Original Article

Immediate Dentin Sealing versus Dentin Air Abrasion Prior to Composite Inlay luting Procedures

Dentin Sealing VS Dentin Air Abrasion

Ola Mohamed Sakr[1,2]

ABSTRACT

Objective: The aim of this in vitro study was to investigate the shear bond of Immediate Dentin Sealing versus dentin air abrasion prior to Composite luting Procedures.
Study Design: Comparative Study
Place and Duration of Study: This study was conducted at the College of Dentistry, Qassim University, Kingdom of Saudi Arabia from January 2019 till December 2020.
Materials and Methods: The study design was comprised 30 non carious molars which were divided into three equal groups. The occlusal third of the crowns were cut with a slow-speed diamond saw. The groups were as follows: group A, dentin etched with 35% phosphoric acid for 10 s directly prior to luting procedures. group B, immediate dentin sealing is done directly after cavity preparation. group C, dentin surface was abraded at 60 psi with 50-μm aluminum oxide for 30 sec directly prior to luting procedures. The resin composite inlays were adhered to different treated dentin surface using adhesive resin cement. The specimens with their adhered inlays of each group were subjected to shear bond strength testing. Analysis of the recorded shear bond strength values (Mpa) were done using one-way analysis of variance and Tukey post hoc test. Statistical analysis was performed using Graph pad Prism-6 statistics software for Windows P values ≤ 0.05 are considered to be statistically significant in all tests
Results: Mean shear bond strength values are presented in Table1: The shear bond strength values (Mpa) were analyzed using one-way analysis of variance and Tukey post hoc test and were revealed a significant influence of the main groups type tested ($p \leq 0.05$) on shear bond strength mean values (Group C > group B > group A)
Conclusion: Dentin Surface treatment by air abrasion can increase the bond strength of total-etch adhesives. Immediate dentin sealing bonding strength is less than air abraded dentin bond strength.
Key Words: Immediate dentin sealing – Air abrasion – Adhesion - Composite inlay

Citation of article: Ola Mohamed Sakr. Immediate Dentin Sealing versus Dentin Air Abrasion prior to Composite inlay luting Procedures. Med Forum 2021;32(4):8-11.

INTRODUCTION

Dentin with a higher organic content, fluid pressure from dentin tubules, and the presence of the smear layer are all factors cleared that achieving successful dentin bonding is still a major challenge [1,2].

It is already accepted that the interaction is mainly micromechanical for total-etch adhesives: hybrid layers and resin tags must be created in order to obtain a reliable dentin adhesion.

The interdiffusion of the resin into the collagen develops a hybrid layer,

Etched dentin surface should show patency of the dentinal tubules themselves to allow resin tags into dentinal tubes [3,4].

Several dentin pretreatment methods have been tentatively implemented in order to enhance the relationship between resin and dentin [5,6]. Pretreatments can be used to remove debris that can affect final bonding restoration in addition to the micromechanical adhesion requirement. [7].

Various methods are used to prepare the cavity or alter the surface of dentin, may result in good features of the smear layer [8,9].

The smear layer characteristics obtained with various dentin pretreatments can be expected to impair different bonding interactions [10, 11].

It is important to determine their effect on the attachment of various adhesives to dental hard tissues due to modern different preparation techniques used in conservative dentistry.

Air abrasion, a mechanical pretreatment method, using Aluminum oxide is an effective surface roughening

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Received: January, 2021
Accepted: March, 2021
Printed: April, 2021

technique which can improve mechanical retention [12, 13]. Air abrasion is now widely used to improve the roughness of composite or ceramic restorations and increase the bond's surface area, potentially increasing bonding values.[14, 15].

Recently, immediate dentin sealing (IDS) approach to freshly cut dentin directly after indirect restoration cavity preparation and prior to the temporalization stage was proposed as a modality of dentin surface pretreatment to improve final luting cement bonding [16, 17].

IDS Studied and greatly enhanced over the years with good findings with regard to the strength of bonds, void formations, Bacterial leakage, and post cementation hypersensitivity [18].

