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Effect of Chelating Irrigation on the Bond Strength of a Fiber Post System

Şelasyon Ajanlarının Fiber Postların Bağlantı Dayanımına Etkisi

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ABSTRACT Objective: The aim of this study was to investigate the effect of different irrigation solutions on the bond strength of the fiber posts to the root canal dentin through resin cement. **Material and Methods:** The sample size of each group was determined by using a power analysis (G Power 3.1.9.2 software). Post cavity of 84 maxillary single rooted teeth were prepared and were divided into 7 groups according to the last irrigation solutions (n=36). G1: 17% ethylenediaminetetraacetic acid (EDTA), G2: 17% EDTA+ 2% chlorhexidine (CHX), G3: Distilled water, G4: SmearOFF, G5: Dual Rinse HEDP (MedCem, Switzerland), G6: Dual Rinse HEDP+5% Sodium hypochlorite (NaOCl), G7: 2% CHX. Fiber posts were cemented using G-CEM LinkAce™ (GC Corp., Tokyo, Japan). Push-out bond strengths were evaluated at three different radicular levels: coronal, middle, and apical. The Kolmogorov-Smirnov test and Kruskal-Wallis test were used to analyze the data. **Results:** The highest push-out bond strength was found in the Dual Rinse HEDP group ($p<0.001$). SmearOFF and 17% EDTA+2% CHX groups were statistically similar ($p>0.05$). Although there was no statistically significant difference between the 2% CHX, distilled water and 5% NaOCl +Dual Rinse HEDP groups ($p>0.05$), these 3 groups showed statistically significant lower push-out bond strength than the other groups ($p<0.001$). **Conclusion:** Clinically, irrigating of the post cavity with Dual Rinse HEDP is recommended, because it increases the bond strength of the fiber posts. However, when the antibacterial effect is desired, SmearOFF may be preferred instead of NaOCl due to its CHX content.

Keywords: Etidronic acid; smear layer; root canal irrigants; adhesion; post-core

ÖZET Amaç: Bu çalışmanın amacı, farklı şelasyon kabiliyeti olan irrigasyon solüsyonlarının fiber post ve kök dentin yüzeyine karşı bağlanma dayanımlarına olan etkisini, push-out test yöntemi ile değerlendirmektir. **Gereç ve Yöntemler:** Her grubun örneklem büyüklüğü, bir güç analizi (G Power 3.1.9.2 yazılımı) kullanılarak belirlendi. Seksen dört adet çekilmiş tek köklü dişin post kaviteleri hazırlandı ve dişler son irrigasyon solüsyonuna göre rastgele 7 gruba ayrıldı (n=36): G1: %17 etilen diamin tetraasetik asit (EDTA), G2:%17 EDTA+%2 klorheksidin (CHX), G3:Distilled water, G4: SmearOFF, G5: Dual Rinse HEDP, G6: Dual Rinse HEDP+%5 Sodium hypochlorite (NaOCl), G7: %2 CHX. Fiber postlar, G-CEM LinkAce™ (GC Corp., Tokyo, Japan) ile yapıştırıldı. Push-out bağlantı dayanımları koronal, orta ve apikal olmak üzere ölçüldü. Veriler, Kolmogorov-Smirnov testi ve Kruskal-Wallis testi kullanılarak analiz edildi. **Bulgular:** Dual Rinse HEDP grubu ($p<0{,}001$) en yüksek bağlantı dayanımını gösterdi. SmearOFF ve %17 EDTA+% 2 CHX grupları istatistiksel olarak benzer bulundu ($p>0{,}05$). %2 CHX, distile su, %5 NaOCl+Dual Rinse HEDP grupları arasında istatistiksel olarak anlamlı herhangi bir fark saptanmadı ($p>0{,}05$) ve bu 3 grup diğerlerine göre istatistiksel olarak anlamlı ölçüde düşük bağlantı dayanımı gösterdi ($p<0{,}001$). **Sonuç:** Fiber post kavitelerinin yıkanmasında Dual Rinse HEDP ile irrigasyon klinik başarıyı artırırken, NaOCl kullanımı düşürmektedir. Bu yüzden antibakteriyel etki istendiğinde, NaOCl'in Dual Rinse HEDP ile birlikte kullanımı yerine, CHX içeren SmearOFF tercih edilebilir.

