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Comparative Evaluation of Shear Bond Strength of Two Nanofilled Posterior Composites as Core Build Up Materials: An *In Vitro* Study.

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ABSTRACT

Core build up is necessary as a foundation for post endodontic restorations when the tooth structure is severely damaged, fractured or extensively carious. Core build up material should provide resistance and retention form for the coronal restoration and possess sufficient strength to resist occlusal forces. An ideal core build-up material should have physical properties similar to those of tooth structure where the occlusal biting loads are transferred to dentin. The study evaluated and compared the shear bond strength of two nanofilled resin composites Group A – Filtek Z350 XT and Group B – Filtek Bulk fill) as core build up materials. Eighteen extracted permanent human molar teeth were sectioned horizontally with a carborandum disk beneath the DEJ to expose the coronal dentin surface and finished to create a uniform flat surface. Teeth are then mounted in custom-made wax molds (size 1.5 cm height, 1.5 cm length, and 5cm breadth) by autopolymerizing pink orthodontic resin, with coronal portion of the tooth exposed. Composite is layered over unset GIC and self-etch primer is used, over which composite is layered and cured. The samples are subjected to SBS test using Instron Universal Testing Machine. Mean and standard deviation for Bulk cure was 2.6033 MPa and 1.50829 and for Z350 2.4267 MPa and 2.65740 Levene's Test for Equality of Variances was done for checking the difference between groups ($p=.090$). The present study concluded that Filtek Bulk fill resin composite is similar to Filtek Z350 XT for core build with no difference in shear bond strength.

Keywords: Core build-up materials, shear bond strength, post-endodontic restorations.

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INTRODUCTION

It is very important to restore endodontically treated teeth to their natural anatomical form, function and esthetics. Core build-up has to be done on badly broken down, severely damaged, fractured or extensively carious tooth teeth as foundation restoration on which full coverage crown is given. Core is an integral part of the load bearing structure of the tooth; it should provide resistance and retention form for the coronal restoration and possess sufficient strength to resist occlusal forces. A restored tooth tends to transfer stress differently than an intact tooth, therefore an ideal core build-up material should have physical properties similar to those of tooth structure where the occlusal biting loads are transferred to dentin as compression that is distributed over a large internal volume of tooth structure reducing local stress.

The process of mastication is related to shearing phenomenon and the nature of the adhesive strength of materials at the tooth-restoration interface is described by the shear bond strength (SBS). SBS test is the most common method to evaluate bond strength.

Recently a high-performance, versatile nano-composite resins have been introduced which have excellent aesthetics for anterior restorations, and are strong enough for posterior restorations.

- Simple to use
- Lifelike aesthetics
- Unique nano-filler technology
- Wears like Enamel

Nano composites have many advantages over conventional glass fiber composites resin. The surface finish of the nanocomposite is much better than that of the glass fiber composite owing to nanometer size of the clay platelets versus the 10–15 μ diameter of the glass fibers.[2]

Filtek Z350 XT Universal provide their unique properties due to the unique nanotechnology first introduced by 3M ESPE in 2002. Bonded nano-fillers are the reason Filtek Z350 XT restorative retains its brilliant polish. A recent 5-year clinical study* measuring "occlusal contact wear", showed no statistically significant difference between Filtek Z350 XT Universal Restorative and enamel. [3]

Filtek Bulk Fill Posterior Restorative uses the same true nanofiller technology that has been time-proven by other leading Filtek restorative products. Not only does this technology contribute to high strength, excellent handling and better wear resistance, but also to restorations that are fast and easy to polish. In addition to this True nano-filler technology, Filtek Bulk Fill Posterior Restorative also contains two innovative methacrylate monomers that, in combination, act to lower polymerization stress, without compromising wear. The combination of these two technologies results in an easy-to-use, one-step placement, and restorative material designed to simplify posterior restorations. There are numerous products in the market; it is very difficult for the clinician to choose the material. Hence properties of the materials have to be confirmed before use.

