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Intricate evaluation of fracture resistance in teeth restored with two commercially available composite resins: An *in vitro* study

SumitaGiriNishad[1], Shubhra Malik[2], Sayak Gupta[3]
[1]Professor & Head, Department of Conservative Dentistry &Endodontics, SantoshDeemed to be University, Ghaziabad, Delhi-NCR
[2]Reader, Department of Conservative Dentistry &Endodontics, SantoshDeemed to be University, Ghaziabad, Delhi-NCR
[3]Post Graduate Student, Department of Conservative Dentistry &Endodontics, SantoshDeemed to be University, Ghaziabad, Delhi-NCR

Corresponding Author: Dr. SumitaGiriNishad
Email: sgiri_2000@yahoo.com

ABSTRACT
Background and Aim: Root canal therapy undoubtedly saves teeth but paradoxically weaken the hard tissues also. Restorative materials which are used for crown buildup can easily fracture or detached due to weakened tooth substructure. This clinical dilemma is very common in endodontically treated tooth restored with composite resins. Therefore, authors conducted this study to evaluate fracture resistance in teeth restored with two commercially available direct composite resins.
Materials & Methods: Total seventy five sample teeth (Mandibular first premolars) were selected byrandomized sampling procedure All samples were preserved into 10% neutral buffered formalin for three days at room temperature. Standard root canal procedure was completed in all teeth andcoronal portion of all samples were prepared identically. 3MFiltek Bulk Fill Posterior Restorative resin (group one) andTetric N-Ceram bulk Fill (group two)were studied.Group three samples were not prepared and non-restored (control). The test samples were positioned on the universal testing machine. The magnitude of the applied load was noted for each sample in Newtons and entered in to table. Data thus obtained were subjected to statistical analysis wherein P value less than 0.05 was considered significant.
StatisticalAnalysis and Results: Statistical evaluation was attempted using statistical software Statistical Package for the Social Sciences version 21.0.Mean fracture resistance for group one samples (3MFiltek Bulk Fill Posterior Restorative) was 1.320 KN wherein p value was highly significant. Mean fracture resistance for group two samples (Tetric N-Ceram bulk Fill) were 1.198 KN. Mean fracture resistance for group three samples (control) was 1.542 KN wherein p value was significant.Two sample t- test was conducted for comparison of variables between three groupsand revealed highly significant p value.
Conclusion: Within the limitations of the study, authors have drawn few very significant conclusions. In restoration of posterior endodontically treated teeth, 3MFiltek Bulk Fill Posterior Restorative resin showed superior fracture resistance as compared to Tetric N-Ceram bulk Fill. Moreover, mean fracture resistance values for 3MFiltek Bulk Fill Posterior Restorative resin was highly significant.

Keywords: 3MFiltek Bulk Fill Posterior Restorative,Tetric N-Ceram Bulk Fill, Composite Resin, Fracture Resistance, Universal Testing Machine

I. INTRODUCTION

In literal meaning, dental caries is a procedure of dental tissuedecomposition that starts from the enamel and encroaches into thedentine. The most popular and universally accepted method to treat dental caries is restoration of the affected part.[1,2]For successful clinicalrehabilitation of endodontically treated teeth, the mainfocus must be on exploration of best material andmethod. Literature has shown many materials and methods to increase the longevity of restored teeth. Ideally, any restorative materialmust possess excellent aesthetics and high strength.[3,4,5]Literature has well evidenced that to attain successful restoration, accurate selection of filling materials is crucial.Complete rehabilitation of endodontically treated teeth ends with the restoration of coronal portion with appropriate material. Therefore, this material plays a key role in the success of endodontic therapy.[6,7] Studies have confirmed that root

