

# BOND STRENGTH BETWEEN SILORANE-BASED COMPOSITE RESIN AND DENTIN SUBSTRATE

## ABSTRACT

The aim of this study was to evaluate the bond strength between composite resin and dentin using different bond systems. **MATERIAL AND METHODS:** 16 human molars extracted were selected. Each tooth was vertically cut in 3 dentin fragments of 2 mm of thickness (n=42) and randomly divided among the groups. Groups 1 was used Adper Single Bond 2, for groups 2 Silorano primer, groups 3 Adper SE Plus, and 4 Scotchbond Multiuse. Two composite resin cylinders were built up on each dentin surface (n=10) and subjected to a micro shear bond strength test until failure. To evaluated the results were used the Kruskal-Wallis OneWay Analysis of Variance and Tukey Test (p=0.05). **RESULTS:** Kruskal-Wallis test evidenced at least one statistical significant difference (p=0.001). The Tukey test showed statistical significant differences among the group (P<0.05). Group 1 showed statically significant higher results when compared with group 4. **CONCLUSION:** The results of this study evidenced that the adhesive system can effect the bond strength between silorano-based composite resin and dentin.

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## KEYWORDS

Silorane. Composite resin. Dentin.

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## INTRODUCTION

Composite resin, due to its elevated aesthetic potential, was initially recommended for anterior teeth restorations. However, after the improvement of this group of materials, resulting in better mechanical properties and low potential of abrasion, its use could be recommended for posterior teeth.<sup>1</sup> (Unfer et al. 2006).

The development of restorative composite resin with methacrylate matrix lead to its acceptance as restorative material for several clinical applications. Nevertheless, this restorative system still presents limitations which demands improvement of this class of material. Some of these limitations present greater abrasion potential in relation to the silver amalgam, problems linked to the bond system, such as pulpal damage,<sup>2,3</sup> and the shrinkage which occurs during the polymerization process.<sup>4</sup> The composite resin shrinkage that has place during the changing of monomers in a polymer chain, can exceed the bond strength in the interface tooth/restoration and lead necessarily to the formation of gaps, compromising the interface, becoming susceptible to the microleakage and can generate postoperative sensitivity.<sup>5,6</sup>

As a restorative alternative for different clinical condition, it was developed a restorative system formed by silorane monomer, obtained by the combination of oxirane and siloxane molecules. During the

polymerization of this monomer, molecules become greater according to the increase of conversion degree, reducing the postoperative sensitivity and the microleakage, due to the formation of gaps in the interface.<sup>7</sup> It is due to the chemical reaction during to the polymerization, because it promotes the opening of cationic rings, which are connected one towards other,<sup>7</sup> that would result in an inferior volumetric contraction, whether compared to the contraction of conventional composite resins.

Silorane-based composites resins present biocompatibility and they are hydrophobic, stable and insoluble in contact with biological fluids,<sup>8</sup> and they seem to be an alternative to the current restorative composites.<sup>9</sup> The analysis in different scales reveals high mechanical properties, when the silorane-based composite resin was compared to the methacrylate-based<sup>10</sup> and it can observe good stability when the silorane was stored in different solvents.<sup>10</sup> For clinical application, this composite is used jointly with specific self-etching bond system, recommended by the manufacturer that aims to provide a resistant and durable bond in the enamel and dentin, besides the excellent marginal integrity. To ensure the maintenance of integrity of bond interface, it is important combine lower polymerization contraction and high values of bond strength. The complexities of oral environment and of dentin substrate represent

a challenge to the maintenance of the bond between the resinous material and dental substrate.

When dentin is compared to enamel, it represents a challenge to obtain the maintenance of bond durability and stability, once the composition is characterized by a collagen matrix involved by inorganic material, with approximately 20% water.<sup>10,11</sup> Dentin also represents physiological and morphological varieties; in other words, tooth age related to the aggression of dental element has been exposed in the oral cavity change its characteristics, become it less resistant to acid etching.<sup>12,13</sup>

Silorane-based composite bond system is characterized by an acidic primer with pH about 2.7, which promote a moderate etching in dental structure when compared to the phosphoric acid; its depth of penetration can be smaller and, sometimes, inefficient to the substrate hybridization. In this way, this study aims evaluate the bond strength between composite resin and dentin using different bond systems. The research hypotheses are: there is a significant difference between the bond strength of composite and the different adhesive systems.

## MATERIAL AND METHODS

To perform this study, it was used 16 healthy human molars extracted until three months before the test and stored in 10% formalin<sup>14</sup>; they

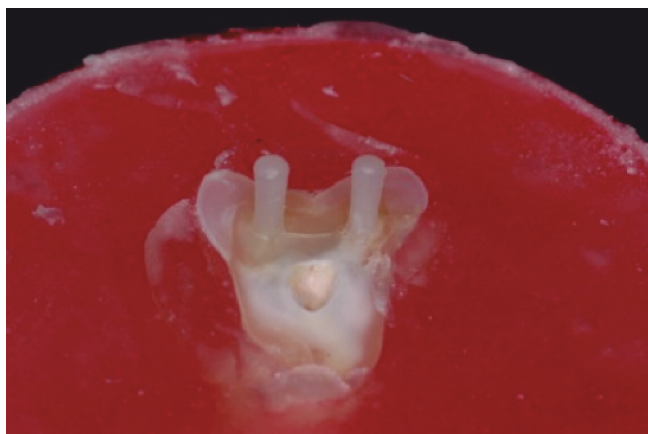
were submitted to manual scrapping with periodontal curette (S.S. White/Duflex, Rio de Janeiro, RJ, Brazil) to remove organic debris (Microdont, São Paulo, SP, Brazil) using pumice paste and water. Teeth were maintained in formalin solution until use.

