

**How to Cite:**

Talesara, K., Bhat, N., Puri, S., Sharma, A., & Srishti, S. (2022). The influence of the salivary contamination on the shear bond strength of 6th and 7th generation dentin bonding agents: An invitro study. *International Journal of Health Sciences*, 6(S1), 11228–11237. <https://doi.org/10.53730/ijhs.v6nS1.7709>

# **The influence of the salivary contamination on the shear bond strength of 6<sup>th</sup> and 7<sup>th</sup> generation dentin bonding agents: An invitro study**

**Dr Kunal Talesara**

General practitioner, MDS CONS and ENDO

**Dr Nagesh Bhat**

Chairman and professor, Faculty of Dentistry, Al Baha University, Kingdom of Saudi Arabia [n.bhat@bu.edu.sa](mailto:n.bhat@bu.edu.sa)

**Dr Surekha Puri**

HOD, Hazaribagh College of Dental Sciences and Hospital

**Dr Abhinav Sharma**

Assistant professor, Department of Oral Medicine and Radiology, Subharti Dental College, Meerut  
[Drabhinavkaushik@gmail.com](mailto:Drabhinavkaushik@gmail.com)

**Dr Srishti**

Senior Lecturer, Department of Oral Medicine and Radiology, Hazaribagh College of Dental Sciences and Hospital

**Abstract**---The essential goal of any adhesive restoration is to achieve a tight and long-lasting adaptation of the restorative material to enamel and dentin. The key challenge for new dental adhesives is to be simultaneously effective on two dental substrates of conflicting nature. Some barriers must be overcome to accomplish this objective. While bonding to enamel by micromechanical interlocking of resin tags within the array of microporosities in acid-etched enamel can be reliably achieved and can effectively seal the restoration margins against leakage, bonding effectively and durably to organic and humid dentin is the most puzzling task in adhesive dentistry.

**Keywords**---contamination, dentin bonding agents, shear bond strength.

## **Introduction**

Adhesive dentistry is a rapidly evolving discipline and it has revolutionized restorative dental practice during the past 30 years. Recent advances in resin adhesives and restorative materials as well as an increased demand for esthetics, have stimulated a great increase in the use of resin based composites in anterior and posterior teeth. Improved adhesive materials have made resin based composite restorations more reliable and long lasting, therefore well placed composite restorations provide an excellent alternative to traditional posterior restorations. Adhesive restorations reinforce the weakened tooth structure by effectively transmitting and distributing the functional stresses across the bonding interface.

Adhesion also reduces microleakage at restoration tooth interface resulting in lesser clinical problems such as postoperative sensitivity, marginal staining and recurrent caries all of which otherwise jeopardize the clinical longevity of the restoration<sup>2</sup>. Earlier adhesives bonded to the smear layer, the smear layer was a weakest link in the system because of its loose attachment to dentin surface. This layer gave away easily when polymerization shrinkage stresses were encountered and the adhesive bond failed. To overcome this problem, the subsequent dentin bonding agents employed an additional step of acid application, to either modify or remove the smear layer before application of the actual adhesive.

A very recent development in the field of adhesive dentistry is the introduction of self etching primer adhesive. A further development of the concept of self etching primers, the self etching adhesives or self etching primer adhesives was recently introduced<sup>12, 14</sup>. These materials have incorporated all the components of bonding systems (acidic conditioner, hydrophilic primer and hydrophobic adhesive resin) into one bottle and are the first true 'one step agents'. This takes simplification of the bonding procedure a step further ahead.

Currently there are several self etching systems available but little is known about their capacity to adhere to dental hard tissues. Since bond strength testing is used as a screening tool to help understand and predict the clinical behaviour of adhesives, this invitro study was designed to investigate and compare the shear bond strength (SBS) to dentin achieved with several self etching primer / adhesive systems.

## **Aim & objective**

To evaluate the influence of salivary contamination on the shear bond strength of two newer generation dentin bonding agents. To investigate whether salivary contamination during various stages of the bonding procedures of Clearfil SE Bond and Xeno V<sup>+</sup> influences shear bond strength.

**Inclusion criterion:** Teeth that are extracted for orthodontic needs or are periodontally compromised, Non carious teeth & Intact teeth.

**Exclusion criterion:** Carious teeth, Tooth cracks/fractures, Restored teeth, Primary teeth& Teeth with any developmental anomalies.

