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The effect of assure plus resin on the shear bond strength of metal brackets bonded to enamel and surface of porcelain and amalgam restorations

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ABSTRACT

This study evaluated the shear bond strength (SBS) of metal brackets bonded to amalgam and porcelain using the conventional and Assure plus methods. 60 human maxillary premolar teeth used in this study. Group1 contained 12 samples; groups 2 and 3 groups contained 24 samples. In Group 1, the specimens were after acid etching, Assure plus and light Bond adhesive were applied to enamel surfaces. In group 2 a cavity was prepared in the buccal surface of teeth and sandblasted, then divided to 2 subgroups. In subgroup1, the brackets were bonded with assure plus and light bond. In subgroup 2 were used conventional method (metal primer and light bond adhesive). In group 3, 24 glazed metal-ceramic crowns were fabricated for maxillary premolar teeth. The samples were sandblasted and randomly divided in to 2 subgroups. In subgroup 1 one coat of porcelain conditioner was applied then Assure plus and light Bond adhesive were applied. Samples were etched by 9.6% hydrofluoric acid and bonded with light bond In subgroup 1. SBS was evaluated by a Universal testing machine. Statistical analysis was conducted by analysis of variance (ANOVA) and Tukey tests. Group 1(enamel surface) showed a significantly higher value compare to other groups (14.52 MPa) (P<.05). There were no significant difference in SBS value between subgroups of amalgam and porcelain (7.70, 7.97 and 8.85, 8.54 MPa, respectively) (P>.05). Bracket bonding to amalgam and porcelain with assure plus resin produced suitable bond strengths. Although they produced the lower bond strength compared with enamel surface.

KEY WORDS: ASSURE PLUS; SHEAR STRENGTH; ORTHODONTIC BRACKETS

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INTRODUCTION

Requests for orthodontic treatment in patients especially adults are increasing.(1) The patients often have different dental restorations such as porcelain or buccal amalgam restorations.(2) Firm bonding of orthodontic brackets to restoration surfaces is a challenge in orthodontic treatment (1, 3). It has been shown that the conventional method is not effective in bonding orthodontic brackets to restoration surfaces (4, 5). In recent years, different methods have been suggested to overcome this problem. Sandblasting and use of intermediate resin containing 4-META is the most common method used for surface preparation in amalgam restorations (6, 7). Derya Germec et al (1) evaluated the shear bond strength of bracket bonded to amalgam with different intermediate resins including metal primer, Power Bond™ OLC and One-Step Plus. There were no statistically significant difference in mean SBS between the amalgam bonding groups but it was significantly lower than the control group (enamel) One of the most common techniques of surface preparation for porcelain is deglazing the surface with a diamond bur or sandblasting with aluminium oxide particles(4). Hydrofluoric acid (HFA) is used as a chemical preparation of the deglazed porcelain (8, 9). Grewal Bach GK et al conducted a systematic review regarding orthodontic bonding to porcelain. They concluded the best method was etching with HF for 1 minute and rinsing for 30 seconds then drying followed by application of HF and saline (2). Recently Reliance has introduced a new product named assure plus and claimed it has the ability to bond to every dental surface such as normal and atypical enamel, amalgam and porcelain. Regarding the various methods for bonding orthodontic attachments on different restoration surfaces such as amalgam and porcelain, using a simple method is worthwhile. The aim of this study was to compare the shear bond strength (SBS) of metal brackets bonded to amalgam using the conventional and Assure plus method and also to compare the shear bond strength of brackets bonded to porcelain using the conventional and Assure plus method.

MATERIALS AND METHODS

In this study, 60 human maxillary premolar teeth, extracted for orthodontic reasons, were collected. The sample teeth were examined to make sure of the absence of crack lines, dental caries or restorations. Then all the sample teeth were washed and then disinfected using .1% thymol solution for one week. The root of the teeth were mounted in self-curing acrylic resin (Cold cure acrylic, Acropars, Marlic Inc., Iran) so that the buccal surface of the teeth was parallel to the shearing force exerted by the blade of the instron device (Zwick Ltd, Here_fordshire, UK) then the teeth were divided to three groups. Group1 contained 12 samples, whilst groups 2 and 3 groups contained 24 samples.

In group1, the buccal surfaces of the teeth were cleaned by a rubber cap and pumice, then washed for 10 seconds and dried. After wards they were etched with 37% phosphoric acid gel (Fine etch Co, Chung-cheongnam-do, South Korea) for 30 seconds, rinsed thoroughly with water and dried with air spray until a frosty white surface was revealed. one coat of Assure plus was applied by brush on all surfaces and lightly dried with air to evaporate the solvent, the stainless steel bracket bases (Dentarum GmbH & CO.KG, Ispringen, Germany) were coated with Light Bond (Reliance Orthodontic Products, Inc., Ill, USA) adhesive and were placed at four-milimeters from the buccal cusp tip and pressed lightly in the position, then the extra composite was removed with a dental explorer and the adhesive was cured using a light curing unit(LED curing, Morita, Kyoto, Japan) for 20 seconds.

