# THE INFLUENCE OF DIFFERENT SURFACE PRETREATMENTS ON THE SHEAR BOND STRENGTH OF REPAIRED COMPOSITE

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**By**

**Reham Sayed Abd EL Mageed Abd Allah**

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Ain Shams University

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**بسم الله الرحمن الرحيم**

***" قالوا سبحانك لا علم لنا إلا ما***

***علمتنا إنك أنت العليم الحكيم "***

**صدق الله**

**العظيم**

سورة البقرة الأية ٣٢

# Supervisors

**Dr. Hanan Abdel Aziz Niazi**

Professor and Head of Operative Dentistry
Department, Faculty of Dentistry,
Ain Shams University

**Dr. Mohamed Hussein Zaazau**

Associate Researcher Professor of Operative
Dentistry, Restorative and Dental materials
Research Department, National Research Center

**Dr. Omaima Hassan Ghallab**

Lecturer of Operative Dentistry, Faculty of
Dentistry, Ain Shams University

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# Dedication

*This work is dedicated*

*To the soul of my lovely father who always wished to celebrate this day with me. Special dedication to my great mother for her everlasting love and support. To my sister and my brother for their continuous encouragement. To my kind husband and my small son Suhail whom I always get thankful.*

Despite the development of resin composites with improved properties, their degradation rate is high in the oral environment. In addition, fatigue can accelerate the wear process in composite materials. All these factors resulted in discoloration, degradation, microleakage, wear and ditching at the margins[48,52]. Silorane-based resin composite was developed with the intention to solve the problems of polymerization shrinkage, polymerization stress and water sorption [30]. But still there are some limitation in Silorane based resin composite. There is a controversy about its repair potentiality, hence our study focused in this point.

Resin composite restorations failed as a result of recurrent caries, discoloration, and degradation/wear, ie, loss of anatomic form. One comprehensive study emphasized recurrent caries and discoloration as the main reasons for replacement of resin composite restorations in general dental practice[30]. Other reasons for resin based composite restorations failure included loose or lost restorations, fracture of the tooth and pain or discomfort leading to replacement [26,48,52].

In the light of the operative philosophy, complete removal and remaking of a defective composite restoration is frequently neither necessary nor desirable. As it is time consuming and involves the risk of removing sound tooth substance as well as injuring the pulp tissue. Selective replacement or veneering of the unsatisfactory part can be considered as the most conservative approach [9, 21,47].

Various chemical and/or mechanical methods have been suggested to establish adequate bond strength between the existing composite and the new composite. Chemical methods include using

acid etching with hydrofluoric or phosphoric acid. Mechanical surface pretreatments such as roughening with burs and air-borne particle abrasion with Aluminum oxide have been used to improve repair bond strength [9,13,21].

Surface pretreatment of the aged resin composite has many advantages as it removes the superficial layer altered by the saliva hence exposing a clean, higher energy composite surface. Also it increases the surface area through creation of surface irregularities[49].On the other hand, the bonding agent enhances the repair bond strength by improving the surface wetting and chemical bonding with the new composite [9,14,59].

During clinical service or aging, resin composite surface interact with the surrounding environment. Absorbed water causes softening of the matrix, micro-crackes formation, resin degradation, debonding of the filler/matrix surface and leaching out of some constituents. Changes in the surface layer of the aged resin composite could affect its bonding quality to the newly added material during repair [21,24].

In Silorane based resin composite reduced shrinkage exhibited due to the ring-opening cationic polymerization [30,42]. On the basis of different chemical composition, low water sorption and solubility it may probably attain good repair bond strength [32].

Therefore, it was thought it would be valuable to investigate the effect of different pretreatment protocols on shear bond strength of repaired Silorane based composite. Moreover, the durability of this bond was investigated.

## 1. Repair as a viable clinical procedure:

Selective repair of the unsatisfactory part can be considered a more conservative approach than remaking of defective resin-based restoration. While the replacement of resin composite restoration is a time consuming procedure and the re-restoration cycle may result in weakening of the tooth and renewed insult to the pulp tissue **Mjor, 1993[45], Blum et al, 2003[3] and Dall□ Oca et al, 2008[15]**. Moreover, it was found that that repair had a significant impact in the first and second year recall visits, with significant improvement of the margins of restorations **(Lynch et al, 2006[38] and Gordan et al, 2009[25])**.

**Gordan et al, 2006[26],** studied the effectiveness of alternative treatments to replacement of composite resin restorations. Forty patients with 88 restorations, with one or more features that deviated from ideal, participated in the study. They were assigned to five groups. Group I: repair, Group II: sealing of the defective margin, Group III: resurfacing, Group IV: replacement and Group V: no treatment. The quality of the restorations were evaluated according to specific criteria prior the treatment and at recalls visits at one and two years with two clinicians. The results showed that marginal adaptation was improved with sealing by 72% however marginal staining showed significant improvement about over 75% with repair and replacement. They recommended that restorations with inadequate marginal adaptation and stained margins should be repaired.

