Contemporary Orofacial Sciences (2023) 1(1):1-5
DOI: 10.30486/cofs.2023.1976381.1000

ORIGINAL RESEARCH

In vitro effect of propolis and 2% chlorhexidine as intracanal medicaments on push-out bond strength of fibre post-cemented with resin cement

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Received: 2023-03-14 / Accepted: 2023-05-02 / First publication date: 2023-05-10

Abstract

Background: **This study assessed the effect of propolis and 2% chlorhexidine (CHX) on push-out bond strength of fibre post-cemented with resin cement.**

Materials and Methods: **This in-vitro, experimental study evaluated 36 extracted human mandibular premolars in three groups (n=12). After root canal cleaning and shaping, propolis and 2% CHX gel were applied as an intracanal medicament in groups 1 and 2, respectively. Group 3 received no medicament. The access cavity was sealed, and the teeth were incubated for one week. The root canals were obturated and post space was prepared using the #2 Angelus drill. After 72 h of incubation, the crowns were cut, and the roots were mounted in acrylic and incubated for one week. The roots were sectioned into apical, middle and coronal thirds and underwent a push-out test. Data were analyzed using ANOVA and Bonferroni and Tukey's tests.**

Results: **The propolis group showed maximum and minimum bond strength in the middle and coronal thirds, respectively ($P>0.05$). The CHX group showed the highest and the minimum bond strength in the coronal and middle thirds, respectively ($P>0.05$). The control group showed maximum and minimum bond strength in the middle and coronal thirds, respectively ($P>0.05$). The mean bond strength in the propolis group was significantly higher than the control group ($P<0.05$).**

Conclusion: **using propolis as intracanal medicament can increase the push-out bond strength of fibre post-cemented with resin cement in the middle third of the root while using CHX increases the push-out bond strength of fibre post in the coronal third.**

Keywords: Propolis, Chlorhexidine, Resin Cements, Fibre Post, Bond Strength

Introduction

Endodontically treated teeth have a biomechanically higher risk of fracture than teeth with vital pulp (1). Thus, endodontic posts are more commonly used for constructing endodontically treated teeth that have lost a substantial portion of their structure. Using tooth-coloured restorative materials and non-rigid transparent posts is a routine method for restoring endodontically treated teeth. These posts are made of glass or transparent or white fibres. They provide optimal esthetics and enable the use of adhesive types of cement for their cement and subsequent root reinforcement in endodontically treated teeth (2). These posts are often used with bonded composite resins and enhance the structural strength and integrity of the root's dentin (2). Fibre posts are popular due to having an elasticity coefficient like that of dentin. They enhance the distribution of functional loads applied to the root compared with casting posts (3).

Today, dental clinicians commonly use resin types of cement for the cementation of posts in the root canal of non-vital teeth (4). Although, the physical structure and chemical composition of dentin does not allow proper micromechanical retention of these resins, in contrast to etched enamel (5).

Several factors can affect the dentin structure, like root canal irrigating solutions, intracanal medicaments, and endodontic sealers (6). Chlorhexidine (CHX) is a commonly used root canal irrigating solution and

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intracanal medicament due to its sustainable long-term antimicrobial activity, and attachment to hydroxyapatite crystals (7). CHX has dose-dependent bacteriostatic, bactericidal, anti-fungal and anti-viral properties. It possesses strong antimicrobial activity against obligate anaerobes, and thus, it is highly effective as an intracanal medicament and irrigating solution (8).

Recently, propolis was proposed as a beneficial substance for human health (9). It is a resinous substance with anti-inflammatory and anti-microbial properties (9). Propolis is prepared by the honeybees and is composed of resin, balsam oil (50%), wax (30%), aromatic and essential oils (10%), amino acids, minerals, vitamin A, vitamin B complex, and vitamin E. The organic content of propolis varies depending on the time, weather and location of the collection of propolis. Accordingly, it does not have the same chemical formula in different geographical areas (9)

Propolis contains flavonoids with high biochemical, antibacterial, antiviral, antifungal, anti-oxidative and anti-inflammatory properties (10). Jahromi et al. (11) evaluated the effect of calcium hydroxide alone and in combination with propolis as an intracanal medicament for dentinal tubule disinfection. In that research, CHX and propolis showed efficacy against Enterococcus faecalis at 100 μ depth. However, propolis was more effective than CHX in reducing microorganisms at 200 μ depth. They confirmed the effectiveness of propolis as an intracanal medicament.

Endodontic treatment prior to post cementation can compromise the cementation of intracanal posts (12). Debonding is the most common mode of failure in fiber posts (13). As mentioned earlier, use of fiber posts in endodontically treated teeth is increasing. Thus, assessment of the retention of fiber posts, and factors affecting their retention and cementation is highly important in provision of coronal seal and prevention of vertical root fracture in endodontically treated teeth. Considering all the above and the inevitable use of intracanal medicaments in endodontic treatments, this study sought to assess the effect of propolis and 2% CHX intracanal medicaments on the push-out bond strength of fibre post-cemented with resin cement.

