



## Comparison of Bonding Strength of Composite Resin to Feldspathic Ceramic Denture Using two Different Universal Adhesives and Standard Method

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### ABSTRACT

Several different bonding systems are available that may be applied to the composite bond to the feldspathic porcelain. The purpose of this study was to investigate the shear bond strength between composite resin and feldspar porcelain using universal adhesives in comparison with the usual method of conventional bonding and silane application. 30 cubic feldspath porcelain (5 × 5 × 6 mm) disk were prepared from a 2 vita marker disc and then washed with 9.6% hydrofluoric acid and then washed and dried and were divided into 3 groups of 10 adhesive type according to AdPr single bond 2 (common adhesive) and Clearfil Universal bond (Universal Adhesive) and FuturabondU (Universal Adhesive). A resin composite with dimensions of 5mm diameter and 2mm thickness was placed. Samples were stored in distilled water at 37 ° C for 24 hours and thermocycled at 5000 rpm in 5 and 55 ° C with a retention time of 30 seconds. The shear bond strength test was performed by universal test machine at a speed of 1 mm / min. Data analysis (MPa) was performed by LSD test (P > 0.05). The highest shear bond strength was in the Adper single bond U (9.88 MPa) and the Clearfil Universal bond group (11.01 MPa) and the lowest was for the future bond U group (4.82). Clearfil universal bond had better shear bond strength than other adhesives, but since its difference was not significant with the control group, and due to the lesser and simpler steps, Clearfil Universal adhesive is recommended.

**Key words:** Universal Adhesive System, Silane, Shear Bond Strength, Feldspathic Porcelain

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### INTRODUCTION

Today, beauty needs for most communities are among the most important needs. Among existing beauty treatments, dentists can choose their own material from composite resins to ceramic materials. For a long time, the selected material was composite resin for this purpose, but short-lived and their color change leads to beautiful defects. In addition, the organic matrix of the composites decomposes and leads to

water absorption that requires continuous refinement during its shelf-life. Porcelain restores the natural state of dental surfaces and is an ideal choice against composite resin imperfections [1]. The use of porcelain in modern dentistry due to its excellent biocompatibility and its good mechanical properties, sometimes even on The metal is also surpassing [2]. Feldspathic parasites have a good clinical sensitivity and good laboratory practice, especially in low thickness [3]. Porcelain veneers are used to rebuild the facial surfaces of the teeth and allow the conservative restoration of irregular, damaged, and

discolored teeth to be restored [4, 5]. Feldspathic porcelain veneers have shown a long shelf life [6]. In the case of filling, due to sudden forces such as impact, if the fracture area is small, it can be corrected by polishing and re-forming, but when the fracture area is large and the remainder and the vierum is also healthy, it can be repaired [7]. Due to the increased demand for dental treatment, many materials have been investigated for the reconstruction of the natural appearance of dental tissue that are among the best ceramic materials. Many years they have been working on weaknesses such as fragility, tensile strength and flexural strength, and progressive improvement in the mechanical properties of dental ceramics has led to an increase in the use of non-metallic restorations [8]. Universal adhesive is a new group of adhesives that, according to manufacturers' claims, can be used in all techniques including Total H, self-H selections, and banding to all direct substrates such as ivory, enamel and indirect, such as metal and zirconia and glass ceramics in just one product. These adhesives also contain MDP-10 phosphate monomer, which justifies the effect of etching and the ability to bind to these substrates [9]. These veneers have many benefits, such as restoring beauty, resistance to abrasion and stability in the oral environment. When teeth are prepared for porcelain veneers, the highest rate of tooth structure, especially the enamel and dentin and enamel bonding, is maintained [10]. The success of the porcelain veneers depends on the bonding stability between the two materials as well as the elastic modulus of the teeth and porcelain [11]. Today, a very conservative design scheme for these veneers is used that includes the least amount of tooth extraction, incomplete tooth finishes and the lowest thickness of the porcelain is about 0.3 to 1 mm [12]. However, problems such as leakage, marginal color variation, loss of interdental bonding and porcelain, aesthetic problems, caries, periodontal problems, and pulpal diseases may occur, which is the most common case of porcelain veneers failure. Clinical fractures of porcelain veneers including radial cracks, vernier filling or insisal lumbar fractures, areas with occlusal contacts and marginal areas, which in this case resembles half-crescent failure, which are fractures due to Flexural and tensile stresses that occur when functional forces enter the veneer and shrink

during polymerization of resin cements and thermal cycles [13]. In 2015, Salehi and colleagues in Iran conducted a laboratory study aimed at determining the bond strength of composite resin to feldspathic porcelain and its topography after sandblasting with different pressures. In this study 68 discs of porcelain were made and divided into 4 groups with 17 members. The porcelain surface of the first group was acidified with hydrofluoric acid and the 2, 3 and 4 groups were sandblasted.

