Effect of triple antibiotic paste and calcium hydroxide as intracanal medicaments on bond strength of composite to dentin

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Abstract

Objective: Considering the use of triple antibiotic paste (TAP) for root canal treatment of open apex teeth, this study aimed to assess the effect of TAP and calcium hydroxide (CH) on bond strength of composite to dentin.

Methods: This in-vitro study was conducted on 32 extracted human premolar teeth. After disinfection with 2% thymol solution, the enamel on the buccal surface of specimens was removed to expose a smooth dentin surface parallel to the long axis of the teeth with approximately 19mm^2 surface areas. Specimens were divided into three groups of 11, 10 and 11 specimens. In group one, TAP, in group two CH and in group three, saline solution were applied to dentin surfaces for 14 days. After removal of medicaments, composite cylinders were bonded to the dentin surfaces using a bonding agent. Shear bond strength was measured in an Instron machine at a crosshead speed of 1mm/min. Data were analyzed using one-way ANOVA.

Results: The highest mean bond strength belonged to the control group (14.4760 MPa) and the lowest belonged to the TAP group (11.5808 MPa). The mean bond strength in CH group was less than that of the control and higher than that of the TAP group (11.7834 MPa). However, the difference among the three groups was not statistically significant (p=0.327).

Conclusion: Use of medicaments such as CH and TAP has no effect on bond strength of composite to dentin.

Key words: Calcium hydroxide, Composite, Shear bond strength, Triple antibiotic paste.

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Introduction:

A common method for restoration of endodontically treated teeth is use of tooth-colored restorative materials and translucent or non-rigid intracanal posts. These posts are made of glass and translucent or white quartz fibers. In addition to their esthetic appearance, they enable the use of adhesive cements in the root canal system, which reinforce the roots of endodontically treated teeth (1). The structure and chemical formulation of dentin, in contrast to enamel, do not provide micromechanical retention for resin bond to dentin (as in etched enamel). Several factors can effectively modify the structure of dentin such as the use of irrigating solutions, intracanal medicaments and endodontic sealers. Calcium hydroxide is the

most acceptable antimicrobial medicament used in the root canals. But, some studies have raised concerns regarding its disinfectant effect on dentinal tubules (2). Use of TAP has been recently suggested in endodontics and for pulp regeneration treatments. In premature traumatized teeth, use of TAP is part of the routine treatment protocol. This paste can disinfect the root canal system and enable tissue regeneration (3-5).

CH is increasingly used in apexification treatments and application of TAP is a new approach for root canal treatment of open apex teeth (6).However, during the delivery of these medicaments into the root canal system, they may be accidentally applied to the dentinal walls of the access cavity and if not cleaned, the bond strength of tooth-colored restorations to dentin may be compromised. Thus, this study aimed to assess the effect of TAP and CH as intracanal medicaments on bond strength of composite to dentin.

Methods:

Human premolar teeth extracted within the past 6 months were used in this in vitro study. Thirty-two sound premolar teeth were selected using convenience sampling. The teeth were cleaned with water and brush and immersed in 2% thymol solution (Merck, Darmstadt, Germany) for disinfection for 5 days and remained in saline solution until the experiment. To mount specimens, cylindrical molds filled with polymerizing acrylic resin were used. Specimens were mounted in these molds to the level of the cementoenamel junction. To prevent thermal damage to teeth due to the polymerization of acrylic resin, the molds were placed in distilled water after slight polymerization of resin. Crown surfaces were then cleaned and buccal enamel was removed using 008 fissure bur and high speed hand piece (NSK, Japan) under water spray to expose a smooth dentin surface parallel to the long axis of the tooth with 19mm^2 surface area. Dentin surfaces were used in this study because during the delivery of the intracanal medicaments, they may be accidentally applied to dentinal walls of the access cavity and if not cleaned, bond strength of coronal restoration may be compromised. The specimens were randomly divided into three groups of 10, 11 and 11 specimens. In group one, TAP was applied to the exposed dentin surfaces. In group two, CH (Merck, Darmstadt, Germany) was applied to exposed dentin. In group three, saline solution was applied to exposed dentin. In group one, TAP was prepared by mixing equal ratios of 100mg minocycline (Teofarma, Varna, Italy), 500mg ciprofloxacin (Alborz Darou, Tehran, Iran) and 250 mg metronidazole (Pars Darou, Tehran, Iran) with distilled water. The mixture was applied to exposed dentin surfaces and a moist cotton pellet was placed over it. To prevent surface contamination, a plastic wrap was placed over it.