Anahtar Kelimeler: Etidronik asit; smear tabakası; kök kanal yıkama solüsyonları; adezyon; post-kor

Most endodontically treated teeth end up with extensive loss of structure. Treatment options are often appearing as posts and cores combined with crown restorations. Fiber posts are choice of preference due to the similar elastic modulus values to dentin and ease of use. Moreover, they promise high esthetic properties with enhanced translucency. Also tooth-colored resin cements are recommended for fiber posts since they present higher retention rates and decreased microleakage.[1]

The bonding of fiber posts depends on both the bond strength between post-resin cement and the

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bond strength between the resin cement-root canal dentin.[2] The smear layer which forms during post cavity preparation is a crucial concern for post cementation. It creates clogging in dentin tubules. Since the resin cement can not reach to the root canal dentin, adhesion decreases and microleakage occurs.[3]

Sodium hypochlorite (NaOCl), ethylenediaminetetraacetic acid (EDTA) and chlorhexidine (CHX) are the most commonly used irrigation solutions during endodontic treatments. NaOCl not only dissolves the organic tissue but also provides antimicrobial activity. Nevertheless, it can not dissolve the inorganic structures.[3] On the other hand, EDTA, a chelating agent, plays a role in the removal of the debris and smear layer by dissolving the inorganic tissue.[3] However, the sequential use of EDTA and NaOCl causes erosion in the dentin tubules.[3] Furthermore, the use of EDTA decreases the availability of free chlorine from NaOCl and decreases its antimicrobial effect.[4] CHX is preferable for both extending the life of the adhesive bonding of the composite resins and its antibacterial properties.[3,5]

Currently, many innovative irrigation solutions that aim to increase the co-availability of antibacterial and chelating agents are commercially available. SmearOFF (Vista Dental Products, Racine, WI) is a smear layer removal agent with antibacterial effects. SmearOFF contains CHX gluconate, tetrasodium EDTA dihydrate and a surfactant as well as the active ingredients.[6] The sequential use of SmearOFF with NaOCl does not cause any P-chloranilin formation. Thus, it can be safely used after NaOCl irrigation. Besides, it does not affect the availability of the free chlorine of NaOCl. Therefore, it does not reduce the antimicrobial activity of NaOCl.[6,7]

The recently commercialized Dual Rinse HEDP (MedCem, Switzerland) contains 9% A1-hydroxyethylidene-1, 1-bisphosphonate (HEDP, etidronate or etidronic acid). Dual Rinse HEDP is a biocompatible, “soft” chelating agent, suitable for the use with NaOCl.[8] This solution can be prepared and used by mixing the capsule containing powdered etidronate with distilled water or NaOCl.[9] Combined or sequential use of etidronate and NaOCl have a minimal effect on the root canal dentin. Besides, it effectively removes the smear layer from the root canal dentin walls.[10] Also, etidronate does not affect the proteolytic or antimicrobial activity of NaOCl.[8]

To the best of our knowledge, there are few studies that investigated the effect of post cavity irrigation with these solutions on the bond strength of fiber posts cemented with a self-adhesive resin cement. Besides, there was no study that evaluate the effect of Dual Rinse HEDP irrigation solution on the bond strength of fiber posts.

Therefore, the aim of this study was to evaluate the effect of post cavity irrigation with various solutions on the bond strength of fiber posts cemented with a self-adhesive resin cement. Our null hypothesis is that irrigating root canal dentin with 17% EDTA, 17% EDTA+2% CHX, distilled water, SmearOFF, Dual Rinse HEDP, Dual Rinse HEDP+5% NaOCl, and 2% CHX would not affect the bond strength.

MATERIAL AND METHODS

This study was conducted in accordance with the Helsinki Declaration.

SPECIMEN PREPARATION

After the ethics committee approval was obtained from the ethics committee of Usak University (2017-72), 84 maxillary single rooted, recently extracted for orthodontic or periodontal reasons without cracks or caries were collected. Selected teeth were in similar mesio-distal and bucco-lingual dimensions. Soft tissue remnants and dental plaque on the teeth were cleaned with a periodontal curette, and the samples were stored in 0.5% chloramine T solution at room temperature until use.