## **Methodology**

All the collected teeth were cleared of gingival remnants, blood and saliva and were stored in formalin solution. The occlusal surfaces of the teeth were grounded with help of diamond discs, to prepare flat dentin surfaces at a depth of 1.5 mm from the cuspal tip of the tooth. They were randomly divided into two groups, based on the dentin bonding agent used with the eighteen specimens in each group, as follows:

**Group I** - Clearfil SE Bond

**Group II** - Xeno V<sup>+</sup>

Each group was further randomly subdivided into three subgroups, with six specimens in each group. In subgroup B and Subgroup C, the specimens were contaminated with artificial saliva, which was painted for 20 seconds using disposable brush saliva, at different stages of bonding.

**Subgroup A** - Uncontaminated specimens (control).

**Subgroup B** - Specimens contaminated with artificial saliva for 20 seconds, followed by application of bonding agent.

**Subgroup C** - Specimens contaminated with artificial saliva for 20 seconds, after light curing of the bonding agent.

The prepared specimens were mounted on prefabricated moulds using self cure acrylic resin in such a way that the flat dentin surface was 5 mm from the mould. The specimens were kept in distilled water for 24 hours. All specimens were transferred to the universal testing machine individually and subjected to shear bond strength analysis at a crosshead speed of 1.5 mm/minute.

The data obtained was subjected to statistical analysis using One-way ANOVA, followed by Tukeys HSD test. When a comparison of the shear bond strength of the uncontaminated specimens with the contaminated specimens in each group was made using One-way ANOVA, as it shows very high statistical significance. When comparisons of the shear bond strength of subgroups within the group was done using Tukeys HSD test.

