Effects of dycal on shear bond strength of 3 resin cements

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Abstract

It has been proposed that calcium hydroxide weaken dentin. Calcium hydroxide is the main composition of Dycal which has been using for temporary cementation. Objective: The purpose of this study was to investigate the effect of Dycal, which is used as a temporary cementation on the shear bond strength of three different resin cements. Methods: The occlusal dentin surface of ninety extracted human third molar teeth were exposed by cutting with an Isomet saw and then randomly divided into 3 groups (n=30). The first and second group were covered with Dycal for 7 and 28 days and the third group was left uncovered and served as the control group. Each group was divided into 3 subgroups for each resin cement. After reaching the cover time Dycal was removed and dentin was cleaned with pumice-water slurry. Each of resin cement systems (self-adhesive;RelyX U100, self-etch;PanaviaF2, total etch;Superbond C&B) was applied according to manufacturer's instructions followed by placement of resin composite rod. All bonded specimen were stored in distilled water at 37°C for 24 hours. The specimens were then subjected to the shear bond strength test by universal testing machine. The fracture surfaces were examined under stereomicroscope at 40x magnification. Results: The data were statistically analyzed by 2 way ANOVA. For RelyX U100 resin cements, there were significant differences between the control group and the Dycal covering dentin group, the mean shear bond strength of Dycal covering dentin at 28 days and 7 days was lower than control group whereas there was no significantly different between 28 days and 7 days. It was found that no significant differences in PanaviaF 2 and Superbond C&B groups at any duration of treating dentin with Dycal. The mode of failure was mostly adhesive in nature. Conclusion: Dycal reduced bond strength of dentin to RelyX U100 (self-adhesive) resin cement but does not affect bond strength of dentine to PanaviaF2 (self-etch) and SuperbondC&B (total etch) resin cement.

Keywords: Dycal, Shear bond strength, Resin cement

Introduction

The longevity of fixed restorations is critically linked to the retention and marginal fit, which are affected by many factors but all are related to properties of the luting cement [1]. Resin cements have the ability to bond to both tooth structure and restoration. This integration produces reinforcement of both structures and reduces microleakage at the restoration-tooth interface, postoperative sensitivity, marginal staining and recurrent caries [2]. Resin-based adhesive luting materials are widely used for the fixation of indirect restorations which are inlays and onlays, crowns, posts and veneers [3]. Indirect bonded restorations provide better proximal contacts, occlusal morphology and marginal accuracy, with reduced shrinkage of the composite cement, compared with direct restorations. However, as indirect procedures require multiple appointments, the use of temporary restorations and cements becomes a factor for the protection of the pulp, amongst other factors before the patient’s cosmetic and functional needs are fully restored [4].

Zinc oxide-eugenol temporary luting cements are commonly used because of their sedative effect on sensitive teeth. Like other phenolic compounds, eugenol is a radical scavenger, which inhibits the polymerization of resin materials [5]. Eugenol temporary cement adversely affect the bond strength of resin cement diminish the bond strength of resin cement to dentin [6]. An alternative for temporary cementation is the use of Dycal which is one form of calcium hydroxide. Dycal is a rigid, self-setting, radio-opaque calcium hydroxide composition. It does not inhibit the polymerization of acrylic and composite restorations. Base paste consists of disalicylate ester of 1, 3, butylene glycol, calcium phosphate, calcium tungstate, zinc oxide and iron oxide. Catalyst paste consists of calcium hydroxide, N-ethyl-o/p-toluene sulfonamide, zinc oxide, titanium dioxide, zinc stearate and iron oxide pigments.

