

**Republic of Iraq
Ministry of higher education And Scientific Research
University of Baghdad
College of Dentistry**



Comparison of Shear Bond Strength of Sapphire Bracket Bonded to Zirconium Surface After Using Different Surface Conditioning Methods (An inVitro Study)

**A Thesis Submitted to the Council of the College of Dentistry at the
University of Baghdad, in Partial Fulfillment of the Requirements for
the Degree of Master of Science in Orthodontics**

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Baghdad- Iraq

C.E 2017

A.H 1438

Abstract

The number of adults seeking orthodontic treatment is increasing. Many of them present to orthodontic clinics with restorations such as crowns and bridges in their mouth, the challenge of direct bonding to non enamel surface (zirconium) had been increased. The current study was accomplished to compare shear bond strength of sapphire bracket bonded to zirconium surface after using different methods of surface conditioning, and assessment of the adhesive remnant index.

The sample composed of 40 cylindrical zirconium specimens (A diameter of 8mm and a height of 6mm), were divided into four groups according to the surface conditioning method; the first was the control group with no surface conditioning, the second group was conditioned by sandblasting with aluminum oxide particle 50 μm , the third and fourth groups were treated by (Nd: YAG)laser irradiation with two different manners of laser, then all samples were coated by z-prime plus primer. A central incisor sapphire bracket was bonded to all groups with light cure adhesive resin.

Shear bond strength was measured by utilizing Tinius Olsen universal testing machine at crosshead speed of 0.5mm/min. After debonding, each bracket and zirconium surface were inspected using magnifying lens and adhesive remnant index was recorded. The difference in shear bond strength among main groups was analyzed by using ANOVA test.

Regarding the methods of surface conditioning, the 2nd laser group (0.444 watt for 10 seconds) had the highest mean value of shear bond strength ($30.67 \pm 2.33 \text{ Mpa}$), followed by 1st laser group (0.888 watt for 5 seconds) ($30.25 \pm 2.31 \text{ Mpa}$), followed by the sandblasting group ($22.29 \pm 1.18 \text{ Mpa}$) while the control group had the least value ($11.08 \pm 1.96 \text{ Mpa}$); however, highly-significant difference in the shear bond strength was found among all tested groups except between 1st and 2nd laser groups, non-significant difference was

found. Non-significant differences in the sites of bond failure were found between the laser groups and sandblasting group, and between the two laser groups, cohesive failure within the adhesive itself (score II) was the predominant in these groups, while the only reported score was score III (zirconium-adhesive interface) in the control group; however, highly significant differences in the sites of bond failure were found between control group and all other groups .

In conclusion, Zirconium surface conditioning with an air abrasion and a laser provides a good value of shear bond strength for sapphire brackets, however laser conditioning is the best.