ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

*International Journal of Dental Science and Innovative Research (IJDSIR)*

*IJDSIR : Dental Publication Service*

*Available Online at: www.ijdsir.com*

*Volume – 5, Issue – 3, June - 2022, Page No. :107 - 113*

# Effect of chlorhexidine rinse and blood contamination on bond strength of brackets bonded with self-etch primer-An ex vivo study

[1]Dr. Abhishek Choudhary, Private Practitioner, Bhopal (M.P), India

[2]Dr.Ankur Chaukse, Professor, Department of Orthodontics, Rishiraj Dental College of sciences & Research center, Bhopal (M.P), India

[3]Dr.Amitabh Kallury, Department of Orthodontics, Peoples Dental Academy, Bhanpur, Bhopal (M.P), India

[4]Dr.Kshitij Gupta Professor, Department of Orthodontics & Dento-facial Orthopedics, Rishiraj College of Dental science and Research Centre, Bhanpur, Bhopal (M.P),India

[5]Dr.Chandni Bharti, Reader, Department of Orthodontics, Peoples Dental Academy, Bhanpur, Bhopal (M.P), India

[6]Dr.Rajesh Balani, Department of Orthodontics**,** Peoples Dental Academy, Bhanpur, Bhopal (M.P), India

**Corresponding Author:** Dr. Chandni Bharti, Reader, Department of Orthodontics, Peoples Dental Academy, Bhanpur, Bhopal (M.P), India

**Citation of this Article:** Dr. Abhishek Choudhary, Dr. Ankur Chaukse, Dr. Amitabh Kallury , Dr. Chandni Bharti, Dr. Kshitij Gupta, "Effect of chlorhexidine rinse and blood contamination on bond strength of brackets bonded with self-etch primer-An ex vivo study", IJDSIR- June - 2022, Vol. – 5, Issue - 3, P. No. 107 – 113.



**Type of Publication:** Case Report

**Conflicts of Interest:** Nil

## Abstract

**Introduction**: The purpose of the present study was to determine effects of chlorhexidine (CHX) on blood stained tooth during boding of brackets with self-etch primer (SEP) and effect on Shear Bond Strength.

**Method**: A total of 90 taken out human premolars were assembled and maintained in normal saline solution & divided into 3 categories of 30 teeth each. In Group Sample A (Control group) the teeth were bonded using self-etching primer(SEP) applied for 15 seconds and cured for 10 seconds followed by bonding with Trans bond XT composite. In Group Sample B the teeth were etched with SEP for 15 seconds followed by contamination with blood, washed with water and dried. The teeth were again etched with SEP for duration of 15 seconds and cured for 10 seconds followed by bonding with Trans bond XT composite. In Group Sample C the teeth were made etch with SEP for 15 seconds duration time followed by contamination with blood, washed with 0.12% chlorhexidine oral rinse and dried and then same procedure is followed as in group B.

**Result**-The results obtained by analysis of variance (F _ 6.891) specify that the SBS of the 3 group samples were significantly different (P _ 0.002). The highest value of SBS occurred when chlorhexidine ( Group Sample C) was used to remove the blood contamination (mean=

15.874 MPa), as compared to Group sample B. Tukey's Post Hoc Analysis was done for intra group comparison and the result showed that the mean difference in SBS between group sample B & C is 4.815 which is highly significant (P value =0.001).

**Conclusion-**Blood contamination when removed with the chlorhexidine solution results in significantly increased SBS.

**Clinical implications-**Blood contamination is a common procedural difficulty. This study helps us to improve SBS in blood contaminated field for lesser bracket debonding and better treatment results.

**Keywords:-**Blood contamination, Chlorhexidine oral rinse, self etch primer, Shear Bond Strength.

**Introduction**

The direct procedure of bonding orthodontic brackets has dramatically improved the clinical practice in orthodontics but abomination either with saliva or blood[1] still poses a problem, especially while bonding attachments too difficult to access areas such as the inflammatory gingival region, second/third molars, partially or impacted teeth, bonding during exposure of impacted teeth, and in periodontally compromised patients. In such cases, bond failure is common and rebonding is both cumbersome and time-consuming procedure for the orthodontist and patient as well. The sixth generation self-etching primer system (SEP) provides an advantage as it consists of etchant component and primer both added as a single unit. Acid component of the system de-mineralizes the enamel surface and itself become a primer as the pH increases. Hence, the etching and priming are merged as a single step leading to a fewer stages in bonding procedure, resulting in time saving for the clinician, which has cost implications.[2,3]

