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## Research Article

### COMPARISON OF DENTINAL SHEAR BOND STRENGTH OF TWO COMPOSITES 3M FILTEK™ P60 AND 3M FILTEK™ P90 IN VITRO

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#### Abstract

**Background and objective:** The objective of this study is to compare the dentinal shear strength of two composites, 3M FILTEK™ P60 and 3M FILTEK™ P90 in a laboratory study. **Material and methods:** In this laboratory study, 50 human premolar teeth that were extracted due to orthodontic reasons without any fracture or caries, were collected and sterilized. They were grinded up to 3 mm before CEJ surface of occlusal surface using grinding device. Then they were sandpapered with sandpapers with 600 Grit degree of roughness to make a smear layer. Samples were divided into two 25-teeth groups. On the dentinal surface of the first group, cylinder of p60 composite and in the second one, p90 composite. The diameter of composite cylinders was 2.5 mm and their height 2mm. After going through two stages including thermocycling and aging, the shear bond strength of the composites to dentin was measured using tensile – pressure Instron machine with applying force at rate of 0.5 mm/min. **Findings:** The average shear bond strength of the first group (p60) was obtained 11.16 MPa and the second group (P90) 11.42 MPa. Data analysis was done using SPSS and T-Test showed no significant relationship ( $P_{value}>0.05$ ). **Conclusion:** No significant difference exists between shear bond strength of two composites P60 and P90.

**Keywords:** shear bond strength- composite P60- composite P90.

#### Introduction

Composite materials in dental applications have been used for many years to repair teeth.(1) Teeth are divided into two groups based on their form and anatomy: posterior and anterior. Posterior teeth are generally affected by pressure stresses, while the anterior affected by shear and bending stresses (1). According to this classification, the type of composites used for anterior teeth is different from the posterior ones. According to this classification, the most important factor in applying composite in repairing posterior teeth is its strength. (1) One the other hand, based on the materials used in their construction and their mechanical properties, composites are divided into two main groups: Silorane-based and methacrylate - based. Silorane-based are

much newer composites than methacrylates, and in many mechanical characteristics, substantial improvements have been made in these composites. For example, Composite p90.

(3M ESPE, Dental Products, St Paul, MN, USA) Silorane-based has much lower shrinkage compared to methacrylate-based composite z100 (3M ESPE, Dental Products, St Paul, MN, USA). (1)

The properties of these two groups use is very different depending on their application. According to experts, the methacrylate-basis bending strength is more than silorane-based bending strength in dental flat

cavity (2), but no significant difference exists in the first type cavity. (2, 3)

One of the major flaws of the resin-based composites is shrinkage while polymerization. Volumetric shrinkage created, causes stress between the bond restoration and the walls of tooth resulting in gap and leakage. This deficiency can lead to sensitivity after work, further decay, discoloration in the margin and early failure of restoration. Over the years, various strategies have been proposed that reduce the negative features associated with the polymerization shrinkage of the resin-based composites. (4)

Silorane-based composite is available on market with brand Filtek P90 (3M ESPE). This type of composites are microhybrids filled with quartz and radiopaque yttrium fluoride particle. Filtek P90 is used with P90 adhesive system which has two steps etching and bonding. The system includes a self-etching primer that is hydrophilic and adheres to the teeth and a bonding system which is hydrophobic and adheres to resin. Although most acceptable results on the performance of bonding systems in the mouth should be obtained from clinical trials, but laboratory tests are still useful to compare the performance of bonding. Bond strength test is used as a screening tool for evaluation and prediction of adhesive systems. There are conflicting reports on the bond strength of resin composite bonded to enamel and dentine with self-etch and total-etch adhesives. More research have reported that the bond strength of total-etch adhesive is higher than the self-etch. (5, 6) Although recent studies have concluded that the self-etch adhesives may have a strength as the total-etch adhesives. (7, 8, 9 and 10).

This study evaluates the shear bond strength of two composites *in vitro* which belong to two different groups. Composite P60 belongs to methacrylate based and composite P90 belongs to silorane base.

## Materials and Methods

In this *in vitro* study, 50 premolar teeth extracted for orthodontic reasons with full roots, that were intact and without decay in examining by sound and stereomicroscope and since removing up to a month were kept in Chloramine T 0.5 percent. They were grinded up to 3 mm before CEJ surface of occlusal surface using grinding device and the dentin was completely appeared. Then they were sandpapered with silicon carbide sandpapers 600 Grit (Gelva, Achilles, *Netherland*) under water to make a smear layer. Samples were divided into two 25-teeth groups. Then, they were grinded by grinding device abrasive device up to 3 mm of occlusal wear was still CEJ to Ivory fully emerge. Then using silicon carbide abrasive paper No.

600 Great (Gelva, Achilles, *Netherland*) and the water flow, the smear layer was created. Then, randomly, were divided into 2 groups of 25.