It has been proposed that teeth are weakened by calcium hydroxide. This suspicion was supported by histological demonstration of circumpulpal dentin changes after treatment with calcium hydroxide. The
flexural strength of dentin depends on an intimate link between its two main components, the hydroxyl apatite crystals and the collagenous network. Part of the organic matrix is composed of acid proteins and proteoglycans containing phosphate and carboxylate groups. These substances may act as bonding agents between the collagen network and hydroxyl apatite crystals [7, 8]. Due to its strong alkalinity, calcium hydroxide may denature the carboxylate and phosphate groups leading to a collapse in the dentin structure.[9]

There are many studies on the effects of calcium hydroxide to physical properties of dentin. In 1991 Machi et al. applied calcium hydroxide 1 millimeter thick (Dycal advance formula II, Dentsply, Caulk, USA) on dentin bar for 48 hours and then prepare photo cured posterior composite resin onto tooth surface. After 7 days storage in water at 37°C, the specimen were submitted to tension with 4 Newton per minute loading until detachment. Calcium hydroxide appeared not to interfere with the adhesive system and spontaneous detachment was not seen.[10] In 1997 S.J. Paul et al tested calcium hydroxide (Self-hardening calcium hydroxide, Kerr Life®) on teeth for 24 hours at 37°C then cleaned teeth with cotton roll and polished with pumice powder for 10 seconds. The dentin bonding agent was applied to the dentinal surface then the luting composite was applied respectively. The specimens were subjected to the load from the Instron testing machine until a fracture occurred. Result was calcium hydroxide effect by reducing shear bond strength [11].

The pH of calcium hydroxide is achieved by the releasing of hydroxyl ion (OH). The hydroxyl ions that are released in the process effects an alkalinization of the surrounding environment with pH shift of approximately 12-13. The pH of dycal is approximately 11.8-12. There is not much difference of dycal and calcium hydroxide pH so the weakening dentin effect from strong alkaline properties should take place in dycal treated dentin too [12].

Previous experiment used composite bonding with total etch systems for testing effects of calcium hydroxide on dentin. Nowadays self-etching adhesive systems and self adhesive systems have been increasingly used in recent clinical practice. They simplify the adhesive procedure by eliminating the need for rinsing the dentine surface after etching. For self-etching, the primers contain acidic polymerizable monomers which dissolve or incorporate the smear layer into the bonding interface [4]. Self adhesive sytems used its multifunctional monomers with phosphoric acid groups simultaneously demineralize and infiltrate enamel and dentin [13]. The different dentin treated procedure of self etch, self adhesive and total etch resin cements which could affect the shear bond strength of treated dentin by temporary cementation with Dycal.

Materials and Methods

Substrate

Ninety human permanent third molar were used in this investigation. All teeth were free from caries lesion, enamel hypoplasia, hypocalcification and restoration. Soft tissues were mechanically removed. The teeth were stored in 0.5% chloramines-T trihydrate bacteriostatic/bacteriocidal solution for a maximum of one week at 20°C and used within six months of extraction.

Specimen preparation for shear bond strength testing

Teeth were embedded in dental die stone. The occlusal dentin surfaces were exposed by cutting with an Isomet saw (ISOMET 1000 series 15 Buehler, USA) for the bonding procedure. To created a standardized smear layer, the wet 600-grit silicon carbon paper was used for polishing the exposed dentin. The teeth were rinsed with water to remove debris and then were randomly divided into 3 groups (n=30). The first and second group were covered with Dycal for 7 and 28 days (Figure 1(B)) and the third group was left uncovered and served as the control group (Figure 1(A)).

Bonding procedure

Dycal was removed and dentin was cleaned with pumice-water slurry (In Dycal treated group) and dentin surface of the specimens were cleaned with water and dried with a short air blast (oil and water-free air) in order not to overdry the dentin surface. A thin non-reactive adhesive tape with 4 millimeters diameter hole was attached onto the dentin surface.

RelyX U100

RelyX U100 cement catalyst and base were dispensed from the double-push syringe on mixing pad and mixed in 1:1 ratio for 20 seconds. The cement was applied on the dentin and then the composite rod was bonded. Excess cement was removed after brief light exposure for 2 seconds. The adhesive cement was cured at marginal area by using a halogen light curing unit for 20 seconds.