The topography of 7 samples from each group was examined by electron microscopy and 40 remaining samples received the same silane, bonding materials and composite and all of them passed 5,000 thermal cycles. The highest shear bond strength was in group 4, but no significant difference was observed between the groups and the greatest failure was observed in porcelain mass [14]. Due to the fact that several different bonding systems are available that may be applied to the composite bond to the feldspathic porcelain, the purpose of this study is to investigate the effect of two universal adhesives called Clearfil Universal bond and FuturabondU (both contain MDP-10 monomers) And without the need to use of silane in a separate step (and Adper single bond2) has no MDP-10 monomer and requires the use of silane (on the shear bond strength of composite resin to feldspathic porcelain).

#### MATERIALS AND METHODS

In this experimental study, 30 discs of feldspathic porcelain were used to determine the adhesive bond strength of the adhesives used. Using a diamond cutting blade, the porcelain block (vita mark II, vident, Germany, 18 A3c) 5 mm in diameter in 5 mm and Thickness mm6 in cutting machine (DWX-51D axis milling machine, DGA, USA) prepared and washed with distilled water to remove the debris. In order to determine the bonding range, one piece of a tygon tube was placed on the surface of each specimen, in the middle of which there was a hole of 3 mm in diameter, and finally, all samples using Hydrofluoric acid (9.6% PULPDENT CORPORATION-WATERTOWN, MA 02471 USA). H for 1 minute, then washed for 10 seconds with air and water syringe then dried for 5 seconds with air to determine the surface of the plaster facade. Finally, the specimens were divided into 3

groups of 10 according to the type of adhesive / primer. In each respective adhesive group, according to the factory's order, it is applied to the desired surface and is cured by every samples were also made by using the Panalux, UK (LED) light-emitting diodes (800 to 1200 mW / cm<sup>2</sup>). The use of adhesives according to the factory's order in each group was as follows: Group 1: The bonding surface was dried to Sylan (PULPDENT CORPORATION WATERTOWN, MA 02471 USA) and dried for 5 seconds with air syringe, then, a thin layer of adhesive Adper single bond 2 was applied with a microbe to the surface and dried with air for 5 seconds. The second layer was applied in the same way and finally curing was performed for 10 seconds.

Group 2: apply a clearfil universal bond bonding layer with a micro brush to the surface and rubbing for 10 seconds and then apply gentle air flow to the surface for more than 5 seconds as long as the bonding does not move is applied to the surface and cured for 10 seconds.

Group 3: FuturabondU is a single-dose adhesive that consists of two components, mixed according to the order of the plant and applied a layer of it with a micro brush to the desired surface and was thinned with air for 5 seconds, then curing was performed for 10 seconds. In the next step, using a tygon tube with an internal diameter of 5 mm at a height of 2 millimeters (in order to equalize the composite dimensions), the valox composite (3M ESPE, GmbH, USA), the A3 color was applied to each of the specimens and cured for 20 seconds. After about 1 hour, the tygon tubes were torn and separated by a blade around the composites. All specimens were stored in distilled water at 37 ° C for 24 hours, then thermocycled to 5,000 degrees in water at 5 and 55°C (30 seconds in

each bath). The specimens were mounted in Acrylic auto polymerized, Marlic Dental, Iran, so that the acrylic surface is 2 mm lower than the composite-porcelain interfaces (The interface is 2 mm out of acrylic). A MacroSherar test was carried out using the Zwick / Roell, Germany (Z050TN) device, the mounted samples were fixed between the two arms of the device and by the device's chisel, the parallel force was interfaced with Crosshead speeds of 1mm / min until the band was breaking. The data were reported in MPa (MPa). Finally, using descriptive statistics methods including frequency distribution tables, appropriate charts and indices and appropriate dispersion, according to the description of the variables studied, Then, by using Kolmogorov and Smirnov tests, the normality of quantitative data was checked and the comparisons were performed by using one-way ANOVA or its nonparametric equation. Data analysis was performed using SPSS 22.0 software.

## RESULTS

A total of 30 samples in this study were examined for shear bond strength. The shear bond strengths in group 4 Voco, was 82 MPa, and in the clearfil Universal bond group, was 11.01 MPa and in the single bond2 group was 9.82 Mpa. The mean values, standard deviation, maximal value and minimum shear bond strength that obtained in each group are given in Table 1.

