Influence of aluminium oxide particles on bond strength after dentin sealing

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INTRODUCTION

Immediate dentin sealing technique (IDS) was introduced as an alternative to conventional procedure after teeth preparation for indirect restorations.[1] In this technique, a dentin bonding agent is immediately applied on the freshly cut dentin before taking impression and before the provisionalization. It promotes decontamination of the dentin, the decrease of both post-operate sensitivity and microleakage and the increase of bond strength values.[2,3] Sandblasting with aluminium oxide particles (AOP) has been referred to as the best surface treatment, improving the wettability for the adhesive process and therefore dental adhesion.[1,4,5] However, it is not clear how to optimize bond strength to indirect restorations.[1,3,6]

OBJECTIVE

To test the microtensile bond strength (μTBS) of immediate dentin sealing, after applying different types and sizes of aluminium oxide particles with different exposure times.

MATERIALS AND METHODS

Eighteen healthy molars received IDS technique with Optibond™ FL (Kerr, Orange, USA) after dentin exposure and were stored in distilled water at 37ºC for 24 hours (Fig. 1 and 2).

Fig. 1 – Dentin exposure with a diamond saw in a microtome

Fig. 2 – IDS technique sequence with Optibond™ FL (Kerr, Orange, USA)

The teeth were randomly separated into three groups following size and type of AOP applied to the teeth's surface (Airsonic Mini Sandblaster - Hager & Werken, Duisburg, Germany): 27μm; 30μm-silica-coated (CoJet - 3M ESPE Neuss, Germany) and 50μm. Each one of these groups was divided into two subgroups (n=3) according to exposure time to AOP (4 and 10 seconds) (Fig. 3). The procedure applied to the teeth's surface is schematized in the Figure 4.

Fig. 3 – Exposure time calibration: 4 or 10 seconds, depending on the group; Length calibration: 10 mm and blasting with AOP according to predetermined groups.

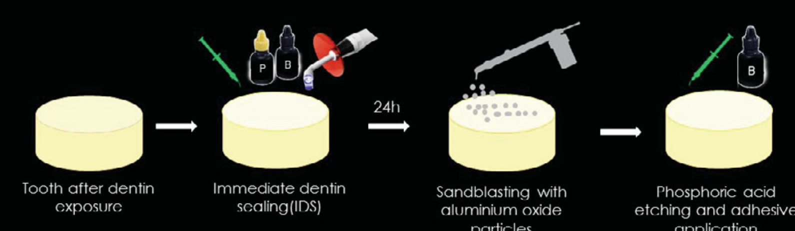

Fig. 4 – Schematic protocol of surface treatment applied to the teeth.[2] P - Primer; B - Bond / Resin adhesive

By using a calibrated cylinder, eighteen resin composite discs (Filtek™ Supreme XTE (3M ESPE)) were produced and luted to the teeth through a pre-heated composite (Z100™ MP Restorative (3M ESPE)) (Fig. 5 and 6). After 24 hours, the specimens were cut with a diamond saw with slow rotation speed in X and Y directions in order to obtain sticks with 1±0,2 mm² section. The sticks were stressed to failure in tension using a universal testing machine at a crosshead speed of 0,5 mm/min (Fig. 6). For the statistical analysis, ANOVA one-way and Tukey HSD post-hoc test (p≤0,05) were used (SPSS 20.0).

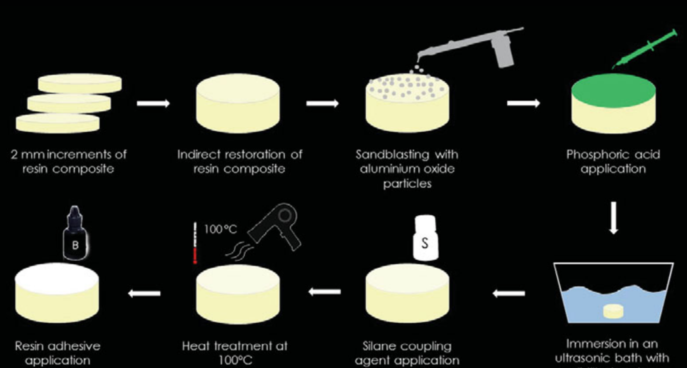

Fig. 5 – Schematic protocol of surface treatment applied to the indirect restoration of resin composite before luting procedure.[2] B – Bond / Resin adhesive; S - Silane