The crowns of the teeth were separated transversally from the cemento-enamel junction by using a diamond disc (Skillbond, Jota, UK). A single researcher who specialized in endodontics conducted the procedures. The canal was located with no-10 K-type file (Dentsply Maillefer, Ballaigues, Switzerland). Then actual canal length was determined for each specimen by following the exit of the no-10 K-type file from the apical foramen and the rubber stop was adjusted to 15 mm. Next, root canal preparation was completed with ProTaper rotary nickel titanium system (WDV Gold VDW, Munich, Germany). All of the roots were instrumented with apical diameters corresponding to tool number 40 and 2.25% NaOCl irrigation was used between each tool. The root canals were dried with paper points (Diadent, Korea). Each root canal was obturated by using the lateral condensation technique with gutta-percha points (Diadent, Korea) that were covered with a resin-based root canal sealer (AH Plus, Dentsply De Trey Gmbh, Germany) and inserted into the canal.

The canal openings of each sample were sealed with a temporary filler CavitTM-G (3M ESPE, GmbH, Seefeld, Germany). The specimens were stored in a 100% humid environment at 37 °C for 24 hours.

POST CAVITY PREPARATION

Post cavities were formed spanning 2/3 of the roots in all specimens using a special drill for the posts (Series 911, Conical Type 2°, Micro.Medica s.r.l., Robbio, PV, Italy) attached to a low-speed hand piece. Then the post cavities were irrigated with 10 mL distilled water for 60 s and dried by using paper points. Then posts (Micro.Medica s.r.l., Robbio, PV, Italy) were placed into each cavity to test their fit.

Afterwards the teeth were divided into 7 groups (n=36) according to the last irrigation solutions.

In G1 and G2: 17% EDTA (MD-Cleanser, Meta-Biomed, Chungju, Korea), in G2 and G7: 2% CHX (Calasept-Spei- ko®, Dr. Speier GmbH, Münster, Germany), and in G6: 5% NaOCl (Wizard; Rehber Kimya, Istanbul, Turkey) were used.

In G1, the post cavity was irrigated with 5 mL of EDTA for 1 min. G2 was also irrigated 5 mL of EDTA for 1 min+5 mL CHX for 1 min. G3 was the negative control group and irrigated with 5 mL of distilled water for 1 min. G4 was irrigated with 5 mL of SmearOFF (Vista Dental Inc., Racine, WI) for 1 min. G5 was irrigated with 5 mL of Dual Rinse HEDP for 5 min. G6 was irrigated with 5 mL of Dual Rinse HEDP+5 mL of NaOCl for 5 min, and G7 was irrigated with 5 mL of CHX for 1 min.

Following the irrigation, the post cavities were dried with paper points, and the fiber posts were cleaned with alcohol and dried. Then the posts were applied according to the manufacturer's recommendations by using a self-adhesive resin cement (G-CEM LinkAce™, GC Corp., Tokyo, Japan). Each post was covered with cement. The cement was also placed inside each post cavity. Then the post was placed into the post cavity by using finger pressure for 30 s to get a complete setting. Samples were light cured for 40 s with a LED light source (BluePhase G2, Ivoclar Vivadent Inc., Amherst, NY, USA). All of the specimens were covered with a A1 shade micro-hybrid composite resin (Gradia Direct Posterior, GC Co., Tokyo, Japan), and light cured for 20 s with a LED light source. The specimens were kept in distilled water in dark.

PUSH-OUT ASSESSMENT

The roots were then embedded in a self-curing acrylic resin (Dentsply, Degudent GmbH, Hanau, Germany). Coronal, middle and apical sections were obtained with a precise diamond saw under continuous water irrigation (Micracut, Metkon, Bursa, Turkey; rotational speed 0–300 rpm). Sections were left in distilled water until analysis.

These sections were tested with a 1-mm diameter pushout test tip at a speed of 1 mm/min with the help of the universal testing machine (Devotrans Inc, Istanbul, Turkey). After the maximum loading forces were measured in Newtons and the large and small diameters and heights of samples were measured under the microscope (Mitotoyo, Japan), the results were converted into MPa by applying the N/(pi r1 + pi r2)xsquare root (r1-r2) 2+h2 formula.

