

Effect of Saliva Contamination on Shear Bond Strength of Self-etch Adhesive System to Dentin: An *In Vitro* Study

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ABSTRACT

Aim and objective: This study aimed to evaluate the outcome of saliva contamination on shear bond strength (SBS) of a self-etch adhesive system to dentin.

Materials and methods: A total of 60 premolars were selected. Occlusal surfaces of the teeth were severed off. Three groups of 20 teeth in each were formed after the samples were randomly divided. Group I: Not subjected to any contamination (control group). Group II: Contamination with saliva occurred before coating the teeth with a self-etch adhesive system. Group III: Contamination with saliva occurred after coating the teeth with a self-etch adhesive system. After the contamination, the composite was placed with the help of a Teflon tube. Under the universal testing machine, the SBS of these samples was then tested.

Results: The data obtained after testing were analyzed using SPSS software. Statistical difference was seen between all the three groups. Group II projected the least SBS.

Conclusion: Contamination with saliva has a deleterious effect on the SBS. Contamination that occurs before the application of adhesive systems has shown considerably reduced SBS.

Clinical significance: This study successfully established that saliva contamination acts as a major factor in reducing the SBS of the bonding agent. Hence, in clinical situations, it is necessary to ensure sufficient steps are taken to eliminate or reduce the chances of contamination with saliva to aid in the success of the restoration.

Keywords: Contamination, Saliva, Self-etch adhesive systems, Shear bond strength.

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INTRODUCTION

The dawn of adhesive dentistry has brought about a revolution in the field of direct and indirect restorations, transforming the traditional methods that were prevalent before. Mirroring the rising need for adhesive restorations, dentin bonding systems have also transformed and evolved to attain improved bond strength and reduced technique sensitivity.¹ Buonocore in 1955 introduced the concept of adhesion in the field of dentistry. Over the past 4 decades, dentin bonding agents have opened out with disparity in its chemistry, mechanism, implementation, technique, and potency. In continuity for better adhesion, several studies are being conducted to improvise these adhesive systems.² From the first five generations have different steps of etching and bonding to the newest eighth generation of the self-etch system, there have been various changes and advancements in the adhesive systems.

The self-adhesive system (i.e., seventh-generation) combines etchant, primer, and adhesive in a single bottle. The first no-mix, self-etching, self-priming, single bottle dentin bonding agent representing the most present preparation of dental adhesives on the market is i-bond (Heraeus Kulzer). With bond strength of 25 MPa.³ The rationale behind these acidic primers is to superficially demineralize the dentin and simultaneously penetrate to the depth of demineralization. The one bottle adhesive systems contain 10-methacryloyloxydecyl dihydrogen phosphate (MDP) as the active constituent.⁴

GC SOLARE Universal Bond (GC DENTAL PRODUCTS CORP. 2-285 Toriimatsu-cho, Kasugai, Aichi 486-0844, Japan) is a comprehensive, unique, single bonding agent for all etching

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modes. The supercilious bond strength of SOLARE Universal Bond to the tooth structure, both enamel and dentine is credited to its peculiar preparation. The component dimethacrylate monomer in SOLARE Universal Bond gives a rise to its porosity into both enamel and dentine when measured with other bonding agents, while the increased level of phosphate ester monomer improves the etching.⁵ Self-etch adhesive systems have ensured a rise in user reliability with a faster application as well as a drop in the number of application steps and components. Even though this system lowers the risk of contamination with saliva, it may occasionally be impractical to sustain a dry operative field after application of bonding agent.⁶

Fluids from the gingival crevice, dental handpiece oil, blood, and saliva are contaminants during the bonding process, they can hamper the quality of the bond causing microleakage at the junction of the tooth restoration interface. Which contributes to the fracture of restoration, secondary caries, sensitivity, and stain of the tooth.⁷

In alliance to saliva contamination, it is hypothesized that the existence of salivary glycoprotein reduces dentinal permeability up to 65%, leading one to suppose that adhesion would be impaired in the presence of saliva. Recent studies have reported that hydrophilic adhesive systems are less receptive to contamination with saliva than are hydrophobic bonding agents.⁸

This study aimed to evaluate the effect of saliva contamination on the shear bond strength (SBS) of the self-etch adhesive system to dentin.

MATERIALS AND METHODS

This *in vitro* study was carried out in the Department of Conservative Dentistry and Endodontics, Mahatma Gandhi Dental College and Hospital, Jaipur.

Sample Selection

Sixty human premolars extracted for orthodontic and periodontal reasons were collected, scrubbed of any tissue and calculus, and then sterilized by 5.25% NaOCl.

