Original Research

Evaluation of the Effect of Sodium Hypochlorite Irrigant on Pull-out Bond Strength of FRC Posts Using Different Resin Cements

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Abstract

Introduction: To evaluate the effects of using sodium hypochlorite irrigant on pull-out bond strength of self-etch and self-adhesive resin cements to dentin. **Methods:** Sixty intact premolars were decoronated and the root canals were prepared by step-back technique. The teeth were divided into two groups according to the irrigant used during root canal treatment: 5.25% sodium hypochlorite and normal saline. The canals were obturated and after 48 hours storage, 8mm depth post space was prepared with application of normal saline as irrigant. Then, each group was divided into two subgroups depending on the type of the cements used for cementation of fiber reinforced composite (FRC) posts (Panavia F2or Embrace). The pull-out bond strength test was evaluated. Statistical analysis was performed by Two-way AONVA. **Results:** The type of cement had no statistically significant effect on the bond strength; however, the type of irrigant was statistically effective. There was no interaction between two independent variables. The application of sodium hypochlorite significantly decreased the pull-out bond strength in Embrace cement in comparison with the use of normal saline. **Conclusion:** The type of irrigants used in endodontic treatment may affect on bond strength of FRC posts cemented by self-adhesive cements.

Key words: FRC post, pull-out bond strength, resin cement, sodium hypochlorite.

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Introduction

Fiber reinforced composite (FRC) posts were introduced in 1997 for the restoration of endodontically treated teeth with little tooth structure to provide retention for the core of final restorations (1). The main advantages of these posts include better esthetic, elastic modulus similar to dentin, the ability of bonding to the tooth structure via resin cements, homogeneous stress distribution in the canal space, lower risk of root fracture, easier post removal in comparison with metal posts, more conservative approach, and less chair time need(2). The adhesion of FRC posts to the radicular dentin can be influenced by different factors such as the existence and thickness of smear layer after root preparation, type of irrigants, intracanal drugs and lubricants used, using eugenol-based materials, post space preparation methods and secondary smear layer production, and geometric factors (3).

The application of irrigants during root canal treatment (RCT) may change dentin structure and so, they can affect the mechanical properties of bonded restorations (4). Different irrigants such as sodium hypochlorite (5,6), EDTA (5,6), chlorhexidine (6), MTAD (5), H_2O_2 (7) and combination of them are available. Sodium hypochlorite is commonly used in endodontic treatment due to its antimicrobial property and its ability to dissolve the organic components (8). It can change the cellular metabolism of microorganisms by destructing phospholipids, lipids, and fatty acids and inactivate bacterial enzymes by its oxidative activity (9). Sodium hypochlorite is able to remove collagen fibers from the smear layer; this function can improve the push-out bond strength (10). By contrast, several studies showed that sodium hypochlorite reduces push-out or microshear bond strength to dentin (6, 11) or increases the microleakage (12). The major reasons for this reduction are ineffective smear layer removal in addition to the oxidative properties of sodium

hypochlorite that affects the polymerization of adhesive systems. Hence, there is contrary in the literature about effects of sodium hypochlorite on bond strength. In previous studies, sodium hypochlorite was used as a dentin surface treatment agent. It should be considered that this material could be used during the endodontic treatment as irrigant. So, the purpose of this study was to investigate the effect of sodium hypochlorite irrigant applied during RCT on pull-out bond strength of FRC posts cemented by self-etch or self-adhesive resin cements to dentin. The null hypothesis was that either the type of irrigants or resin cements has no effect on pull-out bond strength of the FRC posts.

Materials and Methods

In this in vitro study, sixty intact straight single-root human mandibular premolars extracted for orthodontic reasons were collected. The inclusion criteria were:

- The teeth had mature apices and almost the same root diameter and length.
- No cracks or fractures were observed on the root surface.
- No signs of internal resorption were observed in periapical radiographs.
- The cross-sectional shape of the root canal was circular (evaluated after decoronation).

