



Evaluation the effect of eugenol containing temporary fillings on shear bond strength of composite restoration

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Abstract

The purpose of this in-vitro study was to evaluate the effect of eugenol-containing temporary fillings on shear bond strength of composite to dentin and determine the efficiency of dual bonding technique in improving the bond strength using Adper Single Bond 2 adhesive with 3M composite. Thirty sound human upper first premolars were used in this study. The occlusal surface of each tooth was ground to expose superficial dentin layer, and then dentin bonding agent was directly applied onto freshly prepared dentin together with cylinder of 3M composite and light cured (group I, control group). Dentin surface pre-treated with zinc oxide eugenol temporary filling, then dentin bonding agent together with a cylinder of 3M composite (group II, single bonding technique). While in group III dentin bonding agent was applied first on the dentin surface and light cured, then zinc oxide eugenol temporary filling was added for one week, after removal of temporary filling dentin bonding agent together with 3M composite was applied and light cured (dual bonding technique). The shear bond strength of all the specimens was determined using Zwick universal testing machine. The results showed that all temporary filling treated groups (II and III) had lower mean shear bond strength compared to control group (group I), whereas compared to single bonding technique, dual bonding technique significantly increased the shear bond strength.

Keywords: Dentin bonding agent, bonding technique, adhesive resin restoration.

Introduction

Tooth colored restorations are being inserted even in the posterior region; this is essentially due to the rapid development of adhesive dentistry in recent years. One major advance has been the formation of a hybrid layer that composed of collagen and resin, which has been accepted as greatly contributing to the increased bond strength between dentin and resin⁽¹⁾.

Shear and tensile tests have been widely used to increase resin-dentin bond strength in dental research for

many years⁽²⁾. But because of the complex chemical composition of the adhesive and varying structure of dentin, bond strength is affected by various factors such as contamination with blood, saliva, hand piece lubricant, liners, bases, and especially temporary materials⁽³⁾.

Temporary fillings applications on dentin surface are necessary in routine dental treatment procedures (e.g., vital pulp therapy, endodontic therapy, etc.) to avoid pain and infection and to restore function and esthetic; however,

if these materials remain on dental surface, they may be adhesive inhibiting factors during the final restoration with composite fillings⁽⁴⁾. Various materials had been used as temporary restorations. Zinc oxide-eugenol (ZOE) mixtures are presumably the most commonly used temporary filling materials in dentistry because it is cheap and easily removed. Furthermore, from biological point of view, most authors consider zinc-oxide eugenol one of the safest filling materials and having a sedative effect on sensitive teeth⁽⁵⁾. On the other hand eugenol has been suggested as having the most deleterious effect, because it is known to be a radical scavenger which inhibits the polymerization of resin materials⁽⁶⁾.

Therefore remnants of the temporary filling materials that adhere to the dentin surface have to be removed prior to the adhesive restorative procedure⁽⁷⁾. New study had been shown that dual application of dentin bonding agent with intermediate application of temporary filling materials improved the bond strength of adhesive resin on dentin surface⁽⁸⁾.

Materials and Methods

Thirty sound human upper first premolars recently extracted for orthodontic purposes of comparable size and shapes were used in this study. The teeth were polished by pumice and rubber cup with contra-angle handpiece, and then were stored in normal saline solution at 37°C until sample preparation⁽⁹⁾.

The roots of the teeth were notched on the proximal surfaces for anchorage, and then were embedded in individual cylindrical acrylic block to about 1-2 mm below cement-enamel junction. A standardized preparation of the occlusal dentin surfaces of the teeth

were obtained by using straight handpiece adapted to dental surveyor in a way that the long axis of the bur was kept parallel to that of the tooth. The crowns of the teeth were ground above the level of pulp chamber and below the occluso-enamel fissure to expose superficial layer of dentin.

The specimens were divided into 3 groups, of ten for each:

Group I (control group): Adper Single Bond 2 dentin bonding agent was directly applied onto freshly prepared dentin together with a cylinder of 3M composite and then light cured.

Group II (single bonding technique): Dentin surface pre-treated with zinc-oxide eugenol temporary filling, and then dentin bonding agent together with a cylinder of 3M composite was cured on dentin surface.

Group III (dual bonding technique): Dentin bonding agent was applied first on dentin surface and light cured, then zinc-oxide eugenol temporary filling was added for one week. After removal of temporary filling, dentin bonding agent was applied again onto dentin surface together with a cylinder of 3M composite and light cured.

A paper puncture was used to make a hole of 3 mm in diameter in pieces of sticker paper, and then the sticker paper was placed in the center of the occlusal surface of each tooth.

Adper Single Bond 2 adhesive was used with all samples according to manufacturer's instruction. This system includes 3M ESPE Scotchbond Etchant which contains 37% phosphoric acid. The Scotchbond etchant was applied on the exposed dentin surface for 15 seconds then rinsed for 10 seconds and blotted excess water using a cotton pellet. The

surface should appear glistening without pooling of water. Immediately after blotting, 2-3 consecutive coats of adhesive was applied to etchant dentin for 15 seconds with gentle agitation using a fully saturated applicator then gently air thin for 5 seconds to evaporate solvents and light cured for 10 seconds.

A clear translucent standardized plastic straw with an internal diameter of 3 mm (7.065mm² surface areas) was sectioned with sharp scissor in a perpendicular way to its long axis to form cylinders of 6 mm in height.

To achieve complete curing of the restorative material, each cylinder was loaded to its half height with 3M ESPE composite resin, and then the cylinder was positioned vertically onto the bonding site through the hole and was light cured. The second layer was applied into the cylinder to its full height and then light cured. For the specimens that were planned to receive temporary fillings (group II and III), a suitable copper ring was selected to fit circumferentially around each tooth extended approximately 4-5 mm over the occlusal surface.