The inclusion criteria set for the study were mandibular premolar teeth, teeth with no cracks, abrasion, teeth without caries, teeth extracted because of periodontal reasons, teeth extracted for orthodontic purposes. While the exclusion criterion was teeth extracted for any other reason than periodontal and orthodontic reason, teeth with loss of dentinal structure, teeth which are severely attrited.

The teeth were split into 3 groups randomly, each group containing 20 teeth.

Saliva Collection

The unstimulated human was collected from only one person at least 1 hour after eating or drinking. The saliva was collected in a sterile beaker and was immediately used.

Specimen Preparation and Grouping

After mounting the teeth in self-cure acrylic resin (DPI, Burmah Trading Corporation, India), using the diamond disc (SWISSO) the occlusal surfaces of the teeth were severed off underwater cooling such that flat dentin surfaces at a depth of 2 mm from the cuspal tip of the tooth were obtained. After the final selection of the samples, these samples were then divided into three groups randomly.

Group I: Control group.

Group II: Contamination with saliva occurred before coating the teeth with a self-etch adhesive system.

Group III: Contamination with saliva occurred after coating the teeth with a self-etch adhesive system.

Group I (n = 20)

Control group—No contamination occurred in this group. Self-etching adhesive was coated onto the dentin following the manufacturer's instructions and light-cured with a visible light curing unit for 15 seconds.

Group II (n = 20)

The premolars in this group were subjected to contamination with saliva before the coating of the dentinal surface with a self-etch

adhesive system (Fig. 1). For contamination purposes, fresh saliva was applied onto the specimens using a single-use brush and air-dried for 2 seconds. After contamination with the saliva, the self-etch adhesive was coated onto the surface. Before light-curing for 15 seconds, a gentle stream of air was then applied for 2 seconds to dry the surface.

Group III (n = 20)

The premolars in this group were contaminated with saliva after coating the tooth surfaces with a self-etch adhesive system (Fig. 2). Self-etching adhesive was applied to dentin in accordance with the manufacturer's instructions. Before light-curing for 15 seconds, a gentle stream of air was then applied for 2 seconds to dry the surface. Lastly, the specimen was contaminated with saliva and again air-dried for 2 seconds.

Composite Placement

A Teflon tube was settled on the tooth surfaces with a marking of 2 mm for composite placement (Fig. 3). The Teflon tube was filled with composite resin in layers, each layer was tightly compressed and light-cured for 15 seconds. After light curing, the Teflon tube was removed.

Preparation of Samples for SBS Analysis

The prepared specimens were then stored in distilled water at 37°C for 24 hours before testing. The specimens were then loaded onto a universal testing machine. For the SBS test which was carried out at a crosshead speed of 1 mm/minute (Fig. 4).

Statistical Analysis

The data obtained after testing were tabulated statistically analyzed using SPSS (Statistical packages for social sciences) 20.0, IBM, India. Using the analysis of variance (ANOVA) test, the data were statistically analyzed, and the level of significance was evaluated as $p < 0.05$ with a confidence interval of 95%.

RESULTS

As stated in the table below (Table 1), there was a significant difference found in the values of all the groups, with the highest in group I and least in group II.



Fig. 1: Saliva before application of a self-etch adhesive system



Fig. 2: Contaminated with saliva after application of a self-etch adhesive system