Band strength was higher in group 2 than group 1, which was not statistically significant, but was significantly higher than group 3 ( $p < 0.05$ ). Group 2 showed higher bond strength than group 3 which it was statistically significance ( $P < 0.005$ ).

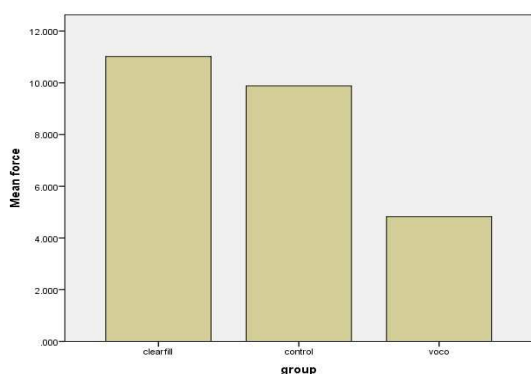
**Table 1: Average, Standard deviation, Maximum Limit and Minimum Shear bond strength in different groups (Mpa)**

Clearfill	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Control	10	11.01900	3.801551	1.202156	8.29953	13.73847	4.728	17.310
Voco Total	10	9.88220	4.566863	1.444169	6.61526	13.14914	5.103	18.060
Descriptive	30	8.57467	4.497253	.821082	6.89536	10.25397	1.133	18.060

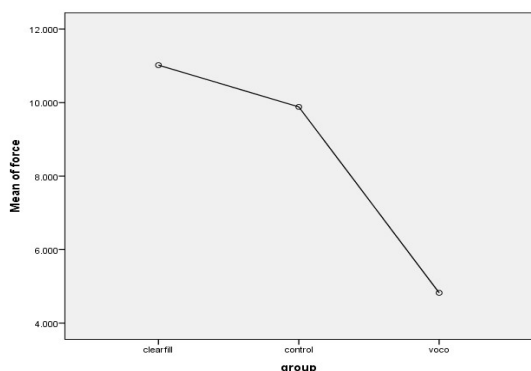
**Table 2: The LSD test was used to compare the two groups of results The shear bond strength in group 3 was significantly lower than all groups (P <0.05).**

(I) group	(J) group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
clearfill	control	1.136800	1.653110	.773	-2.96195	5.23555
	voco	6.196200*	1.653110	.002	2.09745	10.29495
control	clearfill	-1.136800	1.653110	.773	-5.23555	2.96195
	voco	5.059400*	1.653110	.013	.96065	9.15815
Voco	clearfill	-6.196200*	1.653110	.002	-10.29495	-2.09745
	control	-5.059400*	1.653110	.013	-9.15815	-.96065

\*. The mean difference is significant at the 0.05 level.



**Figure 1: Shear bond strength histogram**



**Figure 2: Shear bond strength diagram**

**DISCUSSION AND CONCLUSION**

While dentistry has its own nuances and attractions [15-16-17] there is always the possibility of getting communicable diseases in this profession from patients due to direct contact with them [18-19]. According to the results of the samples, after the shear test under the optical microscope, Forces such as fatigue, occlusal forces, the results were confirmed as the fracture site inadequate design, inadequate teeth in 70% of the samples in group 2 was in preparation, and

imperfections in the porcelain and 30% in the adhesive was laboratory stages, and ultimately trauma, may occurred and in group 1, the degree of failure result in failure of ceramic veneers [20]. The was 60% in porcelain, 30% in adhesive and high price of ceramics, the time constraints, 10% in composite, but in group 3, the greatest and the difficulty of removing ceramic failure rate was 60% in the adhesive layer and veneers, eliminates the complete replacement the remaining defects were in the composite of veneers, and eliminates the need for layer and no fracture was observed in treatment to repair them with composites porcelain [21]. Silane acts as a mediator and, through a dual reaction, improves adhesion between organic and inorganic matrices. In general, the silanes that are used to prepare surfaces for improving adherence (adhesion), Typically, silane ethers, organo-functional trialeoxy silanes are of the basic formula 3R-Y-Six, wherein R contains a nonhydrolyzable organic group, Y is a bonding agent (a propylene bond), and X is a hydrolyzable group. Silane are two-handed mediators. The non-hydrolyzed part of the carbon-carbon double bond reacts with composite monomers containing binary bands, and the alloxy hydrolyzed part reacts with the hydroxyl group of porcelain surfaces and creates a lasting bond between porcelain and composite [22]. According to reference books, the use of hydrofluoric acid followed by the use of silane creates a stronger bond between porcelain and composite [23]. Nowadays, adhesive systems that are less susceptible to technical errors than before and easier to use, are desired. The ability to create strong bonding to different types of substrates is a very useful feature, all of which is based on the manufacturer's claims in Universal adhesives [9]. According to Dr. Zakwei *et al.*, The comparison of shear bond strength of resin composite to denture zirconia ceramics using universal adhesives has the highest bond strength of futurabondU, but its