Then, the fracture modes of all samples were examined under a microscope and classified as (1) adhesive (failure at the adhesive cement-dentin interface), (2) adhesive (failure at the adhesive cement-fiber interface), (3) cohesive and (4) mixed failure in both the adhesive cement and dentin.[11] The results were recorded as percentage values. Surfaces were examined by a scanning electron microscope (SEM) (DSM 940A, Carl Zeiss, Oberkochen, Germany) at x10,000 magnifications (Figure 1A, 1B, 1C, 1D, 1E, 1F, 1G).

STATISTICAL METHODS

The sample size of each group was determined by using a power analysis (G Power 3.1.9.2 software),

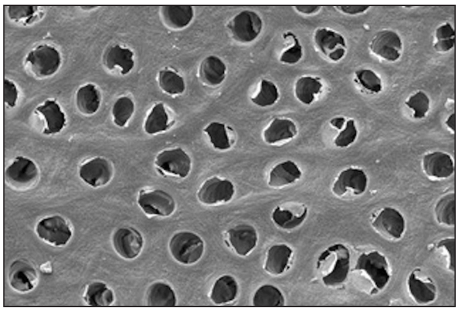

FIGURE 1A: Scanning electron microscope analysis of root dentin surface after 17% EDTA irrigation, original magnification x10,000 magnifications.

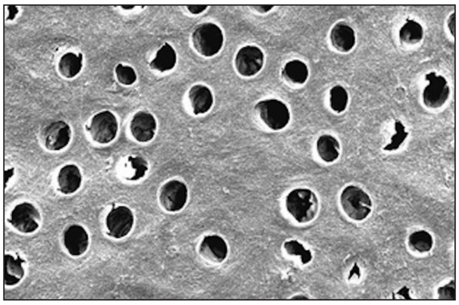

FIGURE 1B: Scanning electron microscope analysis of root dentin surface after 17% EDTA+2%CHX irrigation, original magnification x10,000 magnifications.

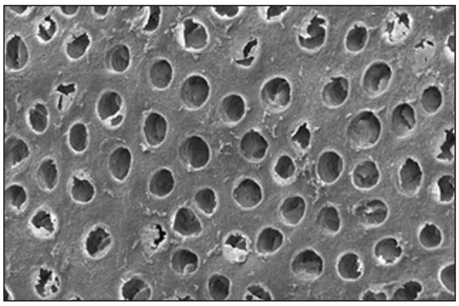

FIGURE 1C: Scanning electron microscope analysis of root dentin surface after distilled water irrigation, original magnification x10,000 magnifications.

providing a statistical difference of a=0.05), and effect size of 0.3 at 95% power.

95% confidence intervals, median and minimum and maximum values were used as descriptive statistics. The Kolmogorov-Smirnov test was used to analyze the statistical distribution of the data, and it was determined that the data did not have a normal distribution. Therefore, the Kruskal-Wallis test was used to determine the differences between the groups in terms of push-out bond strength. When evaluating the significance of paired comparisons in order to determine which groups differed, the p-values obtained by Bonferroni correction were taken into consideration. By using these p-values, different letters were written next to the median for the groups with significance levels $p<0.05$, while the same letter was written for the groups with significance levels $p>0.05$. Hierarchical clustering analysis was performed to determine the similarities between seven groups in terms of apical, middle and coronal push-out bond strength. Wards method and squared Euclidian distance were

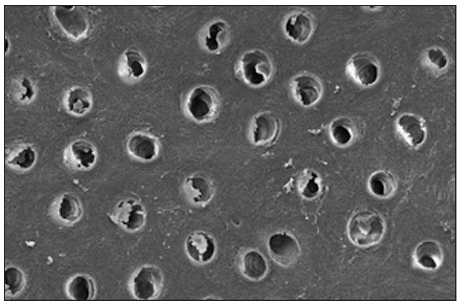

FIGURE 1D: Scanning electron microscope analysis of root dentin surface after SmearOFF irrigation, original magnification x10,000 magnifications.

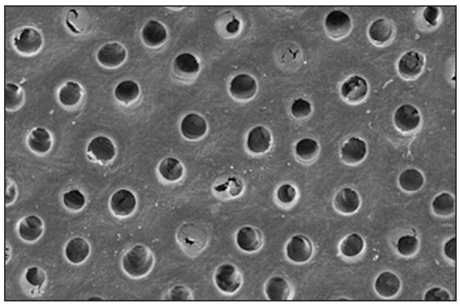

FIGURE 1E: Scanning electron microscope analysis of root dentin surface after Dual Rinse HEDP irrigation, original magnification x10,000 magnifications.