Fig. 3: Composite placement

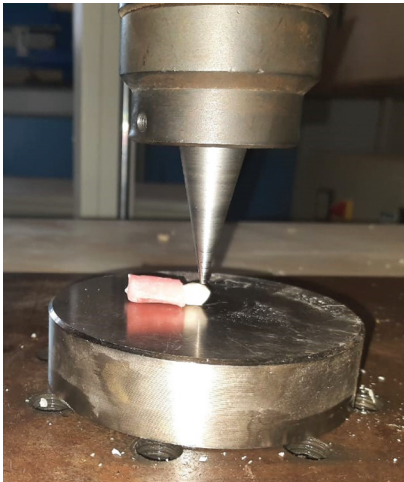


Fig. 4: Universal testing machine

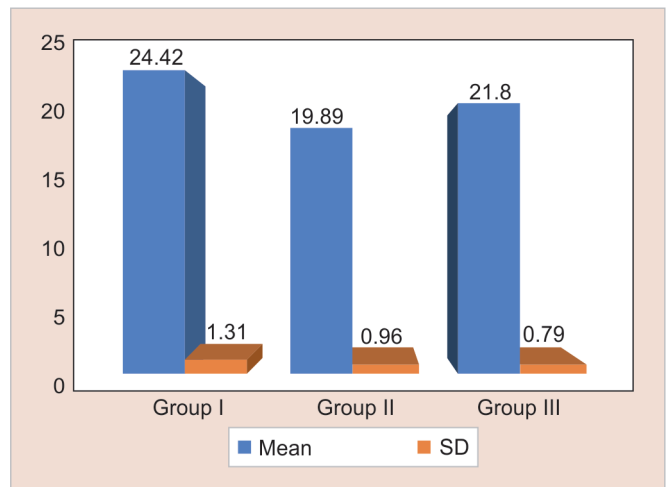


Fig. 5: Column chart shows a comparison of mean and SD among group I, group II, and group III

Table 1: Comparison of group I, group II, and group III

Study group	Mean	SD	95% CI		ANOVA F-value	p value
			Lower	Upper		
Group I	24.42	1.31	23.49	25.36	47.57	<0.0001*
Group II	19.89	0.96	19.2	20.58		
Group III	21.8	0.79	21.23	22.36		

*Significant when $p < 0.05$

DISCUSSION

The present study assessed the effect of saliva contamination at two crucial steps, i.e., first before application of the self-etch adhesive system and the second one being after the application of the self-etch adhesive system. There was an unfavorable effect on the SBS of the dentin when contaminated with saliva.

Though the SBS of dentin was adversely influenced by both contaminations, the worst affected group (group II) was in which the contamination had taken place before the application of the adhesive system (Fig. 5).

Contamination with saliva is unintentional and one of the frequent problems faced by the dentist. Placement of rubber dam is not possible for every case making it prone to contamination.⁹ Saliva, blood, and excess water all these factors contribute to the fact that dentin bonding adhesive systems are technique sensitive. Proper elimination of all these factors is required for good bonding.

The seventh-generation adhesives form a fragile hybrid layer and shorter resin tags resulting because of the low pH of methacrylate monomers when assimilated with 37% phosphoric acid.¹⁰ Various reasons contribute to the compromised mechanical properties of the adhesive systems one of which is water. The

water in the self-etching systems in the form of solvent promotes the ionization of the acidic monomers, making these adhesive penetrable films extremely prone to degrading effects of water. The mechanical properties of the thin adhesive membrane left after the solvent evaporates are also compromised.¹¹

The acidic monomers in the self-etch adhesives demineralize and infiltrate the dentin. The complete polymerization of the adhesive layer depends on the mineral content of the tooth structure to neutralize this acidity. In the case of total-etch adhesives, the smear layer is eliminated by the application of the etchant. Due presence of remaining acidity and incapacity to eliminate the smear layer, there is observed lower bond strength with self-etch adhesive systems.¹⁰

Due to the water content of saliva, it reduces the bond strength of dentin adhesives which results because of the excess moisture.¹² In this study, there was a significant difference between contamination before and after placement of saliva, Pashley et al. concluded that occlusion of the open dentinal tubules by the salivary proteins caused a lowering of adhesion before curing.¹³ Some studies quoted that the increase in contact angle could lower the bond strength.¹²

In the study by Neelagiri et al., saliva contamination brings down the dentine bond strength of both the self-etch systems, which was in accordance with our study, it was also stated that reapplication of the bonding agent after contamination yielded better results in relation to the bond strength.¹⁴

Kesar et al. stated that contaminants may have persisted on the dentin surface, thus obstructing the development of a hybrid layer or hinders the bonding of the adhesive system to composite. Therefore, the prime factor for securing optimal bonding is to circumvent saliva contamination. Even if modern adhesive systems are easier to use, bonding still includes different steps, and saliva contamination may occur at different stages.¹⁵

A study by Fritz et al. also concluded that there was a decrease in the bond strength of the one-step bonding system because of the contamination after curing, similar results were also found in our study.¹⁶

In this study, it was observed by the authors that contamination with saliva before the application of the adhesive system had a greater impact on the SBS. Other studies also showed alike results where contamination by saliva affected the two different self-etch adhesive systems.¹ Bhatia et al. in their study found that reapplication of the bonding agent yielded better bond strength.¹⁷

CONCLUSION

It can be said that salivary contamination affects the bond strength of dentin bonding adhesive systems. The sequence in which contamination occurs is also of equal importance. Contamination that occurs before the application of adhesive systems has shown considerably reduced SBS when compared with contamination after application of the dentin bonding material. Reapplication of the adhesive system has added advantages to regain the binding strength.

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