All teeth underwent debridement with a hand-scaling instrument and were cleaned with a rubber cup and slurry of pumice. All specimens were disinfected by immersing in 1% chloramine-T for 48 hours (13) and were stored in normal saline that was refreshed every week. The teeth were decoronated 1mm above the CEJ by a diamond disk (918 BF, DZ, Lemgo, Germany) under sufficient water coolant. Then, the RCT was performed for all teeth as follows:

The working length was established by 1mm above the radiographic apex. The canal cleaning and shaping were performed with step-back technique by using K-file#15-40 (Mani, Tochigi, Japan) and gates-glidden#1-3 (Mani, Tochigi, Japan). The samples were randomized by computer and divided into two groups according to the irrigants used during the RCT. In the first group, 10 milliliters of 5.25% sodium hypochlorite (Chlora, Cerkamed, Poland) was used during instrumentation for one minute and after that, the canals were rinsed with 10 milliliters of normal saline for one minute. In the second group, the same value of normal saline was used during and after instrumentation. The canals were dried with paper points and obturated with gutta-percha (Dentsply, Maillefer, Ballaigues, Switzerland) and AH26 sealer (DentsplyDeTrey, Konstanz, Switzerland) by lateral condensation technique. The teeth were stored in 100% humidity for 48 hours to ensure complete setting of the sealers and then 8mm post space was prepared by using FRC post drills #2 (DT Light-Post System; Bisco, Schaumburg, USA). The canals were rinsed with normal saline during post space preparation and dried by paper points (Fig 1).

Figure 1. Two prepared samples before post cementation

Then, each group was randomly divided into two subgroups in relation to the cements used for cementation of FRC posts: self-etch resin cement (Panavia F2, Kuraray Medical Inc., Okayama, Japan) and self-adhesive resin cement (Embrace, Pulpdent, Watertown, MA, USA). Each cement was applied according to the manufacturer's instructions (Table 1) and cured with light curing unit (Coltolux LED, Coltene/Whaleden Inc., OH, USA) at 800mw/cm^2 for 40 seconds.

The specimens were stored in 100% humidity for 72 hours and then, pull-out bond strength of FRC posts was evaluated via universal testing machine (Zwick GmbH & Co, Ulm, Germany) at cross-head speed of 0.5 mm/min. A pull-out force was applied until the post dislodged from root. Maximum load on the chart was recorded as the bond strength.

The data were analyzed using Kolmogorov-Smirnov, Two-way ANOVA with a pre-set significance level of 0.05. The statistical analyses were performed by SPSS 11.5 software.

Table 1. The compositions and instruction of cements used in this study

Material	Adhesive strategy	Curing method	Dentin pre-treatment	Luting agent application
Panavia F2 (Kuraray Medical Inc., Okayama, Japan)	Self-etch	Dual-curing	Mix one drop each of Primers ED-A and ED-B. Apply the mixture to the root canal, leave it in place for 60 s. Remove excess primer with paper points. Dry with gentle airflow	Mix paste A and paste B for 20 s Apply the mixed paste and seat the post into the root canal. Remove the excess cement, Light cure 40 seconds
Embrace (Pulpdent, Watertown, MA, USA)	Self- adhesive	Dual-curing	No pre-treatment	Rinse and lightly dry. Remove excess water with a paper points. Leave dentin slightly moist. Automix Cement by placing a mixing tip on the double barrel syringe and dispensing material or dispense equal amount of base and catalyst and hand mix. Place cement into canal. Seat post into the root canal. Remove excess cement. Light cure 40 seconds

Results

The mean values of bond strength and standard divisions (SD) of different groups are presented in Table 2. Normal distribution of the data was confirmed by the Kolmogorov-Smirnov test (P-value>0.05). Two-way ANOVA showed that cement type had no statistically significant effect on the bond strength (P-value= 0.311). But, the type of the irrigant had a significant effect on the bond strength (P-value = 0.005). Also, there was no interaction between two variables (P-value = 0.970).

