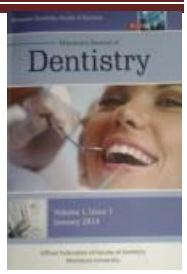


# *Evaluation of cyclic shear bond strength of metal brackets bonded to HFA etched ceramic surface*

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***Abstract:***
**Aim of the study:** Evaluation of cyclic shear bond strength (CSBS) of orthodontic brackets bonded to deglazed porcelain surface etched with hydrofluoric acid.
**Material and methods:** Twentydeglazed HFA etched ceramic disks were divided equally in to two groups (n=10).In group 1 the ceramic disks was treated with HFA then thin coat of Transbond XT primer+Silane was applied u onto its surface. In group 2 Single bond universal was applied on ceramic disks. Using Transbond XT adhesive to bond metal brackets to all ceramic disks. After bonding,all ceramic diskswere subjected to test the cyclic shear bond strength.ANOVA test was used to compare between the two groups.
**Results:** There weresignificant difference between the 2 groups($P<0.05$).
**Conclusion:** Single bond universal could be used successfully instead of Silane.
**Keywords:**Cyclic loading; Bond strength; Orthodontic brackets; Porcelain surface.

## *Introduction*

Nowadays direct bonding of orthodontic attachment is considered as a routine procedure in orthodontic practice. The demand for orthodontic treatment in adults has increased over the past few years and the orthodontist have to bond orthodontic attachments to already existing restorations such as composite, glass ionomer and different types of ceramics.

Bonding brackets to ceramics is difficult than enamel because of surface composition of the ceramic., Several protocols were found in the literature in order to enhance bond strength. Which intended to change the porcelain surfaces either chemically or mechanically. The target of mechanical treatment of the porcelain surface is to provide sufficient mechanical retention for the adhesive for successful placement of the orthodontic bracket by clear away the glaze layer and roughen this surface. The use of abrasive disks, green stones, diamond burs, sandblasting and laser irradiation are considered mechanical alteration. However they may induce permanent damage of ceramics glaze.[1]On the other hand, etching with powerful acid, like hydrofluoric acid or utilization of different primers for chemical alternation of the ceramic surface.

Hydrofluoric acid can breakdown glass by reacting with SiO2 to form hexafluorosilicic acid and silicon tetrafluoride gas and It is also has uncommon ability to dissolve a lot off metal and semimetal oxides.[2] on the other hand, the main drawback of hydrofluoric acid is that it is strong acid cause soft tissue injury.[3]

The Silane coupling agent formsforming a bridge between the two materials through chemical bond with both the ceramics and the resin.The inorganic dental ceramicsreacts with the hydrolysable group of the coupler whereas its organofunctional group reacts with the resin and improve adhesion.[4]

Universal single bond which contains MDP Monomer best Self-Etch performance, gives chemical bonding to alumina, zirconiaand metals with no need for using an autonomous primer, and enhance shelf stabilization so that no necessary of refrigeration. It also contains silane which lets the adhesive to chemically bond to glass ceramic superficies with no need ofan autonomous ceramic primer.[5]

## *Materials and methods*

VITABLOCS MARK II(Vita Zahnfabrik, Bad Säckingen, Germany) were cut to 20 ceramic disks with dimensions(2 mm thickness x 10 mm width x 12mmlength) using slow-speed-water-cooled diamond saw ( Isomet ,4000 micro saw, Buehler, USA).Then the disks were glazed by vita glazing paste. All the disks were deglazed using green stone bur then etched with hydrofluoric acid 9.6 % (Pulpdent,Watertown, Mass)for two minutes, and then water was used to clean the ceramic disks. Finally, the ceramic disks were dried with air which was oil-free for fifteen seconds. Then the disks were divided equally into 2 groups. In group(1) the etched ceramic was coated with small layer of Transbond XT primer (3M Unitek, Monrovia, Calif, USA) using a micro brush then a thin coat of Silane(Pulpdent Watertown, Mass, USA) was applied and was gently dried with air which was oil-free for ten sec. In group(2)a thin coat of Single bonduniversal was used with the etched ceramic surfaces and light cured for ten second.Finally lower incisor metal orthodontic

brackets(Gemini 3M Unitek)with base area 9.81mm square were bonded to the treated porcelain surfaces utilizing Transbond XT adhesive paste (3M Unitek,Monrovia, Calif, USA).Brackets were pressed onto the center of the porcelain surface after the adhesive paste was put to its base. Sharp instrument was used to remove excess adhesive around the base of the bracket. Finally the adhesive was light-cured for twenty sec using Elipar S10 LED light cure (3M ESPE, St. Paul, USA).All disks were kept in an incubator with 37°C temperature for 24 hours after bonding, Thermo cycling for five hundred cycles in hot and cold baths at 5˚-55˚C ± 4 ˚C for 30 seconds (Robota, Egypt).CSBS testing was made for all ceramic disks. Each disk was fixed in the metal mold and was fixed on the lower part of the testing machine (LRX-plus; Lloyd Instruments Ltd).The ceramic disks had been cyclic loaded by using a monobeveled metal chisel that was part of the upper mobile part of the machine.The base of bracket was received the load in the occlusogingival direction (figure 1). Cyclic loading was applied at a frequency of 1 Hz. 500 cycles was the maximum number of cycles at each load step[6]. If the sample withstood the 500 cycles, the stress level was raised by a fixed load increment in the same sample according to the modified staircase (step stress tech.) method.