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canal treated teeth are usually at higher risk due to fragile nature of enamel and dentine. In the same way, dental hard tissues get easily fractured and lead to imbalance in occlusion and mastication.It is therefore very imperative to prevent any undue fracture in such posterior teeth.[8,9,10] Among all posterior teeth, premolars are having distinctive anatomic angulations which frequently encounter oblique masticatory forces. Many of the pioneer researchers have mentioned these forces as shearing forces in their research papers. This is the reason why premolars are more susceptible for restoration fracture than other teeth.[11,12,13] All these factors actually led to the exploration ofhigh-strength tooth-colored restorative material which can withstand shear forces and impart into smile designing processes. Endodontictherapy definitely saves teeth but unnecessarily weaken the hard tissues also.[14,15] Restorative materials which are used for crown buildup can easily fracture or separated due to weakened tooth substructure. This clinical problem is universally faced by practitioners.Hence keeping all these facts in mind, authors planned and conducted this study to evaluate fracture resistance in teeth restored with two commercially available composite resins.

II. MATERIALS & METHODS

This study was conducted in the department of conservative dentistry and endodontics of the institute wherein authors studied total seventy five sample teeth (Mandibular first premolars). Randomized sampling procedure was employed for teeth collection. All mandibular first premolars were having history of non traumatic extraction due to periodontal reasons. Teeth with any developmental defect, attrition, discoloration, caries and fracture were excluded from the study. The study was performed on in vitro basis. Before real execution, outline of the study was prepared and discussed with institutional committee. Storage solution for samples (10% neutral buffered formalin) was prepared by adding recommended fractions of 37% formaldehyde solution, sodium chlorite, Potassium phosphate monobasic, Potassium phosphate dibasic and Distilled water. All samples were preserved into it for three days at room temperature. Samples were then dried up with complete cleaning to remove any hard or soft impurity or tissue. To rule out any internal fracture line or defect, teeth were examined under light microscope. All suspected samples were discarded from the study. Teeth were mounted individually on the rectangular plaster blokes at their cervical regions. Standard root canal procedure was completed in all teeth. Coronal portion of all samples were prepared identically (on occlusal surface simulating class one situation). Authors analyzed and compared two advanced composite resins. First was 3MFiltek Bulk Fill Posterior Restorativeresinwhich requires only one step placement with no additional capping layer. It is basically light cure Nanocomposite with Excellent handling and application. Second was Tetric N-Ceram bulk Fill (IvoclarVivadent, Schaan, Liechtenstein).All samples were evaluated under three groups. Group one consists of 25 teeth in which 3MFiltek Bulk Fill Posterior Restorative used to restore coronal portion. Group two samples (n=25) were restored with Tetric N-Ceram bulk Fill. Group three samples (n=25) were not prepared and non-restored (serving as control). After exactly 36 hours, the test samples were positioned on the universal testing machine. To create the intended fracture,all samples were subjected to an axial compression load which was directed parallel to the long axis of the tooth. The magnitude of the applied load was noted for each sample in Newtons. All readings of load as per different groups were tabulated and transferred to computer for further processing. Data thus obtained were subjected to statistical analysis wherein P value less than 0.05 was considered significant.

III. STATISTICALANALYSIS AND RESULTS

Data obtained from above methodologies and exercises were gathered and sent for statistical evaluation using statistical software Statistical Package for the Social Sciences version 21.0 (IBM Inc., Armonk, New York, USA). The finalized data was subjected to suitable statistical tests to obtain p values and other related inferences and outcomes.Table 1 shows different types of composite resins and related distribution of samples in groups.