MATERIALS AND METHODS

The teeth used in the study were 30 caries-free human molars that were extracted for periodontal purposes. Any residual soft tissue on the tooth surfaces was removed, and the teeth were preserved at room temperature in distilled water. The teeth were mounted vertically in auto polymerizing acrylic resin (Meliodent; Bayer Dental, Newbury, UK). The occlusal enamel was removed using a slow-speed diamond saw sectioning machine under water cooling (Isomet; Buehler, Lake Bluff, IL). The teeth were randomly divided into three groups. Guided grooves were made to a depth sufficient to expose 0.5 mm dentin depth below dentinoenamel junction. Under water-cooling, the dentin surface was abraded with decreasing grits of silicon carbide (SiC) paper (from #800 to #1200) for 30 seconds per paper. A standard superficial dentin surface of about 0.5 mm from the dentinoenamel was formed, along with a standard smear layer.

Dentin surface area for testing was determined with the aid of an adhesive tape punched by a modified Ainsworth rubber-dam punch to provide 3 mm diameter holes. Finally, ten dentin samples were obtained for each group.

The treatment groups were classified as follows:

Group A: Dentin etched with 35% phosphoric acid for 10 s directly prior to luting procedures.

Group B: Immediate dentin sealing is done directly after cavity preparation.

Group C: Dentin surface abraded in a perpendicular direction at 60 psi with 50-μm aluminum oxide for 30 sec directly prior to luting procedures.

The dentin treatments were as follows:

Group A- Acid etching: 35% phosphoric acid gel (Scotchbond etchant gel, 3M, USA) was applied to the dentin surface for 10 s, followed by water rinsing for 10 s and gentle indirect air drying 5 s, followed by luting cement.

Group B-immediate dentin sealing:

Immediately following tooth preparation, the IDS was achieved. With 35% H3PO4 (Scotchbond etchant gel, 3M, USA) for 10 s, Dentin was washed with copious amount of water for 30 seconds.

Primer and adhesive resin are then applied (Optibond FL, Kerr, USA), indirect air-thinned then 10 s photopolymerized using halogen curing light (3 M ESPE, St Paul, USA) with a light output of 1000 mW / cm2.Thin layer of Glycerin gel was applied and, the surface was photopolymerized for 40 s.

Group C- Abrasion: A Microetcher ERC (Danville Engineering, San Ramon, CA) was used to abrade the dentin surface at 60 psi for 1 minute with 50-m aluminum oxide. The nozzle was held 2 mm away from the sample surface during abrasion.

II-Preparation of the composite inlays:

Resin composite discs with 4 mm thickness and 5 mm in diameter were prepared by layering 2-mm-thick per increment of a nanohybrid resin composite ((Filtek Z350XT, 3 M ESPE, St Paul, USA) into a silicone mold. Each increment was photopolymerized using halogen curing light (3 M ESPE, St Paul, USA) with a light output of 1000 mW / cm2 for 40 seconds.

Fitting side of the resin composite discs was abraded, under water cooling system, with 600-grit SiC paper to standardize the surface roughness.

All perpetrated teeth specimens were stored in water at 37°C for five days before the luting procedures.

III: Luting Procedures:

Before starting luting procedures, ultrasonic cleaning for 10 minutes, of the resin composite discs with distilled water. Discs were dried with air, and silanated with (Scotchbond, Universal Adhesive,3M ESPE) for 20 sec, air dried for 5 sec.

Dentin specimens were gently dried using cotton pellets. Air Abrasion procedure for group C: Acid etching with 35% phosphoric acid gel (Scotchbond etchant gel, 3M, USA) was applied to the dentin surface for 10 s, followed by copious water rinsing for 10 s and indirect air drying gently for 5 s. Dentin specimens were rubbed with (Scotchbond, Universal Adhesive, 3M ESPE) for 20 sec. According to the manufacturer's instructions, luting agents (RelyX, Ultimate Adhesive Resin Cement, 3M ESPE) were applied. Resin composite discs were pressed on the cement using digital pressure, which was maintained for 20 seconds per surface. Light curing was performed from the buccal, lingual, and occlusal directions. For 24 hours, cemented specimens were maintained in distilled water.