**Soncini et al, 2007**[69]**,** evaluated the longevity of amalgam versus compomer-composite in posterior primary and permanent teeth. Children aged six up to ten years who had two or more posterior occlual carious lesions were randomized into groups that received amalgam or copomer- composite restorations. Follow up was done semiannually. They compared the longevity of the restorations placed on all posterior surfaces using random effects survival analysis. The results showed that in primary teeth; replacement rate of composite-compomer versus amalgam was 5.8% versus 4%, respectively, due to recurrent caries. In permanent teeth, the replacement rate was14.9%of composite versus 10.8%of amalgam. They concluded that although the overall difference in the longevity wasn't statistically significant, compomer and composite were placed and repaired more frequently owing to recurrent caries.

**Blum et al, 2009**[4]**,** investigated the opinions of manufacturers of resin-based composite towards the repair of their materials. A questionnaire was developed and reviewed independently by five senior academics. It was then revised and distributed by e-mail to twenty of rein based composite manufacturers. The questionnaire's design included both 'closed' and 'open' statements. The results showed that (89%) of the respondents recommended the repair of restorations of their composites. The majority of dentists and materials scientists who responded considered the loss of more than half of the restoration as contraindications for repair. Also about 65% of them stated that they did not provide instructions on how to make repair of composite. And 59% of the respondents suggested the duration of repair success between one and three years. However, 24%respondents suggested a

period of five or more years. So they concluded that repair is a definitive measure.

**Gordan et al, 2009**[25]**,** assessed the effectiveness of alternative treatments to replacement of composite resin restorations. Thirty seven patients with 88 defective restorations participated in the study. They were assigned to five treatments groups. Group I: repair, Group II: sealing of the defective margin, Group III: resurfacing, Group IV: replacement and Group V: no treatment. Survival analysis at baseline and again at six months, one year, two years, and seven years after treatment. The results showed that the percentages of failed restorations of each treatment after seven years were 0%for repair, 0% for sealing of defective margins, 13% for resurfacing, 21% for replacement, and 23 % for no treatment. So they concluded that the survival of the repaired restoration was better than the replaced one.

**Sharif et al, 2010**[65]**,** examined the replacement versus repair of defective resin composite restorations in adults. Adults of 16 years or over with one or more defective resin composite restoration(s) in a molar or premolar tooth/teeth treated by like for replacement and or repair. Studies with the following interventions and controls were included. Intervention: repair of a defective resin composite restoration in a molar or premolar tooth with resin composite. While the control: replacement of the defective resin composite restoration in a molar or premolar tooth with resin composite. The results showed that repair had high success rate and less preoperative and postoperative pain and discomfort. They concluded that repair of restorations could be effective and the survival rate at two years

follow-up is good. This may be important because some repairs can be done without the use of local anesthesia and are therefore less distressing for a patient when compared with replacement.

## 2. Bond strength of repaired composite:

In more recent studies, bond strength between phosphoric acid etched enamel and hybrid composite ranged from 20 to 35 MPa. Based on these considerations, it could be required that bond strength of the repaired specimens should be 20 MPa or more in order to provide sufficient adhesion **Nikkola et al, 2004**[46]**, Hanning et al, 2006** [29] **and Papacchini et al, 2007**[55]**.**

**Tezvergil et al, 2004**[74]**,** tested the repair bond strength of restorative resin composite to aged fiber-reinforced composite substrate. Substrates were made from fiber reinforced composite Ever Stick. They were aged for six weeks by boiling in water for eight hours at 37˚C. Specimens were divided into five groups as follow: Group I: adhesion primer was applied, Group II: silane was applied, Group III: silane was applied followed by adhesive primer then resin was added, Group IV: air abrasion treatment followed by application of silane coupling agent then resin was added and Group V: resin only was applied (control). Then composite resin was added to the substrate and light cured. Half of the specimens were stored in water for 48 hours and the others were thermocycled. Then shear bond strength was measured. The results showed that air abrasion treatment followed by silane application and resin addition yield high bond strength and that thermocycling weakened the shear bond

strength. They concluded that high bond strength can be obtained when silane was used either alone or coupled with air abrasion.

**Malmstrom et al, 2006**[41]**,** assessed the effect of silane and adhesive agents on the shear bond strength of repaired composite. Three different types of resin based composite (Tetric Ceram, Four Seasons and Heliomolar) were used to prepare 540 specimens. Three different adhesive materials (All bond, Optibond and Clearfil SE bond) were used over the cured composite specimens. Half of the specimens were aged by thermocycling then they were microabraded. The others were silanated then adhesive bonding material was applied. Shear bond strength was measured. The results showed that Tetric Ceram demonstrated high shear bond strength (34.4 MPa) when used as a repair material. However, Heliomolar and Four Season resulted in shear bond strength 230.1 MPa and 24.2MPa respectively. When silane was used shear bond strength increased with all adhesive materials. So they concluded that application of silane increase the bond strength of all adhesive agents used and Tetric ceram preferred to be used as a repair material.

**Dall'Oca et al, 2006**[14]**,** examined the effect of oxygen inhibition on composite repair strength over time. Ten resin composite slabs were prepared and light-cured. Then they were divided into two groups in which polymerization were effectuated in the absence of oxygen, and a third one was the control group in which polymerization occurred in the presence of oxygen. For the two groups, the first bonding resin layer was light-cured in atmospheric air. For the control group, the second layer was also light-cured in atmospheric air, while for the experimental group, this