In group two, CH was used and in group three, dentin surface was washed with saline solution only. The specimens were then incubated at 37°C for 14 days under moisture. The specimens were controlled during this time.

After 14 days, dentin surfaces were washed with distilled water and all specimens were first etched with 35% phosphoric acid (Ultra etch, South Jordan, USA) for 15 seconds according to the manufacturer's instructions and were then rinsed with water for 15 seconds. A cotton pellet was then placed on dentin surface for 5 seconds and the area was gently air-dried with air spray for 5 seconds in such way that dentin surface remained moist. Next, a layer of Single Bond (3M ESPE, NewYork, USA) was applied to the surface with gentle movement of an applicator and completely and gentlyair-dried with oil-free air spray. Light curing was done for 20 seconds. After applying the bonding agent to dentin surfaces, transparent plastic molds with an internal diameter of 2mm and height of 2mm

were used to apply composite. Plastic molds were filled with A2 shade of Z100 composite (3M ESPE, USA) and the composite surface inside the mold was formed convex. Thus, in contact with tooth, first the center point and then the surrounding areas were contacted. This was done to prevent gap formation at the bonding area. Plastic mold was filled and placed on the prepared surface. Using a light-curing unit (Turbo LED, Atlanta, USA), visible light was irradiated to 5 points (one point at the center and 4 surrounding points) and each point was light cured for 20 seconds (a total of 100 seconds) to polymerize composite. The transparent mold and excess composite were removed using a scalpel. Then, specimens were stored in saline solution for 48 hours until shear bond strength testing.

Shear bond strength was tested in an Instron machine (K-21046 Dartec, Guisborough, UK) with 5000N capacity with minimum crosshead speed of 1 and maximum of 10 mm/min. Shear load was applied by a fixed blade with 0.5 mm thickness vertically at a crosshead speed of 1mm/min to the nearest point to the tooth-restoration interface. Load at fracture was recorded by device monitor. By dividing the load in N by the interface surface area in mm^2, the shear bond strength in MPa was calculated. Data were analyzed using SPSS version 15 and one-way ANOVA. $p<0.05$ was considered significant.

Results:

Based on the results, the highest mean bond strength belonged to group three (control group, saline) (14.4760 MPa). The lowest mean bond strength belonged to group two (TAP) (11.5808 MPa). The mean bond strength in CH group was 11.7834 MPa.

The mean and standard deviation (SD) of bond strength in the three groups are shown in Table 1 and Diagram 1. One-way ANOVA showed no significant difference among the three groups in this regard ($p=0.327$)(Tables 2 and 3).

Table 1- Bond strength of composite to dentin following exposure of dentin to CH, TAP and saline

Descriptive

					95% Confidence Interval for Mean			
Force_n	**N**	**Mean**	**Std. Deviation**	**Std. Error**	**Lower Bound**	**Upper Bound**	**Minimum**	**Maximum**
Ca_Hydro	10	11.7834	3.11314	.98446	9.5564	14.0104	6.37	17.52
Antibiotic	11	11.5808	5.65638	1.70546	7.7808	15.3808	4.78	22.29
Saline	11	14.4760	5.49096	1.65559	10.7871	18.1648	6.37	25.48
Total	32	12.6393	4.96905	.87841	10.8478	14.4309	4.78	25.48

Table 2- Test of homogeneity of variances

Force_n			
Levene Statistic	df1	df2	Sig.
1.770	2	29	.188

Table 3- ANOVA

Force_n	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	56.757	2	28.379	1.161	.327
Within Groups	708.677	29	24.437		
Total	765.434	31			