The first sample was checked at 6 MPa stresses that were considered the minimum ofbond strength that was clinically acceptable[7]. Then, in each coming test a fixed load of .6 MPa was increased or decreased (ten percent of the minimum of thebond strength which was clinically acceptable) according to whether the preceding load resulted in a failure or no failure. The maximum biaxial flexural fatigue load ($L_E$) supported by each ceramic disk was determined according to the equation described by Nicholas [8]:

$$L_E = L_0 + \Delta L \left( \frac{N_{fail}}{N_{life}} \right)$$

Where $L_0$ is the previous maximum biaxial flexural fatigue load that did not result in failure, $\Delta L$ is the load step increase, $N_{fail}$ is the number of cycles to failure at the failure load step ($L0+ \Delta L$), and $N_{life}$ is the cyclic fatigue life (500 cycle). SPSS was used for collecting and analyzing the data. For two group comparison ANOVA test was used.

**Figure 1: specimen fixed to universal testing machine**

## *Results*

Means, standard deviations and ANOVA test for all tested disks were shown in table 1 figure 2. ANOVA test revealed that there were significant difference in CSBS values between using TransbondXT primer+silane or Single bond universal with deglazed HFA ceramic disksP<0.05.

| | CSBS Mean±SD (MPa) | | ANOVA test | |
|---|---|---|---|---|
| | Transbond XT primer+silane | Single bond universal | ANOVA test | P*value |
| Deglazed HFA etched ceramic disks | 2.63 ± 0.23 | 4.13 ±0.22 | 140.41 | <.0005 |

* statistically significant P<0.05.

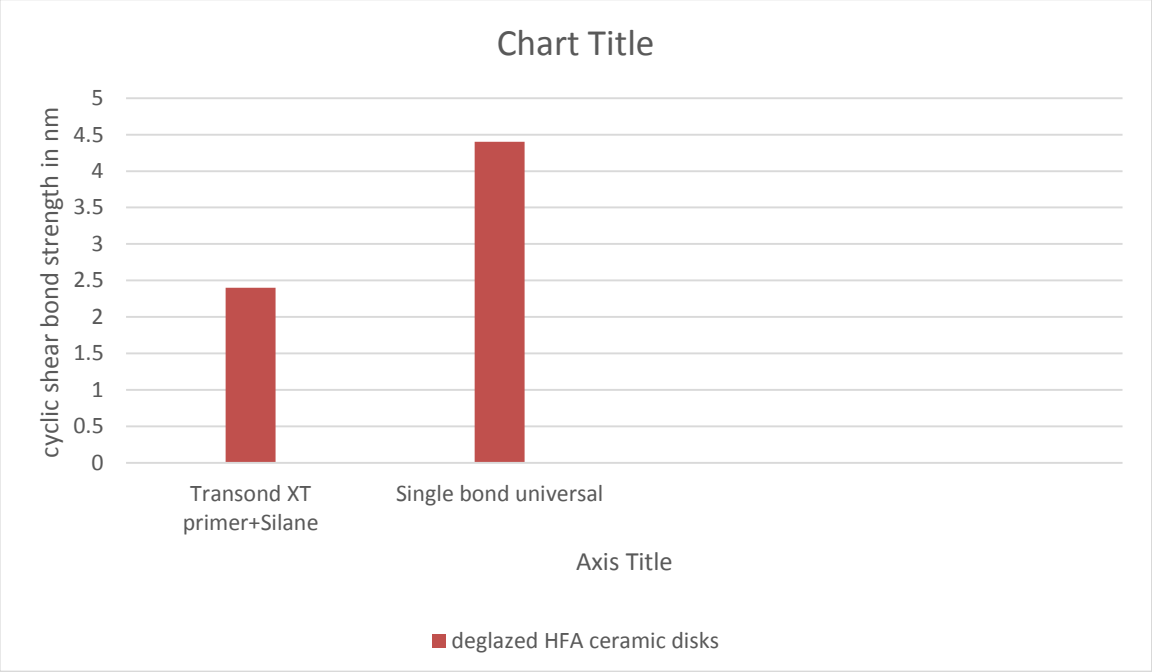


Figure 2: Mean of CSBS (MPa) of deglazed HFA etched ceramic disks bonded with either Transbond XT primer+Silane or Single bond universal.

## *Discussion*

The present study was conducted to assessusing either Single bond universal or silane after etching with HFA and their effect on thebond strengths of metallic orthodontic brackets bondedto deglazed porcelain superficies.CSBSs was evaluatedbecauseit is importantto simulate the oral cavity condition in thelaboratory bond strength researches,. In addition, bond strengths wereevalute after thermocycling.The results of the current study reported that Single bond universal gave highly significant CSBS valuescompared to silane after deglazing and conditioning with HFA and this result because it had MDP in its composition whichhad capability to bond metallic molecules present in some ceramics with methacrylate groups in resin cements9,10. The Transbond XT primer can be regarded as one ofthe standard adhesive systems in orthodontics. It has been the subject of many studies examining its adhesive strength 11-15. This finding in harmony with Hellak et al.16 that found that Single bond Universal gave the best average bonding on all other kinds of surface (composite,metal, and porcelain), without using additional primers. It might therefore be helpful for simplifying bonding in orthodontic procedures on restorative materials. Kim et al17 that investigate the bond strength of universal bonding adhesives glass-ceramic and found that Universal adhesives significantly enhance the bond strength between a resin and hydrofluoric acid-etched

glass ceramic. However, for the most lasting bond, a conventional surface treatment procedure utalizing a separate silane andadhesiveis preferedfor the cementation of leucite-reinforced glass-ceramic than a simplified procedure utalizing a universal adhesive alone.

## Conclusion

Using Single bond universal on deglazed HFA ceramic surface gave higher cyclic shear bond strength than using Transbond XT primer+Silane.

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