Table 2. The mean value of bond strength and Standard deviation of experimental groups (Newton)

Group	number	Mean ± SD
Panavia - normal saline	15	279.65 ± 52.90 a
Panavia – sodium hypochlorite	15	251.17 ± 27.32 a
Embrace – normal saline	15	270.00 ± 34.72 a
Embrace – sodium hypochlorite	15	240.78 ± 31.71 b

Different letters show a statistically significant difference. (P-value < 0.05)

Discussion

The null hypothesis is partially accepted by the results of this study. Based on this study, the effect of sodium hypochlorite on the bond strength of FRC posts depends on the cement type. The application of this material as irrigant had no significant effect on the bond strength of the self-etch cement but, it could reduce the bond strength in the self-adhesive cement. In consistent to the results of the current study, Elnaghy et al. (14)demonstrated that use of 5.25% sodium hypochlorite during the post space preparation reduced the bond strength of self-adhesive cement in comparison with the application of distilled water. In contrast, Bitter et al. (15) showed that the application of 1% sodium hypochlorite with ultrasonic vibration has no significant effect on the bond strength of self-adhesive cement but, use of 5.25% sodium hypochlorite with EDTA can significantly increase the bond strength in comparison with control group (distilled water). Zorba et al. (16) concluded that the application of 17% EDTA with 5.25% sodium hypochlorite after post space preparation increases the bond strength of self-adhesive cement more than self-etch cement. The explained reasons were removal of secondary smear layer before post cementation and chemical bond of self-adhesive cement.

In the present study, the application of 5.25% sodium hypochlorite had no significant effect on the bond strength of self-etch cement that was similar to the results of study by Hayashi et al. (17). They attributed these results to the use of normal saline after the application of the sodium hypochlorite (17). In contrast, Ari et al. (18) and Demiryürek et al. (19) concluded that sodium hypochlorite reduces the bond strength of self-etch cement. It should be mentioned that in Ari's study (18) the canals were not obturated by gutta-percha before the use of self-etch cement and it was applied to canal without post. Also, in Demiryürek's study (19) 5% sodium hypochlorite used after post space preparation and immediately before the cement application.

In the current study, when normal saline was used as an irrigant, no significant difference was observed between the bond strength of self-adhesive and self-etch cements. Likewise, Goracci et al. (20) showed that push-out bond strength of self-adhesive is comparable with self-etch cement. However, Radovic et al. (21) concluded that self-etch approach makes less adhesion in comparison with etch-and-rinse and self-adhesive approach.

Considering the fact that sodium hypochlorite is usually used during RCT to remove pulpal tissue and organic materials, the same protocol was performed in this study. The elimination of organic materials may improve the adhesion and bond strength, but this positive effect of sodium hypochlorite on bond strength can disappear or decrease by new smear layer production during the post space preparation. Furthermore, this material can release the free radicals leading to inhibition of polymerization process and decreasing of the bond strength. The application of adhesive before using self-etch cement can modify the smear layer and allow better penetration of resin and bonding. So, it may neutralize the negative effect of sodium hypochlorite (releasing free radicals). In the self-adhesive cements, no etchant and adhesive were used thus; the secondary smear layer and the remaining free radicals may reduce the bond strength. In the present study, the use of sodium hypochlorite was limited to canal cleaning and shaping process and after that normal saline was applied for 1 minute. Also, in contrast to the previous studies, this irrigant was not used immediately before the application of adhesive or cement and 48 hours after application of sodium hypochlorite, the bonding process was done. This factor may decrease degrading effect of this material on the bond strength. Monticelli et al. (22) explained some reasons for reduction of bond strength when self-adhesive cements were used including the thicker smear layer which was produced during post space preparation, limited decalcification and infiltration of this cements into smear layer, absence of hybrid layer and resin tags in bonded interface.

Variation in the results of different studies on effect of sodium hypochlorite on bond strength may be due to different application times and methods of this material and also use of normal saline after sodium hypochlorite. In previous studies sodium hypochlorite was used as irrigant during RCT process (10) or after post space preparation (23) and as surface treatment agent after acid-etch (24). Some researches demonstrate that the application of sodium hypochlorite as a surface treatment agent for coronal or radicular dentin after acid-etching, could improve the bond strength (24).

The application time of sodium hypochlorite is one of important factors should be considered. Morris et al. (25) reported that sodium hypochlorite treatment for 15-20 minutes decreased bond strength to radicular dentin up to 67% of values. It seems that there is a relation between application time of sodium hypochlorite and bond strength; as the application time increases the bond strength decreases (26).

Due to the limitations of this study, we used only one type of self-etch and self-adhesive cements. Therefore, the results may not applicable to all self-etch or self-adhesive resin cements. Further researches with various type of cement are required.

Conclusion

The type of irrigant used in RCT process may affect on the bond strength of FRC post cemented with self-adhesive cement.

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