Materials and Methods

This in-vitro experimental study evaluated thirty-six sound human mandibular premolars extracted as part of orthodontic treatment. The sample size was 12 in each group assuming alpha=0.05, beta=0.2, 80% confidence interval and detection of a maximum difference of 20% higher than the standard deviation.

The inclusion criteria were sound teeth extracted within the past six months for orthodontic reasons. The teeth had no caries, coronal fracture, cervical wear, or previous restoration. The collected teeth were cleaned with water and a prophy brush and were immersed in 5.25% sodium hypochlorite for 20 min to eliminate the superficial debris and immersed in saline afterwards. The teeth underwent periapical radiography, an access cavity was prepared and the working length was determined. The canals were filed to #40 using the step-back technique and shaped using #2 and #3 Gates-Glidden drills (Mani, Japan). After using each file, we rinsed the canals with two ccs of saline. Next, the teeth were divided randomly into three groups (n=12). We used Propolis (Iran) as intracanal medicament in group 1. Chlorhexidine gel (Cerkamed, Poland) was used as an intracanal medicament in group 2, while we used no medicament in group 3. We sealed access cavities with Zonalin (Golchai, Iran) at 3 mm thickness. The teeth were coded and incubated in saline inside screw-top containers for one week. Then we opened the access cavities again and rinsed the canals with ten cc saline. After the final rinsing and drying of the root canals, we filled them with AH 26 sealer (Dentsply, Germany) and gutta-percha (Gapadent, China) via the lateral compaction technique. A control radiograph was taken to check the quality of obturation. Next, the teeth were incubated for 72 h to allow the final setting of AH 26. Afterwards, the post space was prepared using a #2 Angelus drill (Angelus, Brazil), and 10 mm of gutta-percha was removed. Next, #2 Angelus intracanal posts (Angelus, Brazil) were cemented in the prepared post spaces using Panavia A2 resin cement (Kuraray, Japan) according to the manufacturer's instructions and light-cured. The crowns were cut below the cementoenamel junction as only 15 mm of root length remained. A few grooves were created on the roots. Each root was mounted in auto-polymerizing acrylic resin in cylindrical moulds with one mm diameter and three mm height. The longitudinal axes of the root and cylinder were parallel, and the coronal margin of the root and the acrylic surface were at the same level. The teeth were incubated for one week.

. The roots were sectioned into apical, middle and coronal thirds (three sections) using a fully-automated cutting machine (Nemofanavaran Pars, Tehran, Iran). The push-out bond strength was then measured using a universal testing machine (Zwick Roell, Ulm, Germany). The load was applied parallel to the orientation of posts and the acrylic block, and from the larger cross-section of the root. The load was applied at a crosshead speed of 0.5 mm/min. The load required for dislodgement of the post from the canal space was recorded. Prior to debonding, the larger diameter of the post (R), the smaller diameter of the post (r), and the height of post (h) were measured by a caliper (Mitutoyo, Japan). After debonding, the push-out bond strength was measured in megapascals (MPa) using the formula below:

$$S=\pi(R+r)\sqrt{(R-r)^2+h^2}$$

Data were analyzed using repeated measures, and one-way ANOVA followed by Bonferroni and Tukey's tests via SPSS version 22 (SPSS Inc., IL, USA). The level of significance was 0.05.

Results

Table 1 presents the mean push-out bond strength of fibre posts in the propolis, CHX and control groups at the coronal, apical and middle thirds.

Table 1. Mean push-out bond strength (MPa) of fiber post in the propolis, CHX and control groups at the coronal, apical and middle thirds (n=12)

Group	Root area	Minimum	Maximum	Mean	Std. deviation
Propolis	Coronal	3.14	15.18	8.48	3.51
	Middle	6.45	25.82	11.87	5.79
	Apical	5.08	19.94	9.06	4.27
CHX	Coronal	5.59	14.17	9.18	2.52
	Middle	2.79	13.71	7.67	2.69
	Apical	5.05	12.52	8.28	2.24
Control	Coronal	1.04	12.68	7.31	3.29
	Middle	3.99	20.08	7.83	4.15
	Apical	4.27	14.31	7.68	2.81

The mean push-out bond strength in the propolis group was not significantly different in the apical, middle, and coronal thirds (P>0.05). Repeated measures ANOVA revealed that the effect of root area on the mean push-out bond strength of fibre post was not significant in the propolis group (P>0.05).

The mean push-out bond strength in the CHX group was not significantly different in the apical, middle and coronal thirds (P>0.05). Repeated measures ANOVA revealed that the effect of root area on the mean push-out bond strength of fibre post was not significant in the CHX group (P>0.05).

The mean push-out bond strength in the control group was not significantly different in the apical, middle and coronal thirds (P>0.05). Repeated measures ANOVA revealed that the effect of root area on the mean push-out bond strength of fibre post was not significant in the control group (P>0.05).

In the coronal third, maximum push-out bond strength was noted in the CHX group, but the difference in the mean push-out bond strength in the coronal third was not significant among the three groups of CHX, propolis and control (P>0.05).