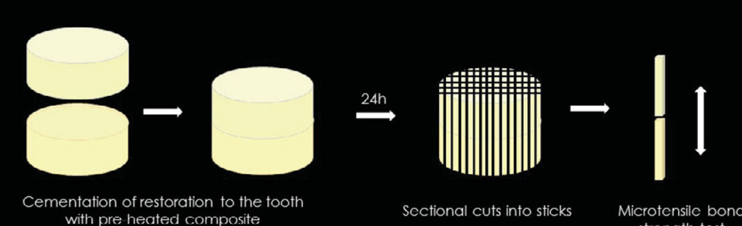

Fig. 6 – Schematic illustration concerning the cementation of indirect restoration to the teeth and the cutting of the specimens into sticks. Thereafter they were stressed to failure in tension using a universal testing machine.

RESULTS

In groups sandblasted with AOP for 4 seconds, the bond strength values vary significantly between 30μm-silica-coated group and 50μm group (53,31±23,89 MPa *versus* 39,50±21,40 MPa, *p* = ,009) (see Chart 1).
In groups sandblasted with AOP for 10 seconds, the significant differences were found between 30μm-silica-coated group and 27μm and 50μm groups (60,27±17,84 MPa *versus* 43,27±21,06 MPa and 41,19±22,17 Mpa respectively, *p* = ,000) (see Chart 1).
Bond strength values are higher in groups sandblasted for 10 seconds than the ones sandblasted for 4 seconds, regardless of particles' size or type (27μm: 43,27±21,06 MPa *versus* 42,27±20,36 MPa); (30μm-silica-coated: 60,27±17,84 MPa *versus* 53,31±23,89 MPa); (50μm: 41,19±22,17 MPa *versus* 39,50±21,40 MPa respectively), even though differences were not statistically significant (*p*>0,05) (see Chart 1).

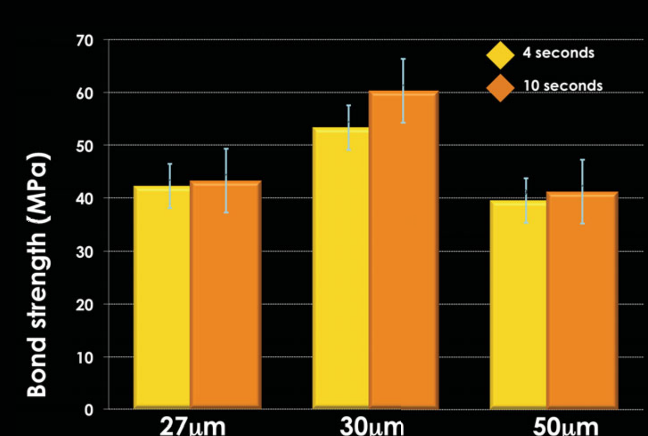

Chart 1 – Bond strength (Mpa) and standard deviations between groups with different sizes of AOP (27μm, 30μm and 50μm) and different exposure times (4 and 10 seconds). Error bars: 95% Confidence Interval

DISCUSSION

Sandblasting teeth's surface with 30μm-silica-coated AOP showed better results on bond strength possibly justified by the chemical composition of the particles.[7] Sandblasting with this type of particles increases roughness because of its impact and coats the surface with silica, allowing the connection with the silane coupling agent that will be applied to the restoration. This is a tribochemical reaction which increases the surface temperature momentarily to about 1200ºC, so particles are embedded into the surface of substrate and leave it partially coated with silica.[8] Currently, there are no studies reporting a standard time at which teeth should be blasted with abrasive microparticles after dentin sealing. However, it is clear that the average exposure times to abrasive particles vary between 4 and 10 seconds, not interfering with the adhesive process. [5,7,9]

CONCLUSION

Microtensile bond strength (μTBS) of immediate dentin sealing was influenced by different types of AOP. Different exposure times to AOP did not influence the bond strength values. In addittion to the results of this research, further studies are needed about adhesive protocols applied to indirect restorations.

CLINICAL IMPLICATIONS

Sandblasting dentin's surface with silica-coated AOP after IDS technique acquires better bond strength values than other diameters or types of AOP.

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