Effects of Alumina Sand Blasting on the Orthodontic Bracket Surface

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The aim of this study was to observe the characteristics of the adhesion surface for different bracket systems after being sandblasted with alumina particles. The brackets that we used in our study were: ceramic(Fairfield Orthodontics), composite(US Orthodontics), sapphire and metallic(American Orthodontics). Sandblasting was performed,with 50μm alumina abrasive particles (Al_2O_3), for a 3 s period. The sandblaster (Microetcher II, Danville) was 10 mm away from the bracket surface. After the sandblasting process, the adhesion surface was examined using a portable microscope (Dino-Lite AM 4515T8). This type of mechanical treatment creates a very fine roughness on the surface area, and increases mechanical and chemical bonding between the tooth surface and the bracket base.

Keywords:sandblasting, alumina particles, brackets, adhesion

Esthetics and functional biomechanical properties are important for the clinical performance and the quality of direct bonding.

Most brackets do not chemically bond to enamel or resin, so efforts have been made to improve mechanical retention by improving the design of the appliances.The increasing demand for a more esthetic metal bonded appliance, led to a reduction in the size of the brackets and their bases areas [1].

Smaller brackets require a better bond strength.

Achieving a good adhesion between the brackets and the tooth surface is essential. One way to increase adhesion is to use a conditioner on the tooth surface and the bracket base. Sandblasting is one technique for conditioning the bracket base and it uses a high-speed stream of aluminum oxide particles, propelled by compressed air; it can be done at chairside .The results of the studies from the literature reported that the shear bond strength values, before and after sandblasting, are equivocal. [2].

Experimental part

Material and methods

Ceramic brackets (Fairfield Orthodontics) , composite brackets (US Orthodontics), sapphire and metallic brackets (American Orthodontics) were used. Sandblasting with 50μm alumina abrasive particles (Al_2O_3) was performed for 3 s, from a distance of 10 mm, with a sandblaster (Microetcher II, Danville).

After being sandblasted, the adhesion surface was examined using a portable microscope (Dino-Lite AM 4515T8).

In this study, the brackets were never used before and have never been sandblasted.

One error that could influence the study was the sandblasting pressure that wasn't constant.

Another variable that can influence the sandblasting is the time and the size of the alumina particles.

In this study the bracket base was sandblasted for 3 s according to the previous study performed by Arici S et al [3]. Arici used 3 different sizes(25,50 and 110 μm) of aluminum oxide powder and three sandblasting time periods (3, 6 and 9 s) for testing. The bond strength values were measured using a Weibull analysis, which showed that the most favorable size was 25μm and the optimal time period was 3 s.

Ibrahim Nergiz et al [4] proved that sandblasting for a longer time leads to material loss, by increasing the roughness, without increasing adhesion For our bracket base sandblasting, 50μm alumina abrasive particleswere used, because a bigger size (110 μm) of Al_2O_3would lead to material loss [4].

In our study, 4 different designs of the bracket base were used : foil mesh base for the metallic bracket, mechanical undercuts for the ceramic bracket,crystalline particles in the base for the composite bracket and irregular base for the sapphire bracket. All of these types of designs should improve adhesion.

Results and discussions

With the use of the digital microscope (fig. 1), photos (20 X magnification) of the bracket base were taken.

This treatment creates very fine roughness, increasing surface area and thus enhancing mechanical and chemical bonding (fig. 2-4). However, bond strengths obtained from sandblasting alone might be insufficient.

Different studies were conducted to analyze the variables that influence bond strength [10-12]. Scott A. Soderquist et al [5] showed in their study the compared mean static tensile bond strength and the mean cyclic tensile bond strength of 3 different ceramic bracket

Fig. 1. The Dino-lite microscope

Fig 2.Mono-cystalline alumina: before and after sandblasting (a better retention surface was obtained)

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Fig.3. Composite material : before and after sandblasting

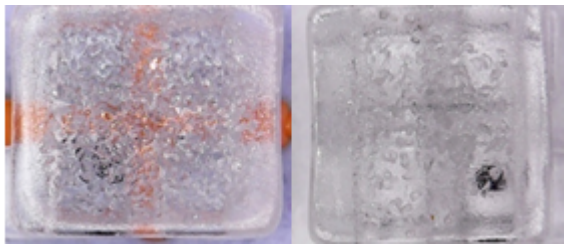

Fig 4. Polycrystalline alumina : before and after sandblasting

Fig 5. Stainless steel : before and after sandblasting

systems and 1 stainless steel mesh-foil base bracket . Four bracket systems were chosen because of their differences in bonding base .The mean static and cyclic bond strengths were measured for the 3 polycrystalline ceramic bracket systems and the stainless steel bracket.The analysis showed that ceramic brackets have unique characteristics compared with stainless steel; the most significant one is the higher bond strength. The effects of cyclic loading proved to be significant, and fatigue testing caused a decrease in mean tensile bond strength for most groups. An additional factor of the bond strength might be the composition and design of the bracket base.

Da-Young Kang et al. [6] concluded that irregular bracket surface features present the highest surface roughness values which contributes to increased mechanically retentive bracket bonding strength.

Some authors say that sandblasting doesn't significantly improve the retention. Sunna S and Rock WP [7] performed a study about the effect of chairside sandblasting of the bases regarding the retention of mesh backed orthodontic brackets. He concluded that sandblasting did not significantly improve the retention of mesh based orthodontic brackets in this study.

Johnston CD and McSherry PF[8] evaluated the effect of sandblasting foil mesh molar tube bases, on the shear bond strength, when bonding to first molar teeth.

For larger shear stresses, the probabilities of bond survival with sandblasted molar tubes were greater than with non-sandblasted molar tubes although the differences were small, which may be explained by the large proportion of bond failures which occurred at the resin to enamel interface in both groups.

In another papers were studied some aspects related to the orthodontic implants aligners and treatment [9-12].

Conclusions

It was concluded that sandblasting foil mesh bases is likely to provide only a minimal improvement in clinical performance when bonding to molar teeth. [13,14]

Sandblasting with alumina particles the 4 bracket systems lead to an increased surface area and enhanced mechanical and chemical bonding, however future studies are necessary to determine the variables that influence bracket adhesion [15-17].

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