In the middle third, maximum push-out bond strength was noted in the propolis group. The difference in the mean push-out bond strength in the middle third was significant among the three groups of CHX, propolis and control (P=0.041). A pairwise comparison by Tukey's test revealed that the mean push-out bond of the propolis group was significantly higher than that of the CHX group (P=0.025). Also, the mean push-out bond strength of the propolis group was significantly higher than that of the control group (P=0.031). The difference in this respect between the CHX and control groups was not significant (P=0.926).

In the apical third, maximum push-out bond strength was noted in the propolis group, but the difference in the mean push-out bond strength in the apical third was not significant among the three groups of CHX, propolis and control (P>0.05).

Table 2 presents the mean push-out bond strength values in the entire root length in the studied groups. In the whole root length, the push-out bond strength was the highest in the propolis group. One-way ANOVA revealed a significant difference in the mean push-out bond strength in the entire root length among the three groups (P=0.047). Tukey's test revealed no significant difference in the mean push-out bond strength in the whole root length between the propolis and CHX groups (P=0.236). The mean push-out bond strength in the entire root length in the propolis group was significantly higher than that in the control group (P=0.040). The difference in this respect between the CHX and control groups was not significant (P=0.648).

Table 2. Mean push-out bond strength (MPa) in the whole root length in the three groups (n=12)

Group	Minimum	Maximum	Mean	Std. deviation
Propolis	7.32	15.05	9.80	2.27
Chlorhexidine	5.25	10.85	8.38	1.36
Control	4.88	14.46	7.61	2.52

Discussion

This study compared the effects of propolis and 2% CHX gel on the push-out bond strength of fibre post-cemented with resin cement. The results showed that the propolis group had maximum and minimum bond strength in the middle and coronal thirds, respectively. The CHX group had maximum and minimum bond strength in the coronal and middle thirds, respectively. The control group showed maximum and minimum bond strength in the middle and coronal thirds, respectively. The mean bond strength in the propolis group was significantly higher than in the control group.

Zare Jahromi et al. (11) concluded that using 2% CHX as intracanal medicament did not increase the bond strength of fibre post and even slightly decreased it, which was different from our current findings. This difference in the results may be due to using disparate self-etch systems applied for fibre post-cementations in the two studies. However, another study also reported that the application of CHX prior to etching did not increase the bond strength (14). Kalyoncuoğlu et al. (15) reported a favourable effect of propolis on bond strength to coronal dentin. Their result was in agreement with our findings. Note that they used resin cement comparable to our methodology. Prabhakar et al. (16) measured the shear bond strength of a glass ionomer cement in combination with a 1% ethanolic extract of propolis and found no significant difference in the shear bond strength of the test and control groups, which was different from our results. This difference can be due to the variability in the constituents of propolis and higher flavonoid content. Also, we used the aqueous extract of propolis in our study. Üstün et al. (17) reported that propolis had a better effect on the bond strength of sealer to root dentin in the apical third. Propolis is a natural antibacterial agent, and its application as intracanal medicament eliminates a broad spectrum of intracanal bacteria and thus can improve bond strength. In our study, propolis had the maximum effect on the middle third of the root and showed minimal outcome on the apical third.

Our study showed that 2% CHX gel as intracanal medicament did not enhance the push-out bond strength. Our results in this respect were different from those of Ceccin et al. (18) and Liu et al. (19). This controversy can be due to the differences in concentration and form of CHX used since they used 2% CHX solution as root canal irrigating solution while we used 2% CHX gel as intracanal medicament. Also, in comparison, the exposure time of the root dentinal walls to CHX in our study was longer. Arslan et al. (20) evaluated the effect of canal disinfecting materials on the bond strength of composite to root dentin. They compared the effects of CHX, sodium hypochlorite, propolis, ozone and Er, Cr: YSGG laser and found no significant difference due to composite bond strength to root dentin between the groups. Their results were different from our findings, which may be due to different methodologies and the use of composite. Matochek et al. (21) evaluated the effect of an aqueous propolis-based solution on the bond strength of intracanal posts to root dentin by using RelyX ARC, Panavia F2.0, and RelyX U200 resin types of cement. They reported that the strength varied using different cement types and irrigation protocols. However, in agreement with our results, the propolis irrigating solution did not interfere with the bonding of intracanal posts to root dentin while being less aggressive.

This study had an in vitro design. Thus, the generalization of results to the clinical setting must be accomplished with caution. Further studies are required to assess the effect of the thickness of root dentin on push-out bond strength following the application of propolis and CHX intracanal medicaments. Measuring the bond strength by implementing loads from different directions in future studies is also advised.

Conclusion

Within the limitations of this in vitro study, the results showed that propolis could be successfully used as an intracanal medicament to enhance the push-out bond strength of fibre posts cemented with resin cement in the middle third of the root. CHX can increase the push-out bond strength of fibre posts cemented with resin cement in the coronal third of the root.

Conflicts of interest: none

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