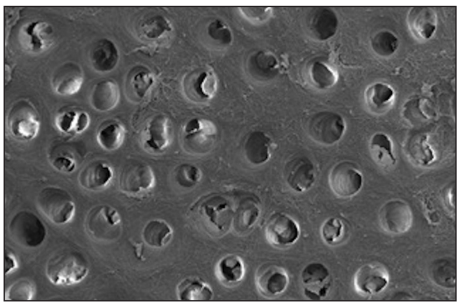

FIGURE 1F: Scanning electron microscope analysis of root dentin surface after Dual Rinse HEDP+5%NaOCl irrigation, original magnification x10,000 magnifications.

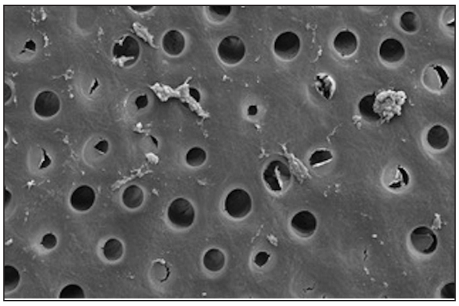

FIGURE 1G: Scanning electron microscope analysis of root dentin surface after Dual 2% CHX irrigation, original magnification x10,000 magnifications.

used in clustering analysis. All statistical analyses were performed using SAS software version 9.4 (SAS Institute Inc., Cary, NC).

RESULTS

Statistically significant differences were found among the 7 groups (p<0.001). The highest push-out bond strength was found in the Dual Rinse HEDP group (4.95 (2.52-8.23)). The SmearOFF and EDTA+CHX groups had similar push-out bond strength and the difference was not statistically significant (4.09 (0.87-8.56), and 3.88 (1.15-9.98), p>0.05). Also, the push-out bond strength of the EDTA group was significantly lower than the Dual Rinse HEDP group (p<0.001) but it was significantly higher than CHX, distilled water, and Dual Rinse HEDP+NaOCl groups (p>0.05). Although there was no statistically significant difference among the CHX, distilled water and Dual Rinse HEDP+NaOCl groups (p>0.05), these 3 groups showed significantly lower push-out bond strength than the other groups (p<0.001) (Table 1).

TABLE 1: 95% confidence lower and upper bound value, median, maximum and minimum of the push-out bond strengths (MPa) of each group. Similar superscript letters indicate no statistically significant difference (p>0.05).

Groups	n	Median	Minimum	Maximum	p value
1	36	3.65b	1.46	6.97	<0.001
2	36	3.88ab	1.15	9.98	
3	36	1.92c	0.36	5.36	
4	36	4.09ab	0.87	8.56	
5	36	4.95a	2.52	8.23	
6	36	1.22c	0.09	5.17	
7	36	1.92c	0.07	9.76	
Total	252	3.05	0.07	9.98	

The coronal third was evaluated and the push-out bond strengths were obtained respectively as Dual Rinse HEDP>EDTA+CHX>EDTA>SmearOFF>CHX>distilled water> Dual Rinse HEDP+NaOCl. In the middle zone, the push-out bond strengths were obtained respectively as: Dual Rinse HEDP>SmearOFF>EDTA>EDTA+CHX>CHX>distilled water>Dual Rinse HEDP+NaOCl. In the apical third, the push-out bond strengths were were obtained respectively as: Dual Rinse HEDP>SmearOFF>EDTA+CHX>EDTA>CHX>distilled water>Dual Rinse HEDP+NaOCl. In all 3 regions, the Dual Rinse HEDP group exhibited the significantly higher push-out bond strength than other groups (p<0.001). The Dual Rinse HEDP+NaOCl group was found to be significantly lower than all other groups in all 3 regions with respect to the push-out bond strength (p<0.001).

The results of the clustering analysis, which show the similarities and differences between the groups in terms of push-out bond strength in the apical, middle and coronal regions, are shown in Figure 2. Dual Rinse HEDP+NaOCl, CHX and distilled water formed a similar group, while Dual Rinse HEDP, Smear OFF, EDTA+CHX, and EDTA formed another group (Figure 2). As a result, there were two groups in terms of bond strength: a low group and a high group. Failure modes are presented in Table 2.