GIC is used in core restorative procedures in endodontically treated teeth as orifice sealing material due to its adhesion to tooth structure, biocompatibility, low cytotoxicity, fluoride release mechanism and the chemical bond to tooth structure. Sealing of pulp chamber will be better with GIC lining under composite resin core. Bond strength of composite to GIC was significantly higher for self-etch primer group employed on unset GIC. [5] Hence composite will be layered over unset GIC and self-etch primer will be used over which composite will be layered and cured.

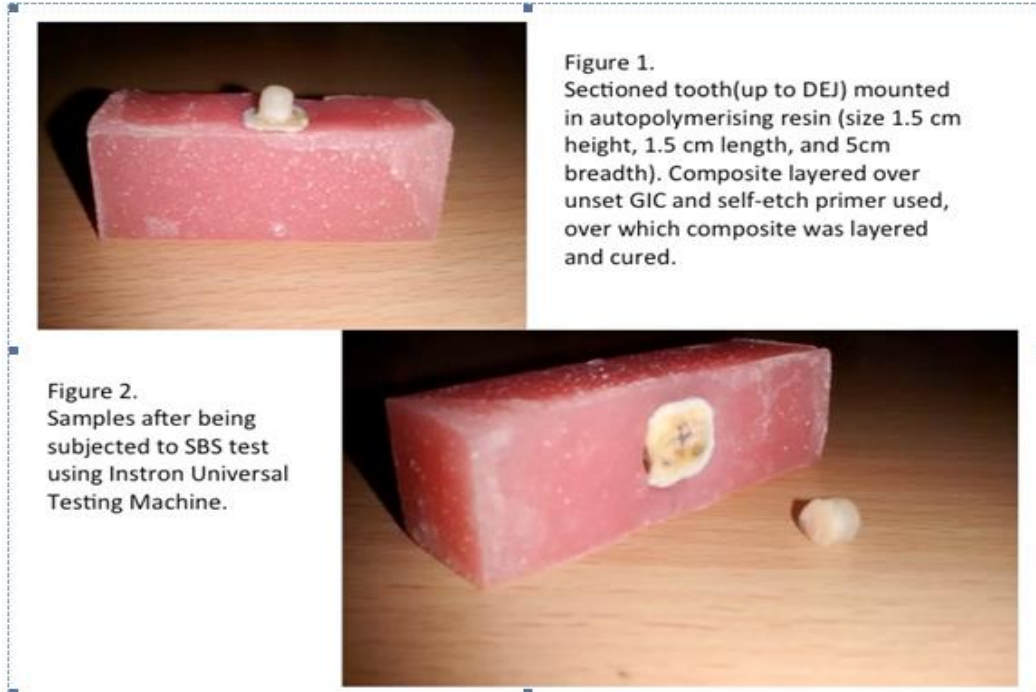
Hence the present study was conducted to compare the shear bond strength of two nanofilled posterior resin based restorative materials namely, Filtek Z350 XT and Filtek Bulk fill over GIC liner.

MATERIALS AND METHODOLOGY

Materials used in the study were Filtek Z350 XT and Filtek Bulk fill posterior restorative resin.

SPECIMEN

PREPARATION(Figures): Eighteen extracted permanent human molar teeth were cleaned and stored in distilled water at room temperature. The teeth were sectioned horizontally with a carborandum disk beneath the dentino-enamel junction to expose the coronal dentin surface and later finished to create a uniform flat surface. The teeth were then mounted in custom-made wax molds (size 1.5 cm height, 1.5 cm length, and 5cm breadth) by autopolymerizing pink orthodontic resin, with coronal portion of the tooth exposed.



Figures: Invitro specimen preparation

The teeth were then randomly assigned to two groups on the basis of material used (Group A – Filtek Z350 XT and Group B – Filtek Bulk fill) each group consisting of ten samples each.

Composite was layered over unset GIC and self-etch primer was used over which composite was layered and cured.

Finally, the samples were subjected to SBS test using Instron Universal Testing Machine. Data was collected and statistical analysis was done using one-way student t test and conclusions were drawn from the results obtained.