The use of fixed appliances in orthodontic treatment increases the deposition of plaque and therefore increases the risks of caries and periodontal problems. Hence, to minimize the caries occurrence or inflammation risk, preventive measures should be taken to directly suppress the cariogenic bacteria by chemotherapeutic agents.[4] The antibacterial protection could be increased by applying chlorhexidine to the enamel surface but it might influence bond strength, depending on the method of application. Studies on higher or lower concentrations of chlorhexidine used have been reported to reduce inflammation and analysers have concluded that use of 0.12(%) percent concentration chlorhexidine mouth rinses could be beneficial in achieving improved oral hygienein orthodontic patients.[5-6]

The effects of different Chlorhexidine forms on the shear bond strength (SBS) of orthodontic brackets was assessed in vitro previously.[7-10] From the results of studies, it can be noted clearly that enamel surface treatment with CHX can increase,[8] decrease,[9] or did not intervene with[10] the bond strength of orthodontic brackets. Till present date knowledge no such other studies have explored or surveyed the effects seen on bond strengths with self-etch primer and chlorhexidine combination during blood contamination on enamel. The present study attempt to investigate whether CHX solution and self-etch primer combination during blood contamination affects the bond strength of the brackets used in orthodontic treatment.

**Material and Methods**

Study was carried out at an institute's Department of Orthodontics and Dentofacial Orthopaedics, Bhopal. Ninety freshly extracted human premolars (any premolar)were collected from Department of Oral and Maxillofacial Surgery extracted for orthodontic

treatment purpose and stored in a normal saline solution to prevent dehydration.

**Inclusion criteria-** Intact buccal enamel surface, not pre-treated with any chemical agents (eg hydrogen peroxide), no cracks presence by faulty extraction, and caries free teeth.

**Exclusion criteria-** carious tooth, restored tooth, tooth from patient with history of orthodontic treatment, Hypoplastic tooth.

The samples were isolated randomly into three groups samples of 30 each. The teeth were stabilised in a self-cure colour coded acrylic blocks (fig:-1,2) with the roots completely embedded in the acrylic up to the cemento-enamel junction (CEJ). The buccal or facial surfaces of individual tooth were cleaned with fluoride free soft pumice abrasive & water slurry paste with a dental rotary hand piece & brush, followed by washing & drying with compressed air. MBT(McLaughlin, Bennett and Trevisi) metal 0.022 slot brackets(Gemini series, 80-gauge mesh, 3MUnitek) were used for bonding(fig:-3) with self-etch primer (3M Transbond Plus self-etch primer, 3M unitek, Monrovia, California, USA) using Transbond XT(3M unitek, Monrovia, California, USA) composite & light cure for 40 seconds as per manufacturer instructions. After specific group bonding procedure thebonded specimens were stored in distilled water at room temperature for 24 hours before testing to simulate intraoral environment.

**Group A/Control group**- The teeth in this group were bonded under clean and sterilize condition using self etch primer applied for 15 seconds and curing for 10 seconds followed by bonding with Transbond XT composite and subjected for testing of bond strength.

**Group B**-The teeth in this group were etched with self etch primer for 15 seconds followed by contamination with blood (obtained from discarded blood from the institution pathology laboratory), washing with water and drying. The teeth were re-etched with self-etch primer for 15 seconds and curing for 10 seconds followed by bonding with Transbond XT composite and subjected for testing of bond strength

**Group C**- The teeth in this group were etched with self-etch primer for 15 seconds followed by contamination with blood, washing with chlorhexidine (0.12 % Clohex ADS mouthrinse from Dr Reddy Laboratory) and drying. The teeth were re-etched with self-etch primer for 15 seconds and curing for 10 seconds followed by bonding with Transbond XT composite and subjected for testing of bond strength.