PanaviaF2

ED PrimersII liquid A and B were mixed in a 1:1 ratio for 5 seconds. The mixed primer was then applied onto dentin surface and left for 60 seconds. Excess primer mixture was subsequently dried with a short air blast with oil and water free air. PanaviaF2 cement paste A and paste B were dispensed from syringe and mixed in 1:1 ratio for 20 seconds. PanaviaF2 cement was then applied on dentin surface and then composite rod was bonded. Excess cement was removed. The adhesive cement was cured at marginal area by using a halogen light curing unit for 20 seconds.
Superbond C&B

The green activator was applied using a sponge pledget on dentin surface for 10 seconds, rinsed for 10 seconds with water and softly dried with oil and water-free air. 4 drops of monomer were mixed with 1 drop of catalyst V (activated liquid). The radiopaque polymer was added to the activated liquid using the supplied small measuring spoon. Stir lightly with a brush. Apply the mixture on dentin surfaces and then composite rod was fixed. Removed the excess cement.

![Figure 1: Specimen preparation for shear strength testing A) Exposed dentin B) Covered with Dycal C) Resin composite placement](image)

Shear bond strength measurement

After 24 hours storage in 100% humidity at 37°C, the test specimens were loaded parallel to the adhesive interface formed between the dentin and the composite rod. The bond strength was tested at a crosshead speed of 0.5 mm/min using a universal testing machine (Instron, Model 8872, UK). The load at failure was recorded and shear strength value was calculated. The de-bonded dentin surfaces were examined under a stereomicroscope at 40 magnifications.

The materials used in this study were three resin cements (RelyX U100, PanaviaF2 and Superbond C&B (Table 1).

<table>
<thead>
<tr>
<th>Cement</th>
<th>Manufacturer</th>
<th>Curing mode</th>
<th>System</th>
</tr>
</thead>
<tbody>
<tr>
<td>RelyX U100</td>
<td>3M ESPE</td>
<td>dual-polymerizing universal resin cement</td>
<td>Self adhesive</td>
</tr>
<tr>
<td>Panavia F2</td>
<td>Kuraray, Osaka, Japan</td>
<td>dual-polymerizing resin cement</td>
<td>Self etch</td>
</tr>
<tr>
<td>Superbond C&amp;B</td>
<td>Sun-medical, Japan</td>
<td>self-cure dental adhesive resin cement based on MMA</td>
<td>Total etch</td>
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</table>

Results and Discussion

The means shear bond strength and standard deviation for each group is shown in Figure 2.

Two way ANOVA showed that there was no interaction between time and type of resin cement. There were significant differences in shear bond strength test among the different time (0 day, 7 days and 28 days) in RelyX U100 (p<0.05) by means of 0 day versus 7 days and 0 day versus 28 days were significantly different but between 7 days and 28 days was not significantly different. There were no significantly different among the different time in PanaviaF2 group and Superbond C&B group (p>0.05).

Superbond C&B attained the highest mean shear bond strength which was significantly greater than other resin cements tested and the shear bond strength of PanaviaF2 was significant higher than RelyX U100. The two way ANOVA showed that there was a significant difference among the bond strengths (p<0.05) between three adhesive resin cements. The null hypothesis that there would be no difference in the shear bond strengths when using the different resin cement was rejected.

The stereomicroscopic evaluation showed that failure was adhesive in all groups.

Dycal is composed of calcium hydroxide and salicylic acid. It has been proposed that calcium hydroxide can denature the carboxylate and phosphate groups leading to a collapse in the dentin structure [9]. This phenomena will affect the penetration of bonding agent to form the hybrid layer and result in decreasing the bond strength of the restoration and the dentin.

From the result of this study, it revealed that the shear bond strength in the group of Superbond C&B (total etch resin cement) is significantly higher than does the PanaviaF2 (self etch resin cement) and the RelyX U100 (self adhesive resin cement) groups. It could be explained that, a combination of 10% citric acid and 3% ferric chloride used as an efficient conditioner for this adhesive resin cement affected this result [1]. This conditioner was applied on the dentin surface for 10 seconds and rinse off with water to remove the smear layer on both enamel and dentin. Due
Conclusions

In RelyX U100, Dycal affects shear bond strength. Longer time of treated dentin with Dycal did not increase effect on shear bond strength. After temporary cementation with Dycal, Superbond C&B and Panavia F 2 are the material of choice for permanent cementation. However, Superbond C&B has the highest bond strength in each duration of treated dentin with Dycal.

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References