DISCUSSION

In the present study, we carried out a comparative investigation on various solutions as root canal irrigants, on the bond strength of fiber posts cemented with a self-adhesive resin cement. The results show that different irrigation solutions affect adhesive bonding to root canal dentin in different ways and our null hypothesis was rejected.[2]

Both light-cured and self-polymerizing dual-cure resin cement types are recommended for bonding of fiber posts to root canal dentin. In this study, a dual-cure, self-etching adhesive resin cement, G-CEM LinkAce, was used. Dual-cure resin cements provide proper polymerization in the apical sites even in the absence of light activation. However, self-cure mechanism for dual-cure materials alone results de-

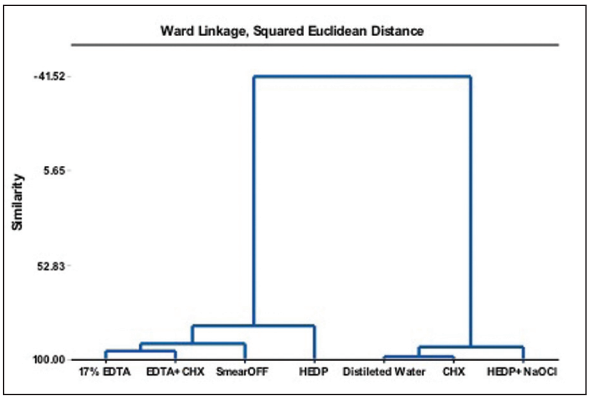

FIGURE 2: The tree graphics of the results. Similarities and differences between the groups in terms of push-out bond strength in the apical, middle and coronal regions.

crease in cement hardness, polymerization rate, solubility and bond strength.[12-14] Therefore, in our study, after each fiber post was placed, polymerization was activated with light for 40 seconds. Also, limited etching potential of self-etching adhesive resin cement is insufficient to remove the smear layer that covers the canal dentine tubules and they are too viscous to infiltrate the demineralized collagen fiber networks.[15] Moreover, bond strengths were affected by their vertical location in the post cavity.

Previous studies reported that the bond strength of posts cemented with adhesive systems decrease from coronal to apical because of decreased tubule density and diameter.[16,17] Besides, it is difficult to remove the smear layer, seal with cement, and to obtain complete polymerization in apical region.[18] Push-out bond strength value decreased from coronal to apical in group EDTA and CHX which was in consistent with previous studies. However, push-out bond strength values increased in group SmearOFF and Dual Rinse HEDP. This could be explained by the differences of anatomic and histologic characteristics of the root canal.[19,20]

TABLE 2: Distribution of failure types in each experimental group (as percentage).

	Adhesive 1 (AC-D)	Adhesive 2 (AC-P)	Cohesive	Mix
Group 1	8.3	75	0	16.6
Group 2	16.6	66.6	0	16.6
Group 3	33.3	50	8.3	8.3
Group 4	25	58.3	0	16.6
Group 5	41.6	50	0	8.3
Group 6	33.3	58.3	0	16.6
Group 7	41.6	58.3	0	0

Adhesive 1 (AC-D): Adhesive cement-dentin; Adhesive 2 (AC-P): Adhesive cement-post.

The push-out bond strength test can be used to evaluate the bonding of root canal filling materials to root canal dentin.[21] It is an *in vitro* stress test that can adequately mimic the stress between root canal dentin and resin cement, and also this test measures the shear stress between dentin and resin cement.[22] Before testing thickness of the dentin sections should be considered. Thick dentin sections cause the increase of the friction area, which may lead to amplified results in push-out connection values.[22] Therefore, in our study, we used 1-mm thick dentin sections.

In this study, the push-out bond strength of the fiber posts was significantly higher when the root canal was irrigated with Dual Rinse HEDP ($p<0.001$). Contrary to general belief, the role of dentin tubules in the adhesion of self-adhesion cement to root dentin is limited. The mineralized region under the collagen matrix in the intertubular dentin and the collagen matrix are responsible for the micromechanical connection.[23] De-Deus et al. observed that strong chelating agents such as EDTA and MTAD enlarged dentin tubules and reduced the intertubular dentin area compared to Dual Rinse HEDP.[24] It is very important that the intertubular dentin tissue is accessible during the hybridization process. In another study by De-Deus et al., it was concluded that widening of the intertubular areas after using a soft chelator such as Dual Rinse HEDP enabled enhanced hybridization, and this hybridization increased the overall adhesive bonding.[25] We suggest that the soft chelation properties of the Dual Rinse HEDP solution are associated with the increase in the fiber post bond strength.