A Instron universal testing machine(model No.3282 manufactured by Instron India, Chennai,India) was used to test shear bond strength at Central Institute of plastic Engineering and Technology (CPET) Bhopal ,India.The mounted specimen in acrylic block been attached with the bottom head of the machine (fixed head). To achieve a consistent force for debonding, a customized blade was made fitted in the upper head (movable head) connected to the load cell. The blade was positioned in such a manner that it touches the bracket. Cross-head speed used was 1 mm/minute. A computer was used to record the force applied to debond the bonded bracket in the unit of Newton.Calculated bond strengthin megapascals was done by formula:

$$\text{Bond strength in MPa} = \frac{\text{Force in Newton}}{\text{Surface area of Brackets in mm}^2}$$

Brackets in $mm^2$

The surface area of the bracket was 10.61 $mm^2$, provided by company manufacturer. To determine whether significant differences were present in the bond strength between the 3 groups, analysis of variance was used.

Tukey's Post Hoc Analysis was done for intra group comparison of shear bond strength. Significance was predetermined at P $\leq$ 05 for all statistical tests.

**Result**

The descriptive statistics including the Mean & Standard deviation for each of the three groups are presented in Table I. The results of the analysis of variance indicated that there was significant differences (F value =6.891, P value=0.002) in bond strengths between the various groups tested.The highest value of shear bond strength was achieved when chlorhexidine (group C) was used to remove the blood contamination (mean= 15.874 MPa).When bonding was done in ideal condition(group A) shear bond strength obtained was slightly lower (mean= 14.497 MPa) as compared to group C.On the other hand lowest shear bond strength among all three groups was achieved when blood contamination (group B) was removed with water (mean=11.059 MPa). Results of Tukey's Post Hoc Analysis showed (Table 2) that the mean difference in bond strength between group B & group C is 4.815 which is highly significant (P value =0.001). Mean difference in bond strength between Group A & Group C is 1.377 which is not Significant (P value =0.559) and the mean difference in bond strength between group A & group B is 3.438 which is statistically significant (P value =0.031).

**Discussion**

Direct bonding of orthodontic brackets during blood contamination results in failure of bonding procedure and rebonding is again time consuming and a burden for both orthodontist and patient. Maintenance of good oral hygiene[11] to avoid or minimize decalcification of enamel is another problem commonly encountered during fixed orthodontic therapy.

Lucas[12] et al stated that the orthodontic procedures like banding, debanding and separator placement are potential source of odontogenic bacteremia and can place patients at risk for serious sequelae in cardiac problems. Moreover Sonis[13] suggested that antimicrobial rinses such as chlorhexidine gluconate temporarily reduces the oral bacterial count when used previous to the placement or the removal of bands thereby reducing the risk of cardiac problems.

Self-etch primers offer a distinct clinical advantage because they join as etching and priming in one stage only. The reactive components are derivative esters from bivalent alcohols with methacrylic and phosphoric acid. The phosphoric acid helps in etching the enamel, whereas the methacrylate component of the molecule is available for co-polymerization with the bonding agent and composite resin. To rinse off the reaction products or residual phosphoric acid esters there is no need as both are subsequently polymerized into the bonding layer.[14]

Chlorhexidine is widely used antibacterial or antiseptic agents nowdays in dentistry. It is also used in adjunct treatment for periodontal disease & inflammatory conditions in the form of mouth rinses as it has been proved to be very effective in plaque control, gingival inflammation & removing of biofilms during blood contamination without developing resistant organisms in the oral flora.[15]

However there are conflicting reports with reference to its use in preventing contamination during bonding procedure as it might alters the shear bond strength.

In present study, the control group (Group A-14.8MPa) and CHX mouth rinse group (group C-15.2 MPa) had higher SBS values in comparison to group B (11.2 MPa) where blood contamination was removed with water and differences between the group B & C were statistically highly significant. This result indicates that use of CHX

mouth rinse to detach blood stains does not significantly affect the bond strength of adhesive.

Catalbas[6] et al in their study on the effects of different chlorhexidine concentration on shear bond strengths of orthodontic brackets concluded that the chlorhexidine mouth rinse before starting bonding procedure did not bring significant change on the SBS value, and the application of chlorhexidine solution and gel significantly decreased SBS.Bishara[5] et al through their study on the effects of various methods of chlorhexidine application on shear bond strength mentioned that the shear bond strength was not significantly influenced when chlorhexidine is applied over bracket and tooth surfaces after the bonding procedure is completed,as a prophylactic paste over the unetched enamel surface. Demir[8] et al and Filler[16] et al described similar results after a Chlorhexedine-immersing procedure with 0.12% CHX gluconate.