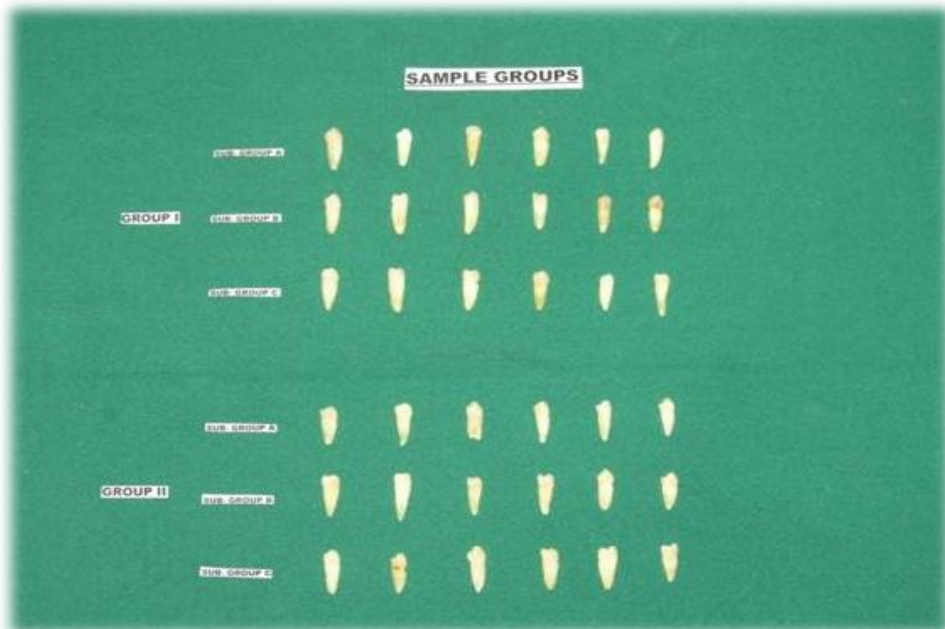


Figure 1: Teeth used for sample preparation

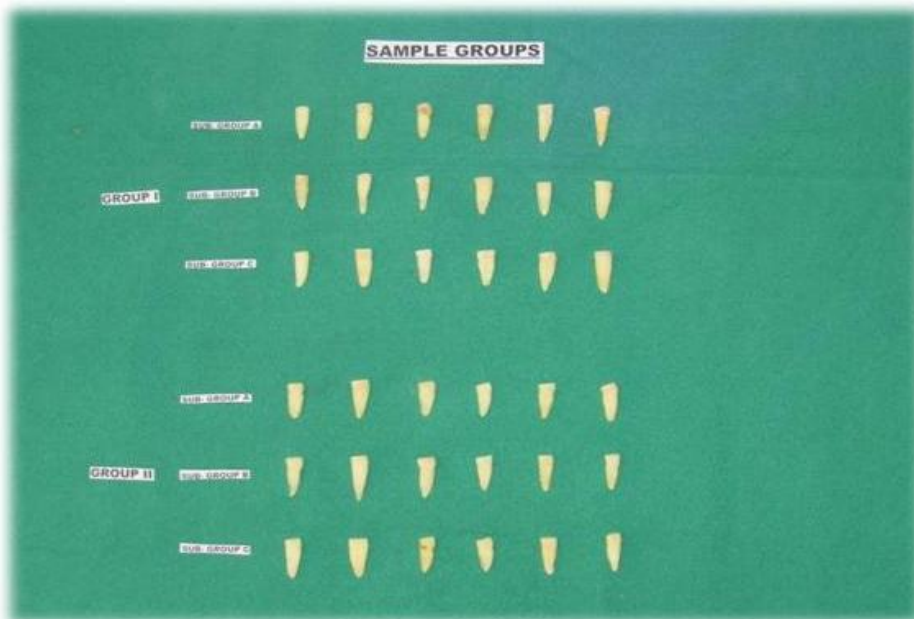


Figure 2: Teeth after flat dentin surface preparation

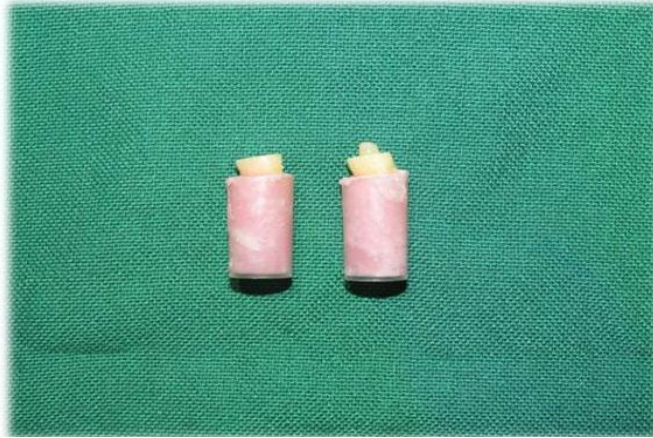


Figure 3: Sample before and after placement of the composite

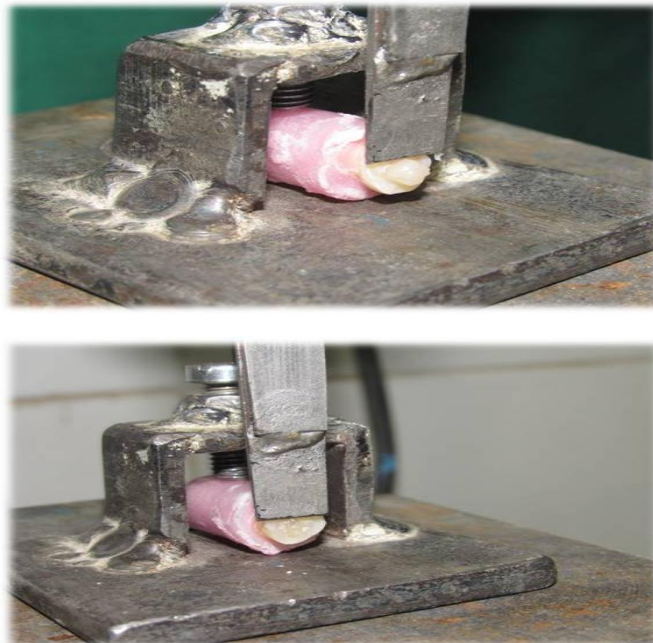


Figure 4: Sample after the load application

### Statistical analysis

Table 1  
Mean and standard deviation values for shear bond strength using one-way ANOVA

<b>Group</b>	<b>Subgroup</b>	<b>n</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>F</b>	<b>P</b>
	Subgroup A	6	34.1783	2.66682		

Group I	Subgroup B	6	27.6483	5.12874	102.083	0.001
	Subgroup C	6	25.6850	5.21882		
Group II	Subgroup A	6	28.3917	3.36147	17.903	0.001
	Subgroup B	6	25.2083	4.53581		
	Subgroup C	6	21.8617	3.85948		

Table 2

Comparison of shear bond strength values of the subgroups within the group in group I and group II using Tukeys HSD test

Group	Control	Experimental	Mean Difference	P
Group I	Subgroup A	Subgroup B	6.53000	0.111
		Subgroup C	8.49333	0.018
Group II	Subgroup A	Subgroup B	3.18333	0.781
		Subgroup C	6.53000	0.111