SmearOFF is a recently commercialized solution that contains tetrasodium EDTA dihydrate (18% wt), CHX gluconate (<1% wt) and a surfactant to increase the wettability of dentin. It enables to reduce the number of final irrigation steps.[6] Low pH (i.e., 7.2) of SmearOFF may lead effectively smear removing.[26]

Ballal et al. showed that the smear removal activity of SmearOFF is similar to EDTA.[26] In consistent with the study of Ballal et al. there was no statistically significant difference between the SmearOFF group and the 17% EDTA+2% CHX group. In addition, Piperidou et al. reported that SmearOFF can be safely used as the last irrigation solution without an additional step such as irrigating with sterile saline.[7,26] Since no para chloroaniline formation was observed after the sequential use of after the use of NaOCl and SmearOFF. However, similar to the EDTA, use of SmearOFF would result in a decrease in free active chlorine content which determine the antibacterial effect of NaOCl.[6] Overall, according to the results of this study and other studies involving SmearOFF, it is known that (i) the dentin wettability is better with the surfactant ingredient, (ii) it has antibacterial activity since it contains CHX, and (iii) only a single solution can be used for two different steps.

Our results are similar to previous studies in terms of the use of NaOCl.[3,27-32] In studies where the post cavity was irrigated with NaOCl, the adhesion decreased significantly.[27] This decrease can be attributed to the dissolution of dentin collagen by imparing the bonds between carbon atoms and resulting in the degeneration of dentin.[27,31] The push-out bond strength was highest in Dual Rinse HEDP group, while the push-out bond strength was the lowest in Dual Rinse HEDP+5% NaOCl group. Although NaOCl is a commonly preferred antibacterial agent for root canal treatment, it leaves an oxygen-rich layer on the root canal dentin.[32] This layer reduces the push-out bond strength of the adhesives.[23] In addition, oxygen inhibits resin polymerization.[33] Therefore, if there is a risk for possible bacterial contamination of post cavities, an irrigation solution such as CHX, which does not interact with dentin collagen, should be preferred instead of NaOCl solution. As in our study, push-out bond strength of post cementing is not negatively affected, because CHX does not interact with collagen in the organic matrix of root canal dentin, which determines the quality of the dentin substrate.[34]

Limitations of the present study included that oral environment conditions may also affect the results and only one type of adhesive cement was used. Moreover, it is hard to standardize the histological characteristics of root canal dentin, smear layers, and residual dentin structure. Therefore, future studies are required.

Within the limitations of our study, the use of Dual Rinse HEDP increases the adhesive bonding of fiber posts to root canal dentin. The irrigation of the post cavity with SmearOFF also increases the push-out bonding strength of the fiber posts similar to levels when irrigated with EDTA; however, the levels were not as high as with Dual Rinse HEDP. On the other hand, the combined use of Dual Rinse HEDP with NaOCl has a negative effect on the strength of the push-out bond strength due to the properties of NaOCl.

CONCLUSION

Clinically, irrigation of the post cavity with Dual Rinse HEDP is recommended, because it increases the bond strength of the fiber posts. However, when an antibacterial effect is desired, SmearOFF may be preferred instead of NaOCl due to its CHX content.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Gülter Devrim Kaki;* ***Design:*** *Gülter Devrim Kaki, Duygu Recen, Bengisu Yıldırım;* ***Control/Supervision:*** *Gülter Devrim Kaki;* ***Data Collection and/or Processing:*** *Duygu Recen, Bengisu Yıldırım;* ***Analysis and/or Interpretation:*** *Duygu Recen, Bengisu Yıldırım;* ***Literature Review:*** *Gülter Devrim Kaki;* ***Writing the Article:*** *Gülter Devrim Kaki, Duygu Recen, Bengisu Yıldırım;* ***Critical Review:*** *Gülter Devrim Kaki, Duygu Recen, Bengisu Yıldırım;* ***References and Fundings:*** *Gülter Devrim Kaki;* ***Materials:****Gülter Devrim Kaki.*

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