Possible reason behind the increased shear bond strength could be attributed to the fact that the presence of bacteria in the blood smear layer cannot be removed completely with water. Chlorhexidine molecules have positive charge, whereas bacterial cell membrane consists negatively charged molecules. Interaction between the opposite charges produces an connection in both . The intercellular activity between them raises the permeability of bacterial cell membranes, resulting in the penetration of devastating agents into cytoplasm and leads to death of the microorganism resulting in clear enamel surface for bonding.

Furthermore the dentin matrix contains endopeptidase called matrix metalloproteinase (MMPs) which have a key role in tooth formation and dentin caries. It can be seen due to release and activation of MMPs during dentin bonding procedures which is responsible for the degradation of collagen fibers which have not been completely covered in the hybrid layer.

In total-etch adhesive resins, the use of chlorhexidine after acid etching prevents collagen fiber degradation and preserves the hybrid layer due to its inhibitory effect on matrix metalloproteinase which are responsible for the degradation of collagen fibers which as a result adds to the increase in bond strength. Although enamel has a lesser organic content than dentin, the same principle is successful.[17-19]

The mean SBS of all groups tested in study was greater than the range (6.0 to 8.0 MPa) mentioned by Reynolds and Von Frauhofer[20] because in vitro conditions may not correspond well with clinical success in the oral cavity, where complex environmental variations in temperature, stresses, humidity, and acidity are evident.

**Conclusion**

From the present study we can conclude that blood contamination is a common procedural difficulty during bonding. Rinsing the blood contamination on tooth surface with water produces SBS of 11.059 MPa (group B) which is significantly less than SBS (15.874) produced by rinsing the blood contaminated tooth with chlorhexidine oral rinse (group C) and SBS of group C is even more than SBS of group A where there is no blood contamination.

**Clinical Significance**

For good bonding absolute isolation and dry field of tooth is required. Blood contamination during orthodontic bonding procedure is a common procedural difficulty. Cleaning the blood stained surface with water followed by re-etching produces bond strength which is significantly less than the bond strength produced by cleaning the blood stained surface with chlorhexidine oral rinse and then re-etching. Thus if there is blood contamination during bonding procedure it should be

thoroughly rinsed with chlorhexidine oral rinse rather than water to get better bond strength.

**References**


1. Oztoprak MO, Isik F, Sayinsu K, Arun T, Aydemir B. Effectof blood and saliva contamination on shear bond strength ofbrackets bonded with 4 adhesives. Am J Orthod DentofacialOrthop. 2007;131:238–242
2. Miller RA. Laboratory and Clinical Evaluation of a Self-etching Primer. J Clin Orthod 2001; 35(1): 42-45
3. Oonsombat C, Bishara SE, Ajlouni R. The effect of blood contamination on the shear bond strength of orthodontics brackets with the use of a new self-etch primer. Am J OrthodDentofacial Orthop. 2003;123:547–550
4. Mandel ID. Antimicrobial mouthrinses: overview and update. J Am Dent Assoc1994;125:25-105
5. Bishara SE,Vonwald L,Zamtua J.Effects of various methods of chlorhexidine application on shear bod strength .Am J Orthod Dentofacial Orthop 1998;114:150-153.)
6. Catalbas B; Ercanb E; Erdemirc A; Gelgora IE, Zorba Y. Effects of Different Chlorhexidine Formulations onShear Bond Strengths of Orthodontic Brackets.Angle Orthod. 2008;79:312–316
7. Karaman AI, Uysal T. Effectiveness of a hydrophilic primer when different antimicrobial agents are mixed. Angle Orthod. 2004;74:414–419.
8. Demir A, Malkoc S, Sengun A, Koyuturk AE, Sener Y. Effects of chlorhexidine and povidone-iodine mouth rinses on the bond strength of an orthodontic composite. Angle Orthod. 2005;75:392–396
9. Cacciafesta V, Sfondrini MF, Stifanelli P, Scribante A, Klersy C. Effect of chlorhexidine application on shear bond strength of brackets bonded with a resin-modified glass ionomer. Am J Orthod Dentofacial Orthop. 2006;129:273– 276
10. Bishara SE, Damon PL, Olsen ME, Jakobsen JR. Effect of applying chlorhexidine antibacterial agent on the shear bond strength of orthodontic brackets. Angle Orthod. 1996; 66:313–316
11. Sukontapatipark W, el-Agroudi MA, Selliseth NJ, Thunold K, Selvig KA. Bacterial colonization associated with fixed orthodontic appliances: a scanning electron microscopy study. Eur J Orthod. 2001;23:475–484
12. Lucas V S, Roberts G J 2000 Odontogenic bacteraemia following tooth cleaning procedures in children. Pediatric Dentistry 22: 96–100
13. Sonis T.S. Orthodontic management of selected medically compromised patients: cardiac disease, bleeding disorders, and asthma. Semin Orthod 2004.10:277-280 2004
14. Bishara SE, VonWald L, Laffoon JF, Warren JJ. Effect of selfetch primer/adhesive on the shear bond strength of orthodontic brackets. Am J Orthod Dentofacial Orthop. 2001;119:621–624
15. Brightman LJ, Terezhalmy GT, Greenwell H, Jacobs M, Enlow DH. The effects of a 0.12 percent chlorhexidine gluconate mouthrinse on orthodontic patients ages 11through 17 with established gingivitis. Am J Orthod Dentofacial Orthop 1991;100:324-9
16. Filler SJ, Lazarchik DA, Givan DA, Retief DH, Heaven TJ. Shear bond strengths of composite to chlorhexidine-treated enamel. Am J Dent. 1994;7:85–88
17. Brackett WW, Tay FR, Brackett MG, Dib A, Sword RJ, Pashley DH (2007). The effect of chlorhexidine on dentin hybrid layers in vivo. Oper. Dent. 32(2): 107-111

