Original Article

Comparative Evaluation of the Shear Bond Strength of Different Core Build Up Materials – An *Ex Vivo* Study

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Abstract

Aim: The aim of this study was to evaluate and compare the shear bond strength of ParaCore, FluoroCore, multicore, and resin modified glass-ionomer cement in mandibular premolar using universal testing machine. **Materials and Methods:** Eighty recently extracted intact caries free Human Permanent Mandibular Premolars and disinfected according to CDC guidelines on infection control in dental health-care setting 2003. The teeth were then randomly assigned to four groups on the basis of material used (Group A – ParaCore, Group B – FluoroCore, Group C – MultiCore, and Group D – Resin modified glass-ionomer cement), each group consisting of 20 samples. The dentin surface was treated with the respective adhesives of the groups and then bulk filled with core build-up materials. The attained samples were than subjected to shear loading in Instron Universal Testing Machine. The data were tabulated and statistically analyzed using analysis of variance, Tukey's HSD test. **Results:** MultiCore material had the greatest shear force followed by Group B – FluoroCore. The least strength exhibited was by Group D – resin modified GIC preceded by Group A – ParaCore. **Conclusion:** MultiCore showed the highest shear bond strength followed by FluoroCore, ParaCore, and RMGIC.

Keywords: Core build up, Shear bond strength, Universal testing machine

Introduction

Tooth structure has been substantially compromised by fracture, widespread caries, or other factors; core build up is required as a framework for post-endodontic restorations.[1] The core needs to provide resistance and retention for the coronal restoration as well as sufficient capacity to withstand occlusal forces since it becomes a vital feature of the tooth's load-bearing structure.[2]

The physical properties of a core build-up material should imitate tooth structure. When a tooth has been restored, a complicated pattern of stress distribution is permitted along the tooth and restoration interface, creating compression, tension, or shear stress.[3] Shear bond strength, which describes the underlying nature of the adhesive strength of materials at the interface between a tooth and a restoration, is mostly related to the shearing phenomena that occur during the process of chewing.[4]

Various dual-cured versions of resin composite build-up restoratives that combine the advantages of light curing and self-curing mechanism have been introduced, with the rationale to develop a material capable of reaching higher degree of polymerization in either the presence or absence of light, and overcome the limitations of reduced interlayer strength.[5,6]

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Dual cure core build up materials provide appropriate properties as, for instance, sufficient flexural and compressive strength and flexural modulus to resist multidirectional masticatory forces. Improvements in dentin bonding systems accompanied by a paradigm shift from "post-and core stabilization" to "adhesively restored core retention" have stimulated the increasing use of resin-based materials for core build-up.[7]

Materials and Methods

Eighty recently extracted intact caries free Human Permanent Mandibular Premolars with single straight root canals and mature apices were selected. The teeth were sectioned horizontally with a carborundum disk beneath the dentinoenamel junction to expose the coronal dentin surface and later finished with silicon carbide paper to create a uniform flat surface. The teeth

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Table 1: Comparative evaluation of shear bond strength among different materials

Variable	Mean	SD	SE	ANOVA statistic	Df	*P*-value
Group A – ParaCore	5.1120	0.20870	0.09333	690.978	3	0.000*
Group B – FluoroCore	10.1526	0.99155	0.44344			
Group C – MutliCore	19.0414	0.44929	0.20093			
Group D – Resin Modified GIC	4.2548	0.32298	0.14444			

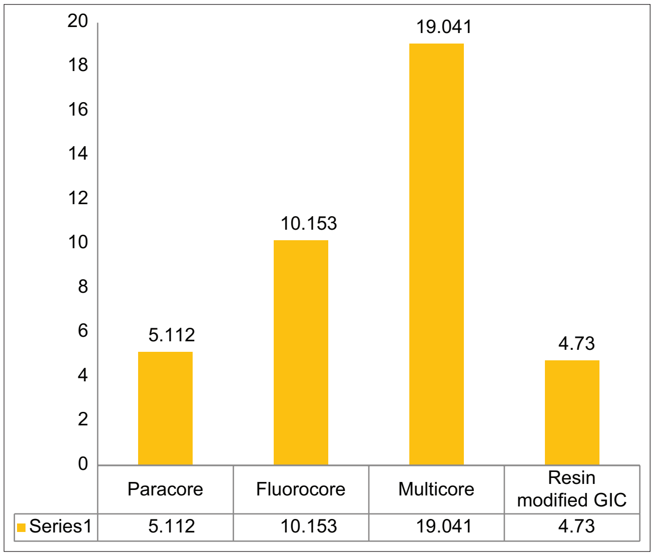

Figure 1: Comparative evaluation of shear bond strength among different materials

were then randomly assigned to four groups on the basis of material used (Group A – ParaCore, Group B – FluoroCore, Group C – MultiCore, and Group D – resin modified glass-ionomer cement), each group consisting of 20 samples.