Table 1: Types of composite resins and related allocations of samples in group

Parameters	Group I	Group II	Group III
Types of Composite Resins	3MFiltek Bulk Fill Posterior Restorative	Tetric N-Ceram bulk Fill	Not prepared and non-restored [Control]
No. of Sample Teeth	25	25	25

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Table 2: Fundamental statistical description with level of significance assessment using Pearson chi-square test [group I, II and III]

Parameters (Single Sitting RCT)	Mean Fracture Resistance [KN]	S.D.	Std. Error	95% CI	Pearson Chi-Square Value	df	Level of Significance (p value)
3MFiltek Bulk Fill Posterior Restorative[G I]	1.320	1.827	0.126	2.92	2.732	1.0	0.001*
Tetric N-Ceram bulk Fill [G II]	1.198	1.042	0.682	2.51	2.206	1.0	0.090
Not prepared and non-restored [G III]	1.542	1.502	0.431	2.83	1.217	2.0	0.002*
							*p<0.05 significant

Group I have 25 samples with 3MFiltek Bulk Fill Posterior Restorative. Group II have 25 samples with Tetric N-Ceram bulk Fill. Group III have 25 samples with no preparation and restorations (control). Table 2& graph 1 demonstrated basic statistical description with level of significance assessment using Pearson chi-square test [group I, II and III]. Mean fracture resistance for group one samples (3MFiltek Bulk Fill Posterior Restorative) was 1.320 KN wherein p value was highly significant (0.001). Mean fracture resistance for group two samples (Tetric N-Ceram bulk Fill) were 1.198 KN wherein p value was not significant (0.090). Mean fracture resistance for group three samples (control) was 1.542 KN wherein p value was significant (0.002). Standard deviation and standard error was 1.827 and 0.126 respectively in group one. Standard deviation and standard error was 1.042 and 0.682 respectively in group two. Standard deviation and standard error was 1.502 and 1.502 respectively in group three. 95% coefficient of interval was in the range of 2.206 to 2.732 for all three studied groups. Two sample t- test was also conducted for comparison of variables between group I, group II and group III (table 3). Results revealed highly significant p value (0.005).

Table 3: Two sample t- test for comparison of variables between group I, group II and groupIII

Variables	Group I		Group II		Group III		p Value
	Mean	S.D.	Mean	S.D.	Mean	S.D.	
Mean Fracture Resistance [KN]	1.320	1.827	1.198	1.042	1.542	1.502	0.005*
							*p<0.05 significant

Graph 1: Depicting Mean, Std. Deviation and Std. Error

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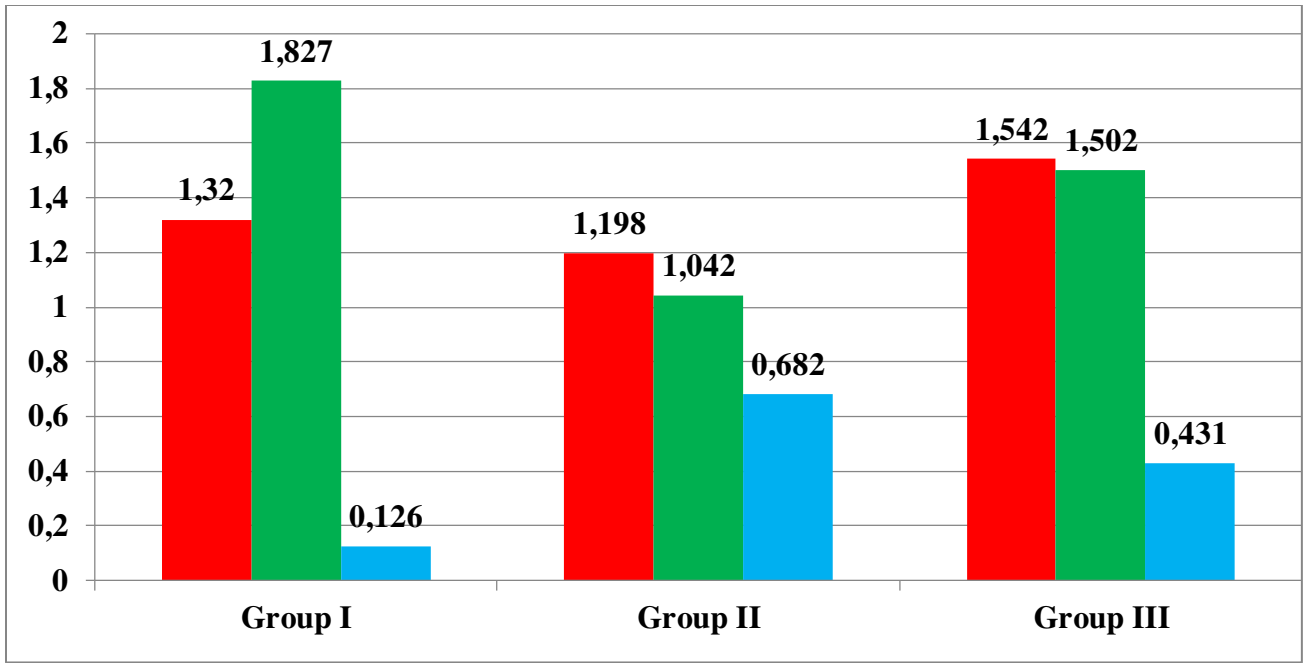