18. Brackett MG, Tay FR, Brackett WW, Dib A, Dipp FA, Mai S, Pashley DH (2009). In vivo chlorhexidine stabilization of hybrid layers of an acetone-based dentin adhesive. Oper. Dent. 34(4): 379-383
19. Chaharom Mohammad E, Ajami Ahmad A, Kimyai S, Abbasi A. Effect of chlorhexidine on the shear bond strength of self-etch adhesives to dentin. African Journal of Biotechnology 31 August, 2011 Vol. 10(49), pp. 10054-10057
20. Reynolds IR, von Fraunhofer JA. Direct bonding of orthodontic attachments to the teeth: the relation of adhesive bond strength to gauze mesh size. Br J Orthod. 1976;3:91–95

**Legends Figure**


Figure 1: Armamentarium used in the research work

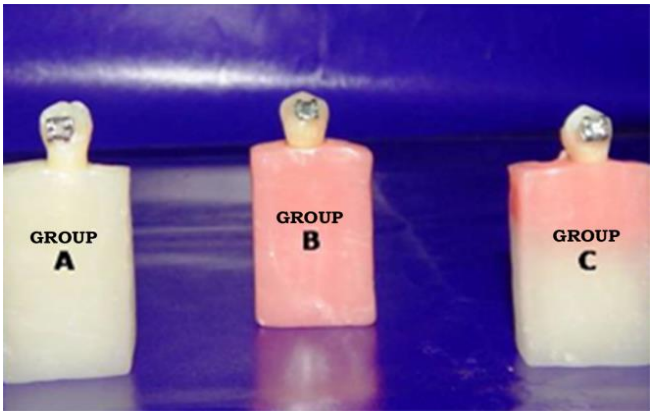


Figure 2: Teeth fixed in a self-cure acrylic block, showing Group A, Group B and Group C blocks

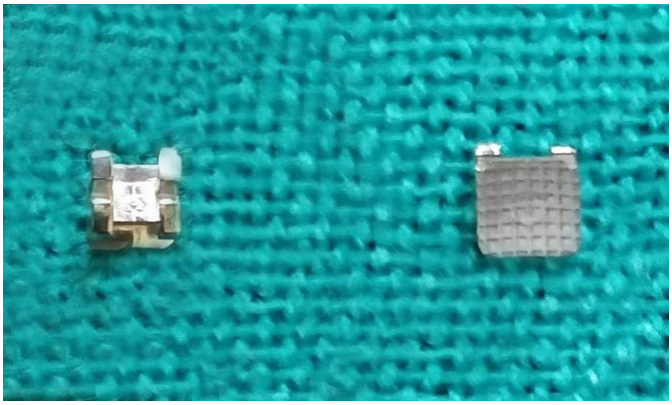

Figure 3: Metal 0.022 slot bracket, 3M Unitel Gemini series, 80-gauge mesh