*t*-Tukeys HSD  $P < 0.05$  – Significant,  $P > 0.05$  - Not significant

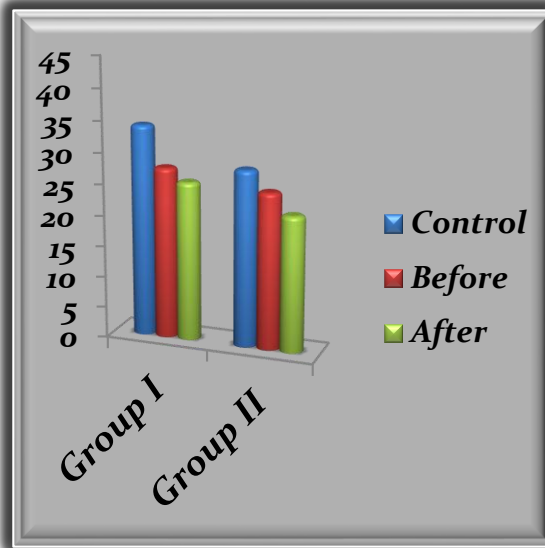
Table 3

Intergroup comparison of shear bond strength values between the subgroups of group I and group II using Tukeys HSD test

Subgroup	Group	N	Mean	Std. Deviation	t
Subgroup A	Group I	6	34.1783	2.66682	5.78667 P = 0.199
	Group II	6	28.3917	3.36147	
Subgroup B	Group I	6	27.6483	5.12874	2.44000 P = 0.915
	Group II	6	25.2083	4.53581	

Subgroup C	Group I	6	25.6850	5.21882	3.82333 P = 0.627
	Group II	6	21.8617	3.85948	

*t*-Tukeys HSD  $P < 0.05$  – Significant,  $P > 0.05$  - Not significant



Graph 1: Showing intra and inter group comparison for Group I, Group II and their Subgroups

## Discussion

Currently many studies have been conducted to evaluate the bond strength of resin composite to enamel and dentin by using different bonding agents. Shear bond strength test is a simple evaluation procedure used to test the adhesion of dental adhesives.<sup>14</sup> In vitro bond strength tests are useful and essential for predicting the performance of new adhesive systems and possible correlation with clinical issues like salivary contamination during restorative treatment, however in vitro investigations are not capable of predicting clinical success.<sup>15</sup> Hence in this in vitro study shear bond strength of two newer generation of bonding agents, i.e., Clearfil SE Bond and Xeno V<sup>+</sup> in relation to salivary contamination were studied.

According to the results obtained from the present study it was observed that in both Group I (Clearfil SE Bond) and Group II (Xeno V<sup>+</sup>) showed comparatively lower bond strength when bonding agent were contaminated with saliva after curing (Subgroup C). According to the study done by Mithra N Hegde *et al*, there

was reduction in the shear bond strength values when contaminated with saliva after light curing of the adhesive, which was statistically significant. This could be due to the adsorption of glycoproteins onto the poorly polymerized adhesive surface, which results in oxygen inhibition.<sup>18</sup>

It was also observed that there was slight reduction in the bond strength in both Group I (Clearfil SE Bond) and Group II (Xeno V<sup>+</sup>) when contamination with saliva was done before application of bonding agent was done (Subgroup B) This is in agreement with the results of a study done by Yoo *et al.* in which SEM also showed less demineralization and less infiltration of the adhesive, which may have resulted in the decrease in bond strength values. Park *et al.* stated that the presence of saliva may result in the dilution of adhesive resulting in a weak hybrid layer.<sup>16</sup> Studies done by Pereira *et al.* showed that dilution of water based system results in a reduction in the degree of monomer conversion and a reduction in the bond strength.

In the present study, it was observed that Clearfil SE Bond showed good degree of tolerance to salivary contamination, when compared with Xeno V<sup>+</sup>. Summitt James attributed the high bond strength values obtained with Clearfil SE Bond to the presence of methacryloyloxydecyl dihydrogen phosphate (MDP), which improved adhesion to enamel and dentin, and has a long hydrophobic and short hydrophilic group that improves wetting of the hydrophilic dentin surface.<sup>21</sup> Being a mild acid, it causes only superficial demineralization to occur partially, keeping the residual hydroxyapatite still attached to the collagen, which may serve as a receptor for additional chemical bonding.<sup>20</sup> Studies by Yoshida *et al.* showed that methacryloyloxydecyl dihydrogen phosphate (MDP) has a chemical bonding potential to calcium of residual hydroxyapatite.<sup>22</sup> It also protects the collagen against hydrolysis and, thus, early degradation of the bond.

According to Fritz *et al.* the decrease in shear bond strength was statistically significant, when contamination occurred following light curing of the adhesive which may be due to three hypotheses<sup>22</sup>:

- Adsorption of glycoproteins to the poorly polymerized adhesive surface, thus preventing adequate co-polymerization.
- Compromise of the co-polymerization with the subsequent resin layer, by removal of the oxygen inhibited un-polymerized surface layer, during rinsing and drying.
- Insufficient filling of the collagen mesh with resin.