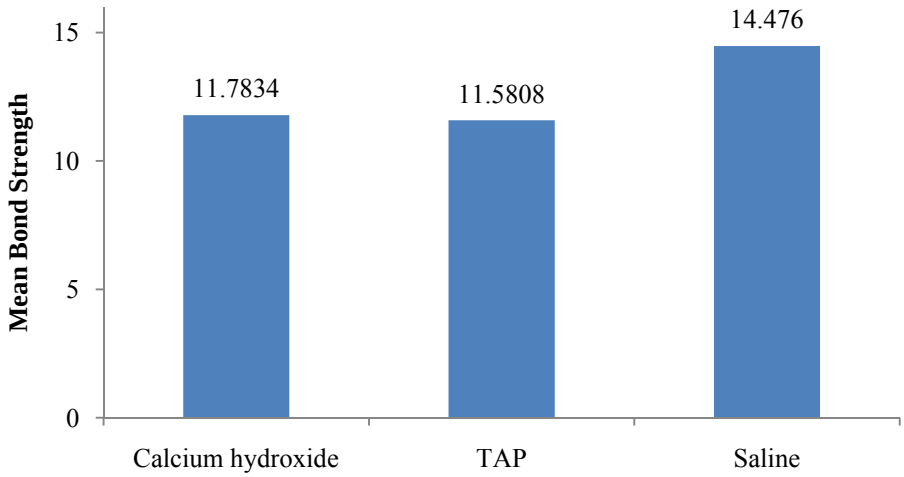

Diagram 1- Comparison of the mean bond strength of composite to dentin following its exposure to CH, TAP and saline

Discussion:

Restorative dentistry and endodontics aim to preserve tooth structure with optimal function and esthetics. Endodontically treated teeth are structurally different from vital, non-restored teeth and require specific restorative treatments (1). Loss of tooth structure due to caries, previous treatments or endodontic therapy significantly compromise non-vital teeth (1). Tooth-colored restorations in endodontically treated teeth are used to preserve the remaining tooth structure, maintain the integrity of the root canal system, replace the lost tooth structure and restore esthetics (1). Bond strength of bonding systems depends on the bond to wet, smooth and porous dentin surfaces. If resins cannot adequately bond to the collagen network in demineralized dentin, bond strength decreases (7). Factors such as the use of irrigating solutions, intracanal medicaments and endodontic sealers can also affect the bond strength (3, 8, 9, 10). Thus, we aimed to assess the effect of CH and TAP as intracanal medicaments on bond strength of composite to dentin. Z100 composite was used in this study, which is commonly used for restorative treatments. The medicaments were placed in contact with dentin for 10 days as in similar previous studies (1). No similar study was found on the effect of TAP on bond strength. The results of our study showed that the mean bond strength of composite to dentin was higher in control compared to CH and TAP groups and the mean bond strength of CH was higher than that of TAP. The lowest bond strength belonged to the TAP group. However, these differences were not significant. Based on the results, CH had no significant effect on bond strength but small reduction in bond strength in this group was due to the penetration of calcium and hydroxyl ions into dentinal tubules and preventing resin penetration into tubules (11). In a study by Windley *et al*. (2003) no significant difference was noted in Single Bond groups with and without CH in short-term. But, in long-term, Single Bond with CH provided bond strength significantly higher than that of Single Bond without CH. The reason was change of collagen matrix in long-term and better resin-dentin bond.

This result showed that in short-term, CH had a significant effect on bond strength of dentin to ethanol or acetone in adhesive resin based systems (12). The results of Windley are somehow in accord with our findings. Samanthini *et al*. (2011) found similar results. They evaluated the interference of endodontic materials such as sealers with composite resin restorative materials and showed no significant difference in tensile bond strength of control and test groups. Permanent cements and root canal sealers such as eugenol-containing and eugenol-free sealers as well as CH had no effect on composite bond to dentin; unless in cases where the remaining material on dentin surface could not be removed by etchant and prevented resin penetration into dentinal tubules (7). The results of the above-mentioned two studies are somehow in accord with our findings because our study showed a slight reduction in bond strength following the use of CH. Feiz *et al.*, in their study in 2009 reported that use of CH decreased composite bond to dentin due to residual CH on dentinal walls (13). With regard to TAP, no previous study has assessed its effect on bond strength of restorative materials to dentin. Our study showed that use of TAP did not have a significant effect on bond strength of composite to dentin; although the mean bond strength in TAP group was the lowest compared to the other two groups. Such slight reduction in bond strength may be attributed to presence of minocycline in the formulation of TAP because the tetracycline family antibiotics bond to calcium in dentin and form a compound that prevents penetration of monomer into dentinal tubules and consequently the bond strength of tooth-colored restorative materials to dentin decreases (14). Difficulty in finding similar samples was among the limitations of this study.