IV. DISCUSSION

Dental caries is generally multi-factorial in originin which dental hard tissue undergoes severe destruction and degradation by bacteriological activities. It usually starts from the enamel and involves dentine. Interestingly, it involves cementum(calcified or mineralized tissue layer covering the root of the tooth) and roots also.[16,17] Traditional method of managing caries is restoration. Here comes the role and importance of selection of appropriate restorative materials. Various techniques have been presented by different researchers and clinicians over last decade. Esthetic and strength are the two primary requirements of any restorative material.[18,19,20] It also determines long term success and acceptability of the material. Fracture resistance is the mechanical parameter with which material can be placed in higher or lower masticatory load areas. By definition, it is a mechanical property that decides the resistance of a material to fracture under fixed pre-determined load. Researchers have used fracture resistance as one of the reliable tool in randomized clinical trials and studies related to clinical testing.[21,22,23] Many compost resins have been evaluated for fracture resistance. It is also used for estimating the brittleness of a restorative material since it calculates maximum strength and pressure that a restorative material can withstandprior to fracture and dislodgment.[24,25,26]Literature has confirmed ever increasing advancements in composite resins. These are particularly introduction of nanotechnology ingredient to upgrade its physical and mechanical properties. Most of the modern composite resinshave particle size similar tonano filler.[27,28,29]Restorative composites resins have been extensivelysince long time to restore posterior teeth. However, occlusal wear and development of caries are the principalreasons of failure.[30,31,32] These issues are not common in anterior teeththerefore clinicians must be very careful while selecting suitable composite resin for posterior restorations.[33,34] In the present study authors compared to popular composite resins for their fracture resistances. 3MFiltek Bulk Fill Posterior Restorative resin wascompared withTetric N-Ceram bulk Fill forfracture resistance. Since, overall success typically depends on several materials and host related factors,results and recommendations should be judiciously applied. Moreover, authors have only studied fracture resistance of materials.Oskoee and colleagues have investigated influence of addition of fiber on the fracture resistance of root canal treated teeth in premolars. They analyzed Z250 composite resin with and without fiber and found that addition of fiber reinforces the composite resin.[35]

V. CONCLUSION

Within the limitations of the study authors concluded that both the tested composite resins exhibited clinically acceptable results in all sample teeth. In restoration of posterior endodontically treated teeth, 3MFiltek Bulk Fill Posterior Restorative resin showed superior fracture resistance as compared to Tetric N-Ceram bulk Fill. Moreover, mean fracture resistance values for 3MFiltek Bulk Fill Posterior Restorative resin was highly significant. Thus, our study indicates that both composites can be rationally used in posterior teeth however; the choice will be solely

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depending on the magnitude of occlusion in the region.Nevertheless inferences of this study must be taken as suggestive only.Authors look forward to have some other large scale studies that may further establish certain crucial and concrete norms in these regards.

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