From this study we conclude that the salivary contamination which occurs before the application of the bonding agent shows greater amount of strength contrary to the salivary contamination which occurs after the curing of the bonding agent which has much lesser strength and amongst the two bonding agent, i.e., Clearfil SE Bond and Xeno V<sup>+</sup> the later one has less resistance to salivary contamination. However further clinical studies are required to assess the efficacy and effectiveness of newer generation of bonding agents in relation to salivary contamination.

## References

- 1) Eakle WS. Fracture resistance of teeth restored with class II bonded composite resin. *J. Dent Res* 1986; 65(2): 149-53.
- 2) Duke ES. Adhesion and its application with restorative materials. *Dent. Clin. North Am* 1993; 37: 329.
- 3) Buonocore MG. A simple method of increasing the adhesion of acrylic filling materials to enamel surfaces. *J. Dent Res* 1955; 34(6): 849-53.
- 4) Buonocore MG, Matsui A, Gwinnett AJ. Penetration of resin dental materials into enamel surfaces with reference to bonding. *Arch oral Biol* 1968; 13(1): 61-70.
- 5) Buonocore MG. Principles of adhesive retention and adhesive restorative materials. *J Am Dent Assoc* 1963; 67: 382-91.
- 6) MC Lean JW, Kramer IRH. A clinical and pathological evaluation of a sulphinic acid activated resin for use in restorative dentistry. *Br Dent. J* 1952;93: 255-69, 291-3.
- 7) Nakabayashi N, Kojima K, Masuhara E. The promotion of adhesion by the infiltration of monomers into tooth substrates. *J. Biomed Mater Res* 1982;16(3): 265-73.
- 8) Duke ES, Lindemuth J. Variability of clinical dentin substrates. *AM. J. Dent* 1991; (5): 241-6.
- 9) Lagidiaco MC. Bonding to dentin (PhD Thesis). Amsterdam, The Netherlands Acta University 1995.
- 10) Naughton WT , Latta M. Bond strength of composite to dentin using self etching adhesive systems. *Quintessence Int.* 2005; 36(4) : 259-262.
- 11) Frankenberger R , Kramer N, Petschelt A. Technique sensitivity of dentin bonding: effect of application mistakes on bond strength and marginal adaptation. *Oper. Dent* 2000, 25(4): 324-330.
- 12) Wet FA , Eick JD, Brandt P, Vander Vyver PJ, Dusevich VM. The bond strength and effect of two self etching primers on dentin. *J. Dent. Res* 2001 special issue Abstract 1340.
- 13) Munck DC, Van Meerbeek B, Vargas MA, Shirai K , Iracki J, Poitevin A, Lambrechts P. Bonding effectiveness of new self etch adhesives to bur cut enamel and dentin. *J. Dent. Res* 2003 special issue B Abstract 0859.
- 14) Leirskar J, Oilo G, Nordbo H. In vitro shear bond strength of two resin composites to dentin with five different dentin adhesives. *Quintessence Int* 1998; 29(12): 787-792.
- 15) Jorge Perdigao. New Developments in Dental Adhesion. *Dent Clin N Am* 51 (2007) 333-357.
- 16) Park JW, Lee KC. The influence of salivary contamination on shear bond strength of dentin adhesive systems. *Oper Dent* 2004;29:437-42.
- 17) Pashley El, Tao L, Mackert JR, Pashley DH. Comparison of in vivo vs in vitro bonding of composite resin to the dentin of canine teeth. *J Dent Res* 1988;67:467-70.
- 18) Meerbeek Van, Yoshida Lambrechts P. Vanherle G. Bonding of a resin - mechanism and micro-tensile bond strength of a 4 MET-based self-etching adhesive. *J Dent Res* 2000a;79:249.
- 19) Yoo HM, Oh TS, Pereira PN. Effect of saliva contamination on the microshear bond strength of one-step self -etching adhesive systems to dentin. *Oper Dent* 2006;31:127-34.

- 20) James SB. Fundamentals of Operative Dentistry A Contemporary Approach. 2nd ed.
- 21) Yoshida Y, Nagakane K, Fukuda R, Nakayama Y, Okazaki M, Shintani H, *et al.* Comparative study on adhesive performance of functional monomers. J Dent Res 2004;83:454-8.
- 22) Fritz UB, Finger WJ, Stean H. Salivary contamination during bonding procedures with a one-bottle adhesive system. Quintessence Int 1998; 29:567-72.