difference with clearfil universal bond was not statistically significant. And the lowest was the control group (adper single bond 2). Because MDP-10 monomer is included in universal bonding and reacts chemically with zirconium oxide. It creates a water-resistant band and is also the most hydrophobic functional monomer used in dental adhesives, this property may be important in relation to the bond's durability. Because water absorption and hydrolysis of adhesive interfaces over time, this considered as one of the primary reasons for the failure of the bond. Due to the superiority of the FuturabondU, bond strength, the nature of the monomer could be changed to increase its resistance to hydrolysis. Resin cements with a base of -10MDP have been introduced as a better bonding agent with zirconia than cements with the base (BisphenolA glycerolate BisGM Adimethacrylate) [24]. According to this, the difference in results with the present study is justified by the difference in the substrate studied and the basic chemistry of the adhesives studied. In the clinic after laceration of porcelain, the resulting surface is usually rough, but sometimes a smooth surface is also present. In the present study, porcelain samples were prepared with a smooth surface to provide a guarantee for the repeatability of their construction [25]. In order to provide micromechanical locking, hydrophobic acid was used to achieve a clean surface, roughness of the surface would increase, resulting in increased surface energy, resulting in a level of wetting of the surface, resulting in a better penetration of the resin to roughness Surface and allows for more locking [23]. Kern in his study also examined the airborne (Air Abergreen) and Silica Kutting in Nable and Metal Base alloys in order to increase the bond strength after thermal cycles, which in the absence of a suitable primer is reduced to zero, application of suitable primer is recommended before applying adhesive [26]. The shear bond strength after 5000 cycles of thermocycle decreases significantly [27]. According to previous studies, the method of using hydrofluoric acid for 1 minute and then washing the specimens was performed. According to a pott study that compared the bonding strength between composites and zirconia using different adhesives, it was found that futura bond U has the highest bond strength due to its functional monomer MDP10 and it was suggested that due to differences in chemistry The content and type of the matrix and the various additives of the composites in each plant, and therefore the

difference in the amount of polymerization contraction, the type of composite, can affect the bond strength of the resin and porcelain [28]. Therefore, in this study, to ensure the removal of the composite confounding effect, all three groups of valox composite (3M ESPE, GmbH, USA) were used.

Since the shear test is the easiest way to prepare the sample, the most common method is to assess the strength of the band, and on the other hand, the anterior teeth, which are the most sought after ceramic restorations, are primarily subjected to shear forces due to their position in the jaw, a shear test for the measurement of the strength of the ceramic repair methods is considered appropriate [28] and is used in the present study. In this study, the highest shear bond strength of the adhesive ceramic to clearfil universal bond was observed, which was statistically significant with Futura bond U, but there was no significant difference between the control group. Basic Chemistry Futura bond U contain Dimethacrylate resin, HEMA, Ethanol, Water, Carboxylic acid ester, Initiator and modified 10- MDP is its functional monomer which is a Phosphate monomer that derivative from phosphoric acid [29]. One of the differences in the Futura bond U with clearfil universal bond is that Futura bond U is silane free and contains functional carboxylic monomer [27-29]. The absence of silane in the Futura bondU compound allows for an increase in the 10 MDP monomer concentrations [15], but at the same time reduces bond strength to feldspathic ceramics. Although silane can be polymerized in an adhesive, it creates a network structure in which water and ethanol are stuck and harder to remove, and it is even more difficult to remove the solvent in the clearfil universal bond due to its higher viscosity which causes a higher technical sensitivity [29]. Due to the impossibility of precise control of the amount of silane applied and its deletion in the control group, the lower bond strength of the band is not far removed from the clearfil universal bond, but it is not statistically significant but comparable to Futura The bond U also shows a higher bandwidth strength. The lowest results in this study were Futura bond U, which was significantly less than 2 control group and clearfil universal bond, which could be attributed to its chemical content and the absence of silane in the bonding process. In general, the study showed that in vitro, the bond strength of the universal cleared adhesive bond to the feldspathic porcelain is better than Single

Bond2, and both of the above groups, is far better than the non-silene universal adhesive, such as Futura bond U.

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