Conclusion:

The results showed that use of medicaments such as CH and TAP had no significant effect on bond strength of composite to dentin. However, dentin exposed to these medicaments must be preferably cleaned carefully before restoration. Drawing a definite conclusion in this regard requires future studies with larger sample sizes.

References:

1. Didier Dietschi, Serge Bouillaguet, Avishai Sadan: Restoration of the endodontically treated tooth.In:Cohen S, Hargreaves NM. Pathways of the pulp. 10th Ed. St. Louis: The C. V. Mosby Co. 2011; Chap 22: 777-807.
2. Shafiei F, Memarpour M. Effect of chlorhexidine application on long-term shear bond strength of resin cements to dentin. J Prosthodont Res 2010; 54: 153-158.
3. Cvek M, Cleaton-Jones P, Austin J, Lownie J, Kling M, Fatti P. Effect of topical application of doxycycline on pulp revascularization and periodontal healing in reimplanted monkey incisors. Endod Dent Traumatol 1990; 6: 170-176.
4. Cvek M, Cleaton-Jones P, Austin J, Lownie J, Kling M, Fatti P. Pulp revascularization in reimplanted immature monkey incisors--predictability and the effect of antibiotic systemic prophylaxis. Endod Dent Traumatol 1990; 6: 157-169.
5. Kling M, Cvek M, Mejarel. Rate and predictability of pulp revascularization in therapeutically reimplanted permanent incisors. Endod Dent Traumatol 1986; 2: 83-89.
6. Yassen GH, Chu TM, Eckert G, Platt JA. Effect of medicaments used in endodontic regeneration technique on the chemical structure of human immature radicular dentin: an in vitro study. J

Endod 2013; 39: 269-273.
7. Samanthini MV, Lata DA, Bharati Deo. Influence of endodontic materials on the bonding of composite resin to dentin –an in vitro study. JIDA 2011; 5: 605-608.
8. Katalinić I, Glockner K, Anić I. Influence of several root canal disinfection methods on pushout bond strength of self-etch post and core systems. Int Endod J 2014; 47: 140-146
9. Guneser MB, Akbulut MB, Eldeniz AU. Effect of various endodontic irrigants on the push-out bond strength of biodentine and conventional root perforation repair materials. J Endod 2013; 39: 380-384.
10. Renovato SR, Santana FR, Ferreira JM, Souza JB, Soares CJ, Estrela C. Effect of calcium hydroxide and endodontic irrigants on fiber post bond strength to root canal dentin. Int Endod J 2013; 46: 38-746
11. Norwich AH, Figdor D, Messer HH. PH changes in root dentin following calcium hydroxide intracanal dressing. Australian Endodontic Newsletter 1993; 19: 30-31.
12. Windley W 3rd, Ritter A, Trope M. The effect of short term calcium hydroxide treatment on dentin bond strength to composite resin. Dent Traumatol 2003; 19: 79-84.
13. Feiz A, Khoroushi M, Gheisarifar M. Effect of sodium ascorbate & calcium hydroxide on shear bond strength of composite resin to bleached enamel. JIDA 2009; 21: 115-121.
14. Mortazavi V, Khademi A, Khosravi K, Fathi MH, Ebrahimi-chaharom M, Shahnaseri SH, *et al*. Effect of MTAD on the shear bond strength of self etch adhesives to dentin. Dent Res J (Isfahan) 2012; 9: 24-30.