Group A

The dentin surface was treated with ParaBond Non-Rinse Conditioner, scrubbed for 30 s, followed by application of premixed adhesive A and adhesive B on conditioned dentin surface for 30 s and air drying for 2 s. Readymade polyvinyl molds of 5 mm internal diameter and 5 mm height, coated with non-reactant lubricant (petroleum jelly) on inner walls were placed on the treated dentin surface and subsequently bulk filled with ParaCore at room temperature. These were then initially light-cured for 10 s per surface to initiate polymerization and to achieve final set, left for 8 min for autopolymerization. Molds were disassembled and will be stored at 100% humidity at 37°C and samples were subjected to SBS testing using Universal Testing Machine.

Group B

The dentin surface was treated using Xeno IV dual-cure self-etching dental adhesive, followed by light-curing for 10 s using curing light (550 mW/cm^2). Readymade polyvinyl molds of 5 mm internal diameter and 5 mm height, coated with non-reactant lubricant (petroleum jelly) on inner walls, were placed on the treated dentin surface and subsequently bulk filled with FluoroCore at room temperature. These were then initially light-cured for 10 s per surface to initiate polymerization and to achieve final set, left for 8 min for autopolymerization.

Group C

The prepared dentin surface was treated using Tetric N-bond self-etch followed by light-curing for 10 s using curing light. Readymade polyvinyl molds of 5 mm internal diameter and 5 mm height, coated with non-reactant lubricant (petroleum jelly) on inner walls, were placed on the treated dentin surface and subsequently bulk filled with Multicore at room temperature. These were then initially light-cured for 10 s per surface to initiate polymerization and to achieve final set, left for 8 min for autopolymerization.

Group D

Readymade polyvinyl molds of 5 mm internal diameter and 5 mm height, coated with non-reactant lubricant (petroleum jelly) on inner walls, were placed on the treated dentin surface and subsequently bulk filled with RMGIC and light cured for 10 s.

Statistical analysis

The data obtained were subjected to statistical analysis using the Statistical Package for the Social Sciences (SPSS Version 23; Chicago Inc., IL, USA). Data comparison was done by applying specific statistical tests to find out the statistical significance of the comparisons.

Variables were compared using mean values and standard deviation. The mean for different readings between the groups was compared using one-way analysis of variance (ANOVA), and the intercomparison between each group was done using Tukey's post hoc analysis. $P < 0.05$ was considered to be statistically significant [Figure 1 and Table 1].

Results

One-way ANOVA analysis showed that Group C – Multicore material had the greatest shear force with a mean of 19.0414 + 0.44929, followed by Group B – Flourocore with 10.1526 + 0.99155 which was statistically significant at $P = 0.000$. The least strength exhibited was by Group D – resin Modified GIC at a mean of 4.2548± 0.32298 preceded by Group A – ParaCore

Discussion

This study compared the SBS of three different, resin-based dual-cure core build-up materials and RMGIC with respective dentin bonding adhesives as provided and recommended by the manufacturer, to achieve the maximum effect of bonding procedure.

Bond strength values are gross assessing tools for evaluating the efficacy of bonding restorative materials to dentin. Bond strength values are a general way of measuring how well restorative materials adhere to dentin.[8] The shear bond strength test, which emphasizes the strength at the bonded contact, is the least technique-sensitive of the several tests.[9]

In this study, Group C had the highest shear bond strength because Group C adhesives had the greatest mean SBS because they contain silicone dioxide nanofillers (around 5 weight percent), whereas the adhesives from the other groups do not. In addition, the filler particle volume is higher. Studies by Miyazaki *et al*. also reported higher filled adhesives yield stronger physical properties due to their ability to flex and relieve polymerization stress.[10,11]

Group A composition as compared to Group B and Group C and Group D, which has high percentage (20%) of UDMA. Studies have shown that composites with a higher percentage of UDMA show increased monomer conversion. Hence, replacement of some low-molecular-weight triethylene glycol dimethacrylate with UDMA, increases the molecular weight per reactive group thus decreasing polymerization stress.[12,13]

The mean SBS of Group C was found significantly ($P < 0.001$) higher as compared to Group A and Group B and Group C which can be due to high filler content of 70 wt.% in Group C. Because Group C contains a high proportion of filler (70 wt.%), its mean SBS was found to be considerably ($P = 0.001$) higher than Group A and Group B. It has been demonstrated that the composites' filler volume and filler weight level correspond with their strength and elastic modulus.[14,15]

Conclusion

MultiCore showed the highest shear bond strength followed by FluoroCore, ParaCore, and RMGIC.

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