In group 2 a cavity (width 6 mm, length 7mm, axial depth 2mm) was prepared in the buccal surface of teeth. The cavity was filled with Non- gamma 2 amalgam (Nordiska Dental AB, Angelholm, Sweden) and burnished with a hand instrument then placed in water at 37c for 48 hours. Then the amalgam surface was roughened using 50µm aluminium oxide powder (Korox 50; Bego, Bermen, Germany) for 3 seconds from a 10mm distance then rinsed and dried. The amalgam specimens were divided in 2 subgroups. In group1 a thin Assure plus layer was applied to the amalgam surface of the teeth and brackets were bonded with Light Bond adhesive, the brackets were placed at four-milimeters from the buccal cusp tip on the center of the amalgam surface and was cured with a light curing unit for 20 seconds. In group 2 the conventional method was used. One coat of metal primer (RMP; Reliance orthodontic products) was applied by brush to the sandblasted amalgam and dried for 30 seconds then the brackets were bonded with composite resin and cured. In group 3, 24 glazed metal-ceramic crowns (Ceramco, Dentsply, York, PA; Heraus Kulzer, Hanau, Germany) were fabricated for maxillary premolar teeth, that were fixed in a acrilyc block. The samples were then sandblasted at 2.5 bar pressure for 4 seconds, rinsed and dried and then, randomly divided in to 2 subgroups. In group 1 one coat of porcelain conditioner (Silane BondEnhancer; Pulpdent Corp) was applied and dried then one coat of Assure Plus was applied on all surfaces and lightly dried with air for 30 seconds. In group 2 samples were etched by 9.6% hydrofluoric acid (ultra porcelain etch, ASA) for 4 min then rinsed for 30 seconds and dried. Then both groups proceeded with application of composite resin on bracket base and cured using a light curing unit.

Table 1. Descriptive Statistics of Shear Bond Strength (MPa) in Five Groups

Study group	Mean(MPa)	SD	Range
Enamel (Assure plus)	14.5225	1.9431	12.23-19.46
Amalgam (Assure plus)	7.7030	1.7359	5.80-12.64
Amalgam (RMP)	7.9733	2.2034	5.29-11.62
Porcelain (Assure plus)	8.8575	1.6559	5.38-11.14
Porcelain (HF)	8.5475	1.7665	5.85-10.83

Following the bonding of brackets, the specimens were stored in separate glasses in distilled water for 7 days prior to the shearing bonding test.

Shear bond strength (SBS) were measured using a Dartec HC10 universal testing machine (Zwick Ltd, Here_fordshire, UK) by application of 50 kgf of force at .5 mm/min. the force was exerted to the bonding site while the bracket base was parallel to the direction of force. Shearing bond strength was measured in Newton, which was converted in to Mpa by dividing the shear bond force (Newton) by the bracket base area (mm^2).

STATISTICAL ANALYSIS

Descriptive statistics including the mean and standard deviation (SD) of SBS values were analyzed using the SPSS16. The ANOVA and Tukey post hoc test were used to compare SBS of between the groups.

FIGURE 1. Testing machine with a specimen inplace from frontal view.

RESULTS

Table 1 shows the results of mean, standard deviation and range of shear bond strength for the five groups. The highest SBS (19.46 MPa) was observed in group 1 (enamel surface) and the lowest (5.29 MPa) was observed in group 2 (amalgam+RMP). Table 2 shows Comparison of the Mean Shear Bond Strength in the Study Groups. There were no significant difference in SBS value between subgroups of amalgam and porcelain (7.70, 7.97 and 8.85, 8.54 MPa, respectively) (P>.05), but group 1 (14.52 MPa) showed a significantly higher value compare to others (P<.05)

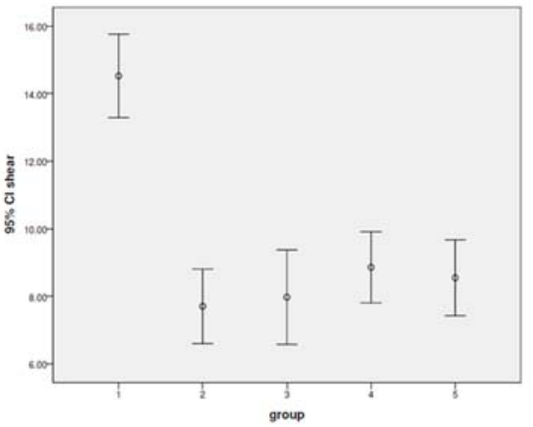
DISCUSSION

Bonding orthodontic attachments to the restoration surface is always challenging because of the high rate of bond failure during orthodontic treatment. Many researchers

Table 2. Two by Two Comparison of the Mean Shear Bond Strength in the Study Groups