Then in the first group, it was etched on the cutting surface of teeth for 15 seconds with phosphoric acid 37% (Scotch Bond Etchant; 3M ESPE, St. Paul, MN, USA) and after washing out, it was dried for 15 seconds with gentle air pressure. (According to manufacturer) After placing the bonding (according to the manufacturer), exposure was done for 10 s with an intensity of 450 mW/cm<sup>2</sup> using light cure device (BONART CO., LTD, ART-L2, Wuchuan, Hsinchuang, Taipei Hsien, Taiwan). The transparent plastic cylinders with an internal diameter of 2.5 mm and a height of 2 mm were used for preparing composite cylinders which was filled with composite P60 (3M ESPE, Dental Products, St Paul, MN, USA) A3 and were placed vertically in the center of the prepared tooth and were exposed in adhesive tube to the composite from the top, left and right each for 20 seconds.

On the prepared teeth of the second group, after etching and rinsing like the first group, bonding special primer for composite P90 (3M ESPE, Dental Products, St Paul, MN, USA) was placed, exposure was performed for 10 seconds. Again, after placing bonding, teeth of this group were exposed for 10 more seconds (according to the factory). Finally, transparent cylinders were vertically placed in the center of the surface and were filled with composite P90, A3 and the exposure was completed according to the manufacturer.

## Analysis of shear bond strength

After placing the bonded samples in distilled water at 37 °C for 24 hours, the thermo-cycling was done (500 CYCLES at 5 °C to 55 °C, SD = 2 °C, interval time = 10 s, dwell time = 30 s). Samples were vertically placed in metal generators in up to 1.5 mm CEJ that were filled with self-cured acrylic. Then, they are placed in the clamp of Universal Testing Machine (SANTAM\_STM\_20) so that the blade is tangent to the junction of resin and tooth composite. After adjusting the speed of the device (half a millimeter per minute), shear force was done in parallel with the junction of composite to dentin and exactly at the junction. Finally, the force at the moment of failure was recorded by the device and the data was obtained as force on surface (MPa).

## Analysis of failure

After measuring the shear bond strength, fracture surfaces in dental samples were evaluated under the stereomicroscope (Hp, SMP-320, China) and with 40 x magnification, and were classified into 3 groups.

Cohesive fracture: fracture in mass of resin or dental composite.

Adhesive fracture: fracture in the boundary between the dental or resin composite.

Mix fracture: a mixture of adhesive and cohesive fracture.

## Findings

The mean shear bond strength (MPa) and standard deviation for each of the study groups is given in Table 1.

**Table 1: Mean shear bond strength in study groups**

Study groups	Shearbond strength(MPa) ± mean Standard deviation	Least	Most
First group	11.16 ± 4.796	3.246	22.74
Second group	11:42 ± 3.806	6.507	20:24

The results of T-test showed that no significant difference exists between the mean shear bond strength in the study groups ( $P_{value} = 0.05$ )

Studying the pattern of fracture in samples by stereomicroscope showed that in the first group (p60), the cohesive failure was 28% from which 24% was for fracture in composite mass and 4% for the tooth, also adhesive and mix fractures were 48 and 24%, respectively.

In the second group (p90), mix and adhesive fracture were 80 and 20%, respectively, while no cohesive fracture was observed.

Statistical analysis of samples fracture pattern using chi-square test showed that there is a significant difference between the two groups ( $p < 0.001$ ).

## Discussion

According to the polymerization method used in silorane-based composites, which is open-loop method (11, 12), it is expected that the polymerization shrinkage is less than methacrylate based composites (11, 13), the stresses exerted on the bond is reduced (11,14) and bond strength is increased. But the results do not show it.

In conditions of this test, P60 and P90 composites shear bond strength have no significant difference. The reasons that may explain the lack of difference may be as follows:

Composite P60 is nanohybrid (11) and contains a high volume of filler and the ratio of filler underlying matrix is increased in it (11). This causes the values of one of the bond's destructive factors, i.e. polymerization stress is reduced (11, 15), as a result, bond strength is increased. In other words, increasing the volume of filler to underlying material may compensate for

reduction of polymerization stress in silorane-based composite.

The composite mass used in the present experiments is small tablets with a diameter of 2 mm. This small sizes may cause minimize the polymerization stress (11), and fail to show its impact and therefore the amount of bond strength get close to each other. The resin matrix used in two composite are different. Resin matrix used in P90 is silorane which is hydrophobic, and its water absorption is very low (11, 16). Due to the difference, water absorption and hygroscopic expansion in Composite P60 may be more than P90. Since water absorption and hygroscopic expansion caused by it can reduce polymerization stress (11), this feature may be an advantage in P60, and can compensate the shrinkage reduction as a result of P90 polymerization (17) and finally approximates the amount of the bond strength of two composites.

## Conclusion

According to the test condition and compliance with procedures recommended by the manufacturer factory, P60 and P90 composite bond strength to dentin have no significant difference.

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