Posteriorly, teeth were cut longitudinally in the mesio-distal direction in 2mm thickness each slice. To expose a dentin area, dental fragments were embedded in round acrylic resin in 3 cm diameter and 1 cm height. After its polymerization, exposed face was submitted to abrasion using silicon carbide sandpaper in 180µm granulation under water cooling until the exposure of a flat area of dentin in 2mm depth; next, it was used sandpapers in granulation of 320 and 400µm. Dental fragments were cleaned in ultrasound bath with distilled water during 10 minutes.

All the teeth (each tooth divided in three fragments) compounded the groups (table 1). Previously the treatment, samples were submitted to abrasion using sandpapers in granulation 600µm under water cooling by 30 seconds to form the smear layer. For the groups which there was necessity of etching with 37% phosphoric acid (3M ESPE, Saint Paul, MN, EUA), it was applied this etching on dentin surface by 15 seconds and next was removed by abundant water/air jet during 15 seconds. Water excess was removed with moist cotton<sup>15</sup> and the bond system was applied. Those samples that do not received previous etching were washed using water jet by 10 seconds and the water excess was removed the same way previously described. After corresponding bond system application, a polyester matrix in 1mm internal diameter and 3mm length was used to the insertion of incremental restorative material corresponding to the experimental group. It was

constructed two cylinders for each dentin surface (n=10) (figure 1). Photo activation of increments was performed during 40 seconds from light matrix (680mW/cm<sup>2</sup>) until its complete fill.

Figure 1 - Two composite resin cylinders built up for microtensile bond strength.



After carefully removal, specimens were stored in 37 °C distilled water by 24 hours.

#### Microshear test:

Each composite resin cylinder was individually involved by steel wire (0.2 mm diameter) that was fixed in the shear device linked to the universal testing machine (DL2000, EMIC, São José dos Pinhais, PR, Brazil), equipped with load cell in 50 N. The wire was adequately positioned in restorative interface. The loading was applied in 0.5 mm/min speed until the failure of specimen. The results were obtained in kgf/cm<sup>2</sup> and express in MPa.

#### Analysis of results:

The bond strength average value was calculated from the loading average value necessary to the fracture of sample for each experimental group. The comparison between groups was performed using the Analysis of Variance in 5% level of significance and Tukey Test ( $p < 0.05$ ) for comparison between groups.

## RESULTS

ANOVA showed significant differences in the bond strength among the groups ( $p < 0.05$ ). Table 2 present the Tukey Test results ( $p < 0.05$ ), means and standard deviation for all groups.

## DISCUSSION

The hypothesis was accepted because there was statistical significant difference among the groups.

In this study, it was chosen Micro shear Test related to Micro tensile Test because the first one shows more faithfully the characteristics of adhesive interface, where the application of force occurs straight on the interface by the use of orthodontic wire associated to a universal test machine, between tooth surface and the cylinder of resin.<sup>16</sup> Some advantages from Micro Shear Test were lower requirements in specimen collections and facility in the preparation and standardization of the area of test by micro tubes fabrication.<sup>17</sup> Thus, the Micro Shear Test is more faithful in bond resistance in the adhesive interface when it is compared to the

Micro Tensile Test, because this one present cohesive failures in dental substratum of teeth due to the preparation of specimens causing

micro fractures in them, while the Micro Shear Test shows prevalence of adhesive failures.<sup>18</sup>

Table 1 - Restorative materials and adhesives used in the groups from 1 to 4, respectively.

Groups	Composite	Bond system
Group 1 (P90+ASB)	Filtek P90	Phosphoric acid + Adper Single Bond 2
Group 2 (P90+SP)	Filtek P90	Silorane primer
Group 3 (P90+ASE)	Filtek P90	Adper SE Plus
Group 4 (P90+ASM)	Filtek P90	Phosphoric acid + Adper Scotchbond Multiuse

\*All the materials were fabricated by 3M ESPE – Saint Paul, MN, EUA.

Table 2 - Tukey test, average bond strength (MPa), and standard deviation.

Group	Number	Average bond strength (MP)	Standard deviation
1 <sup>a</sup> (P90+ASM)	10	16.865 <sup>a</sup>	8.526
3 <sup>ac</sup> (P90+ASE)	10	9.897 <sup>ac</sup>	2.249
2 <sup>ac</sup> (P90+SP)	10	6.536 <sup>ac</sup>	3.175
1 <sup>bc</sup> (P90+ASB)	10	4.89 <sup>bc</sup>	4.113

When comparing the groups 1, 2, and 3 there was not significant statistical difference related to the bond strength between silorano bond system, Adper Scotchbond Multiuse, and Adper SE Plus. It could be explained because a chemical compatibility between the conventional bond system and the silorane resin can exist, like occurs between the silorane composite resin and the particular silorane-based adhesive system that presents methacrylate in its composition.<sup>19-21</sup>

## CONCLUSION

With the growing evolution of self-etching bond systems in the last years, total acid etching

seems to be only another alternative, but it does not have decisive influence in the bond strength between the adhesive system and dentin substrate. Even the manufacturer does not recommend the association between the bond system and composite resin chemically different, according to the present study, some of these associations presented similar results to the materials with the same composition; however, more studies are necessary to prove its effectiveness in order to encourage its use in a safe way in clinical daily. Related to the dentin bond strength, new formulation silorane-based presented similar results when associated with different bond systems.

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