Study group	Mean difference	Significance
1(enamel), 2(amalgam+Assur plus)	6.8191	.000
1(enamel), 2(amalgam+RMP)	6.5491	.000
1(enamel),3(porcelain+Assur plus)	5.6650	.000
1(enamel),3(porcelain+HF)	5.9750	.000
2(amalgam+Assur plus), 2(amalgam+RMP)	.2700	.997
2(amalgam+Assur plus), 3(porcelain+ Assur plus)	1.1541	.560
2(amalgam+Assur plus), 3(porcelain+HF)	.8441	.803
2(amalgam+RMP), 3(porcelain+ Assur plus)	.8841	.775
2(amalgam+RMP), 3(porcelain+HF)	.5741	.943
3(porcelain+ Assur plus), 3(porcelain+HF)	.3100	.994

Table 3. Box of 95 % confidence interval measurements and mean value of shear bond strength in five group



Group 1: Enamel (Assure plus),
Group 2: Amalgam (Assure plus),
Group 3: Amalgam (RMP),
Group 4: Porcelain (Assure plus),
Group 5: Porcelain (HF)

have suggested modified bonding procedures. Bonding to amalgam restoration carried out by sandblasting with 50µm aluminum oxide before bonding (6, 7, 10, 11) and use of RMP (Reliance metal primer) in order to achieve chemical bonding (7). Sandblasting and HF is used for treating the porcelain surface (4, 12-15). Suggested surface preparation methods can be harmful to soft tissues or time consuming (12, 16). In recent years, different alternative methods to achieve adequate surface treatment have been proposed (4, 15). We used Assure plus resin for bonding to enamel, amalgam and porcelain surface and compared them with RMP and HF preparation in amalgam and porcelain restorations respectively. The group1 (enamel group) demonstrates significantly higher bond strength (14.52MPa) when compared with other groups. the mean value achieved in our study was comparable to that reported in other studies, that used transband XT primer as the gold standard for bracket bonding on enamel (bond strength ranging from 10.4 MPa to 20 MPa)(17-19). Hellak A et al evaluated Enamel shear bond strength of two orthodontic self-etching bonding systems (Prompt L-Pop and Scotchbond) compared to Transbond XT that results showed All three adhesives revealed similar bond strengths (15.49 ± 3.28 MPa ,13.89 ± 4.95 MPa, 14.35 ± 3.56 MPa respectively) and was comparable with our study (14.52 Mpa) (20).

Our study found no significant difference between the bond strength of amalgam subgroups (7.75 MPa and 7.97 MPa in amalgam+Assure plus and amalgam+RMP respectively). This finding was comparable with the study of Germic D et al(1) that the brackets were bonded with Unite (3M Unitek) using Reliance metal primer (7.15 MPa) although their result showed less shear bond strength. This lower amount is likely due to the thermocycling process in Germic D' study. That decreases the bond strength between resin composite and amalgam(21). Although some studies showed that the thermocycling process minimally affected the bond strength of composite resin to amalgam surface (6, 7). According to Zachrisson BU et al (10) the mean tensile bond strength to sandblasted amalgam surface was 3.4 Mpa to 6.4 Mpa that showed lower mean strength compared with our study. This is likely due to using a different intermediate resin (All bond2). Buyukyilmaz T (7) showed using 4_META primer (amalgam bond_plus, metal primer) created significantly more effective bond strength to different amalgam surfaces (Lathe-cut, admixed, and spherical amalgams) compared to All_Bond 2 primer, whereas the control group of the study (bonded with Concise to extracted mandibular incisor teeth) was comparable with our study (13.2 Mpa). So in vitro, bonding to amalgam showed significantly lower strength than extracted teeth (10).

Also there was no significant difference between subgroups of porcelain (8.85 MPa and 8.54 MPa in porcelain +Assure plus and porcelain + HF respectively). Comparison of different studies in this field represents some variations. Yadav S et(22) al and Hosseini MH(23) et al used hydrofluoric acid 9.5% and 9.6% respectively for etching porcelain surface. The mean shear bond strength

was 9.9 MPa and 9.4 MPa respectively in that study. Whereas Fan CH study(24) showed lower bond strength (7.055 MPa) compared with our study, which likely was the result of different methods or adhesives used. We could was find no comparable study with our research related to Assure plus resin bonding in improving adhesion to amalgam and porcelain surface. According to Reynolds' study (25) an affective clinical orthodontic bonding requires a minimum bond strength of 6_8 MPa. The findings of the present study show that enamel, porcelain and amalgam treated with Assure plus can yield bond strength values within the suitable clinical range. It appears that using Assure plus as a multipurpose resin not only produces suitable bond strengths but is also a less time_ consuming, simple and safer method compared with conventional methods because of more time_ consuming process is needed for rinsing and drying when working with HFA (4min) and possible cause to soft tissue burn if do not care completely also treating amalgam surface with Assur plus, do not require for application of metal primer.

CONCLUSION

Considering the results of this study, we conclude the following: (1) the group1 (enamel group) demonstrate significantly higher bond strength compared with amalgam and porcelain groups. (2) There were no significant difference in SBS value between subgroups of amalgam and porcelain. (3) This study recommends using Assure plus as multipurpose resin for bonding to enamel, amalgam and porcelain surface.

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