically significant difference ($P < 0.05$) between all the groups.

Table 1 One Way ANOVA test

	N	Mean	Std. Deviation	F	P	Inference
Group A	20	1322.40	113.46	58.59	0.0001 (<0.001)	Highly significant
Group B	20	402.80	111.69			
Group C	20	600.72	122.74			
Group D	20	1037.30	279.15			
Total	80	840.81	400.81			

Table 2 Tukey’s post hoc test

	Group B	Group C	Group D
Group A	919.6*	721.68*	285.1*
Group B		-197.9	-634.5*
Group C			-436.58*

*Indicates that the difference in the mean is significant at 0.05 level.

DISCUSSION

Maxillary premolars were chosen as they are more prone to fracture due the anatomical shape with steep cuspal inclines, leads to cuspal separation during mastication and greater incidence of fracture than mandibular premolars.¹⁰

In the present study significant differences were found in fracture resistance among the restorative materials. Therefore, the null hypothesis is rejected.

Earlier school of thought considered that placement of post was beneficial to compromised tooth structure, but postpreparation can significantly weaken the root and ultimately lead to root fracture which lead s to patient dissatisfaction.¹¹

Hence, selection of postendodontic restorative material is of prime important as the material properties influence the fracture toughness.

So, in this study fracture resistance was taken as a criterion. Filler contents plays a significant role in depth of cure possible with bulk fill composites.

The higher the filler conent, the greter the depth of cure. An increase the filler content, in turn decrease the volume of resin matrix for polymerization and also increase hardness.¹²

Composite	Filler size	Filler loading
Voco Polofil Supra	0.5-2um	76 by weight
Tetric N Ceram	0.4-0.7um	80 by weight
Estelite Sigma Quick	0.1-0.3um	82 by weight

In this experimental study the control group showed highest fracture resistance which is consistence with the studies conducted earlier. Resoprtin that restired teeth had significantly lower resistance to fracture.

In teric N Ceram bulk fill, in addition to comphorquinone/ amine initiator system, it has introduced an “initiator booster”(Ivocerin) able to polymerize the material in depth. However, not much literatur is available that concerns with the polymerization mechanism or the chemical nature of the initiator.¹³

Radical-amplified photopolymerization initiator (RAP technology) is used in Estelite sigma quick. The initiator balances the high polymerization activity. needed to cure the

resin with short exposure times (one-third of that required by conventional composites) and requires exposures of 10 s or less. To achieve high esthetic qualities, it has a suprananofillers 0.2- μ m mono-dispersing spherical filler (Si-Zr). Particle diameters of 0.2 μ m are known to produce the best balance of material properties and esthetics. Estelite sigma quick itself resists wearing without causing unusual wear in opposing teeth. It resists absorbing stains from substances such as coffee better than conventional products.¹⁴ It is 82% filled by weight, which allows it to have excellent strength and durability to withstand the demands of the posterior dentition and the harsh environment of the oral cavity.¹⁵

In this present study show there was a significant difference in fracture resistance of endodontically treated teeth restored with the Estelite Sigma Quick composite. This may be due to higher filler load content in them.

CONCLUSION

- Within the limitations of this study, maximum fracture resistance is shown by the Tokuyama Estelite sigma quick composite
- But compared with the intact teeth, restored teeth had a lower fracture resistance

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