The exposed occlusal surface was washed with air distilled water spray and then air dried, for single bonding technique (group II) zinc oxide eugenol temporary filling was placed over the occlusal surface by cement spatula and well adapted to copper ring walls and margins, while for dual bonding technique (group III), a layer of dentin bonding agent was applied first over the dentin, and then zinc oxide eugenol temporary filling.

All specimens of group II and group III were aged for one week in order to see the effect of eugenol release. Aging was done by placing the specimens in containers of normal saline solution stored in an incubator at 37°C⁽⁹⁾.

The temporary filling was removed as one piece by loosening and removal of the copper ring; any remnants of temporary filling were removed by dental probe⁽¹⁰⁾.

Shear bond strength was tested with Zwick universal testing machine using a stainless steel chiseled-shaped rod with a cross head speed of 5 mm/min. The tooth with its acrylic block was held in lower jaw of the machine in horizontal position, and the long axis of the chisel rod was perpendicular to the long axis of the restorative material cylinder. The chisel rod was positioned at the interface between the tooth surface and the restorative material cylinder and the specimens were stressed until failure. The force was recorded in Newton's which has been divided by the surface area (7.065 mm²) to obtain the shear bond strength calculated in Mega Pascal. The data obtained were statistically analyzed using student t-test.

Results

The descriptive statistics (mean and standard deviation with minimum and maximum values) of the shear bond strength of each group are presented in table I.

The results showed that group I has the highest mean shear bond strength, followed by group III and then group II.

Statistical analysis of data using a student t-test revealed that there is a statistically highly significant difference in comparing group I versus group II and group III, also there is highly significant difference between group II and group III.

Discussion

Light microscope observation studies confirmed the presence of

remaining cements on the dentin surfaces even when the cement macroscopically was completely removed with dental probe ⁽¹¹⁾. The temporary filling treated groups (group II and III) had significant lower mean shear bond strength than the control group (group I). To explain these results:

- A. For the single bonding technique group: after acid etching if temporary filling material remained on dentin, neither hybrid layer nor resin tags were formed. These results strongly indicate that temporary filling remnants inhibit the infiltration of adhesive substances into inter-tubular dentin and dentinal tubules which results in reduced bond strength of composite resin to dentin.
- B. For dual-bonding technique group: The cause of lower shear bond strength is the remnants of temporary filling materials on the resin impregnated surface of dentin, these remnants will interfere with copolymerization between resin and the bonding agent producing a weak layer in between even if resin is firmly bonded in other zones, result in reduced bond strength of resin to resin and resin to dentin.

The shear bond strength of dual bonding technique group is higher than that of single bonding technique group because hybrid layer and resin tags were formed between bonding agent and dentin surfaces.

Conclusion

When it is necessary to temporize the dentin surfaces with temporary filling before adhesive resin restoration, it is preferable to use dual

bonding technique to minimize the effect of temporary filling on dentin surfaces.

References

- 1- Nakabayashi N, Ashizawa M, Nakamura M. identification of a resin dentin hybrid layer in vital human dentin created in-vivo: durable bonding to vital dentin. *Quintessence Int.* 1992; 23: 135-141.
- 2- Gwinnett AJ, Kance JA. Micromorphology of bonded dentin interface and its relation to bond strength. *Am J Dent* 1992; 5: 73-77.
- 3- Xie J, Power JM, McGuckin RS. In-vitro bond strength of two adhesives to enamel and dentin under normal and contaminated conditions. *Dental materials* 1993; 9: 295-299.
- 4- Watanabe EK, Yamashita A, Imai M, Yatani H, Suzuki K. Temporary cement remnants as an adhesion inhibiting factor in the interface between resin cements and bovine dentin. *Internat J Prosthet* 1997; 10(5): 440-452.
- 5- Cotton WR, Siegel RL. Human pulpal response to citric acid cavity cleanser. *J Am Dent Assoc* 1978; 96: 639-644.
- 6- Millstein PL, Nathanson D. Effect of eugenol on cured composite resin. *J Prosthet Dent* 1983; 50: 211-215.
- 7- Bertschinger C, Paul SJ, Luthy H, Scharer P. Dual application of dentin bonding agents: Effect on bond strength. *Am J Dent* 1996; 19: 115-119.
- 8- Paul SJ, Scharer P. The dual bonding technique: A modified method to improve adhesive luting procedures. *Int J Periodont Res Dent* 1997 a; 17: 537-545.
- 9- Ganss C, Jung M. Effect of eugenol containing temporary cements on bond strength of composite to dentin. *Oper Dent* 1998; 23: 55-62.
- 10- Terata R. Characterization of enamel and dentin surfaces after removal of temporary cement-study on removal of temporary cement. *Dent Material* 1993; 12: 18-28.
- 11- Mahmood FJ. Evaluation of the effect of eugenol-containing and eugenol-free temporary fillings on shear bond strength of composite restoration to dentin using two methods of bonding application (in-vitro study). Master thesis, College of Dentistry, Baghdad University, 2002.

Table (I): Descriptive statistics of shear bond strength (in Mega Pascal) for all groups.

Groups	Mean	Standard Deviation	Min. Value	Max. Value
I	11.11	1.389	9.3	13.5
II	6.7	1.018	5.2	8.4
III	8.02	0.941	6.8	9.3

Table (II): Student t-test between control group and other groups.

Groups	t-value	Degree of freedom	Significance (confidence level 0.05)
I versus II	7	18	Highly Significant
I versus III	5.83	18	Highly Significant
II versus III	3.014	18	Highly Significant