IV- Measurement of shear bond strength:

The specimens of each group were subjected to shear bond strength testing. The cemented specimens were clamped to a universal testing machine (LLOYD Universal Testing Machine LR5R series UK). Each specimen in its resin block was hold in the lower jaw of the testing machine. In the upper jaw, a knife edge chisel was attached and allowed force application on interface between the test material and the dentin

surface, the test machine was run at a constant speed of 0.5 mm/min and until the inlays separated. Shear bond strength values were registered in Newton and transformed into Mpa by dividing the maximum load by the surface area. One-way study of variance and the Tukey post hoc test were used to examine the shear bond strength values (Mpa). Statistical analysis was performed using Graph pad Prism-6 statistics software for Windows P values ≤ 0.05 are considered to be statistically significant in all tests.

RESULTS

Mean shear bond strength values are presented in Table1: The shear bond strength values (Mpa) were analyzed using one-way analysis of variance and Tukey post hoc test and were revealed a significant influence of the Main groups type tested (p≤ 0.05) on shear bond strength mean values (Group C > group B > group A).

Table No.1: Shear bond strength results (Mean ± SD) for all groups with different surface treatment of the dentin

	Shear bond strength	P value
Group A	5.06±1.1	0.0001*
Group B	6.198±1.15	0.0277*
Group C	9.15±1.5	0.0001*

different letters indicating statistical significances P≤ (0.05)

DISCUSSION

Etching of dentin with phosphoric acid showed a well-known ability to remove the smear layer. Also, there are many studies documented the effect of air abrasion on dentin surfaces (12,19).

In the current study, shear bond test was used to compare the dentin adhesion of resin cement after different approach of dentin pretreatment.

Many studies strongly suggest that the immediate dentin sealing approach has strengthened the bond strength of the final restoration. The increased bond strength has been shown with either both total-etch or self-etch dentin bonding agents (20-22).

The results of the present study showed a significant improvement of the final restoration bond strength of immediate dentin sealed group .These findings may be explained that the bonding to freshly cut dentin without any temporary cement remnants which may impairment with bond strength .Many studies confirmed these findings as a contaminant-free substrate, such as that obtained at the time of preparation when dentin is freshly cut and clean, is a primary prerequisite for optimum bonding(23,24).

Many authors suggested the immediate dentin sealing as a strategic approach for sealing the dentinal tubules. The application of dentin bonding agent to freshly prepared dentin lead to influence of the retention and placement of the indirect inlay restoration (25).

On the other hand, current study results showed that air abraded dentin pretreatment showed highest bond strength.

Air abrasion treatment may create a rough dentin surface, retaining the original diameter of the orifices of the dentin tubule and consequently the intertubular dentin quantity (13).

According to the literature, the increased adhesive strength reported with abraded specimens could have been achieved by increasing the adhesive system's wettability and micromechanical retention. Air abrasion help in removal of the remnants of the temporary cements and increase the dentin surface roughness (26).

Dentin copious rinsing with water and acid etching could remove Aluminum Oxide powder particles, improving adhesive penetration to dentin which could explain the higher bond strength of abraded dentin surfaces (27).

More over some authors tested different dentin cleansing treatments on the bond strength of composite resin restoration, and they found that the highest bond strength is achieved with the air abrasion dentin cleaning technique (28).

CONCLUSION

Dentin Surface treatment by air abrasion can increase the bond strength of total-etch adhesives.

Immediate dentin sealing bonding strength is less than air abraded dentin bond strength.

Author's Contribution:

Concept & Design of Study:	Ola Mohamed Sakr
Drafting:	Ola Mohamed Sakr
Data Analysis:	Ola Mohamed Sakr
Revisiting Critically:	Ola Mohamed Sakr
Final Approval of version:	Ola Mohamed Sakr

Conflict of Interest: The study has no conflict of interest to declare by any author.

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