RESULTS

Data was collected and statistical analysis was done using SPSS v.11. Student t test was applied to check the statistical significance difference between Filtek Z350 XT and Filtek Bulk fill composite for the compressive stress. Mean and standard deviation for Filtek Bulk fill was 2.6033 MPa and 1.50829 and for Filtek Z350 XT 2.4267 MPa and 2.65740 (Table1)Levene's Test for Equality of Variances (Table 2)was done for checking the difference between groups and found that there is no statistically significant difference between the groups (p=0.090).

| | Group | N | Mean | Std. Deviation | Std. Error Mean |
|--------|-----------|---|--------|----------------|-----------------|
| Values | Bulk fill | 9 | 2.6033 | 1.50829 | .50276 |
| | Z350 | 9 | 2.4267 | 2.65740 | .88580 |

Table 1: Descriptive statistics of Bulk fill and Filtek Z350 composite

| | | F | Sig. | t | df | Sig. (2-tailed) |
|--------|-----------------------------|-------|------|------|--------|-----------------|
| Values | Equal variances assumed | 3.246 | .090 | .173 | 16 | .864 |
| | Equal variances not assumed | | | .173 | 12.670 | .865 |

Table 2: Levene's Test for Equality of Variances for checking the difference between groups

DISCUSSION

On the basis of mechanical properties, resin composites with nanofillers may be used as alternatives to amalgam core as foundation restoration under the crown of endodontically treated teeth. When we choose the material, the amount and mode of stress must be considered. The materials which can withstand this stress transmits the stress of the post. As the firmness increases, the stress goes more directly to the root and less to the post. Metal cores are known to cause great stress in the coronal part and to send the stress directly to the root. It is also important to choose a core that has similar physical properties with the post because of the favourable strong interface and lower risk of microleakage and failure.

In the present study Filtek Z350 XT and Filtek Bulk fill were compared as core build up materials since these are the newly introduced nanotechnological products. GIC was used as a base under resin composite core because of the advantage of chemical bonding biocompatibility, fluoride release and chemical adhesion. Seal at the dentin-GIC is better because of the chemical bonding between them. The feasibility of composite resin to be employed over unset GIC is that there is co-curing of GIC, bonding agent and composite resin to form monoblock. This prevents moisture contamination or desiccation of the underlying GIC and saving precious chair side clinical time. [7]

SBS test is the most common method to evaluate bond strength, as testing in shear mode is more clinically relevant and relatively simple, reproducible, and widely accepted test. [8,9]

The results of the present study showed both the materials were similar in their shear bond strength. This could be because of the same 'True' nanofiller technology that has been time-proven by other leading Filtek™ restorative products. Filtek Bulk Fill Posterior Restorative also contains two innovative methacrylate monomers that, in combination, act to lower polymerization stress, without compromising wear. The combination of these two technologies results in an easy-to-use, one-step placement, restorative material designed to simplify posterior restorations.^[3] Bonded nanofillers are the reason Filtek Z350 XT restorative retains its brilliant polish. The polish retention of Filtek Z350 XT restorative has been proved to be superior to other composites and even microfills, thanks to the patented process used to build the nanocomposite. This process creates unique clusters of nanometer-sized particles, these nanoclusters shear at a rate similar to the wear of the surrounding resin matrix during abrasion. This allows the restoration to maintain a smoother surface, meaning the initial impressive gloss will last for years.[4]

Both the materials used in the study are nano composites, with good mechanical properties.

Newly introduced bulk cure materials - Filtek Bulk Fill produced similar Shear bond strength as Filtek Z350 XT. Bulk fill materials are easy to use with no layering. Hence, there is no reduction in interlayer strength. Since whole bulk can be cured at once, procedure is not time consuming and user friendly. The results conclude that Filtek Bulk fill can be used as a core buildup material over the GIC lining.

Further studies concerning about fatigue load, adhesive strength between the resin cement and the dentin, the effect of deformation of the resin core due to masticatory or shearing force on failure of glass fiber post are needed to be conducted.

CONCLUSION

Within the limitations, the present study concluded that there is no difference in shear bond strength of Filtek Z350 XT and Filtek Bulk fill materials. Newer bulk filled composite resins are easy to use with less time and no incremental build up required, hence the present study recommends Filtek Bulk fill can replace Filtek Z350 XT, nanofilled posterior composite for core build up of post endodontic restorations.

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