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The Influence of Diverse Irrigation Protocols on Resin Sealer Bond Strength to Dentin

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ABSTRACT

Background: The purpose of this study was to assess. The influence of diverse irrigation protocols on resin sealer bond strength to dentin.

Materials and Methods: A sum of 36 single-established andibular premolar teeth were utilized. Root channel forming strategies were applied with ProTaper rotary instruments (Dentsply Maillefer) up to measure F4. The prepared models were then arbitrarily collected into 3 groups ($n = 12$). For each group, an ultrasonic tip (measure 15, 0.02 taper) which was additionally covered with an epoxy resin based sealer and put 2 mm shorter than the working length. The sealer was then actuated for 10 s. A push-out test was utilized to gauge the bond strength between the root canal dentine and the sealer. Kruskal-Wallis test was used to assess the push-out bond strength of epoxy based sealer ($P = 0.05$). The failure mode information were statistically examined utilizing Pearson's chi square test ($P = 0.05$). **Results:** Kruskal-Wallis test showed that there were statistically insignificant difference between the push out bond strength values of 3 mm ($p = 0.149$) and 6 mm ($P = 0.052$) , for group one and two, while there was a statistically significant difference with the push out bond strength value of 9 mm ($P = 0.029$). Pearson's chi square test showed statistically significant differences for the failure types among the groups.

Conclusion: Several epoxy resin based sealers actuated ultrasonically demonstrated comparative bond strength in oval formed root canals. Apical areas for all groups have higher push out bond strength standards than middle and coronal segments.

Keywords: Epoxy resin-based sealers, Ultrasound, Bond strength, Root canal filling.

INTRODUCTION

Even though predictable clinical outcomes have been stated with the utilization of nonbonding root canal sealers [1, 2], there has been a constant search for substitute sealers or methods that bond instantaneously to canal wall dentin along with filling materials [3–5]. Before the start of contemporary methacrylate resin–based sealers that are exactly designed for endodontic application [6, 7], there had been sporadic efforts on the utilization of low viscosity resin composites and dentin bonding agents, such as, sealers for root filling materials and with favorable in vitro outcomes [8, 9].

The preservation of fiber posts in root canals is reliant on adhesion amid the resin cement and the dentine, in addition to the adhesion amid the resin cement and the posts. On the other hand, the adhesion amid the resin cement and the dentine is deliberated to be the weak point in luting a fiber post [10].Even though bonding amid the post and the root canal dentine plays a pivotal role in the long-term success of a restoration, ensuring reliable bonding between the post and the composite core is also necessary. If the bonding of that interface is poor, de-bonding and/or fracture of the core and post can occur [11]. Successful bonding minimizes the wedging effect of the post within the root canal and requires less dentine removal to accommodate a shorter and thinner post; in addition, it leads to lower susceptibility to tooth fracture [12].

The sealing of a root canal structure totally keeps the colonization and re -infection of the oral pathogens in the root canal and periapical tissues; accordingly, this technique may give a long haul effective endodontic management [13, 14]. Gutta-percha can't stick to the dentinal surface so sealer application is needed. The actuation of root canal sealers may probably sustenance their penetration inside dentinal tubules, giving an expansion in the sealability and antibacterial impacts [15]. Numerous scientists have examined different irrigation methods and ultrasonic frameworks to expand the push-out bond strength of sealers [16-18].

Epoxy pitch based sealers have phenomenal physical properties, for example, longer setting time, low dissolvability, high stream rate, low volumetric polymerization reduction, and interfacial adjustment

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and furthermore are identified with covalent bonds between epoxide rings and the uncovered amino gatherings in the collagen system [19, 20].

As of late, Guimaraes et al. [21] demonstrated that ultrasonic actuation of an epoxy resin based sealer expanded dentinal sealer infiltration and diminished breaches (21). There are insufficient sources in the writing for approving this information, so the impact of ultrasonic initiation of the epoxy sap resin-based sealers with respect to the push-out bond strength is obscure. In this way, the point of this examination was to assess the bond quality of Adseal (Meta, Biomed, Cheongju, South Korea, AH plus (Dentsply Maillefer, Ballaigues, Switzerland), and Acroseal (Septodont, Saint Maur des Fosses, France). The null hypothesis being tested was that there was no distinction between the epoxy sap based sealers (AH plus, Acroseal, Adseal) as far as bond quality to root dentin.

MATERIALS AND METHODS

In the present study, 18 single-rooted human mandibular premolar teeth which were removed due to orthodontic, periodontal, and prosthetic causes. Preoperative mesiodistal and buccolingual radiographs were taken of every root to approve the canal anatomy.

The teeth having more than one single root canal and apical foramen, root canal treatment, internal/external resorption, immature root apices, and caries/cracks/fractures on the root surfaces were excluded. The soft tissue and calculus on the root surfaces were mechanically detached by utilizing a periodontal scaler and then the teeth were reserved in refined water at room temperature till they were utilized. Just oval shaped root canals were utilized. To recognize oval shaped channels, the base width of the root canal was measured mesio-distally, and the greatest diameter was measured bucco-lingually. Just teeth canals having buccolingual/mesiodistal proportions of more than 2 were utilized [21].

The span of the apical foramen was controlled by embeddings a #10 stainless steel K-record (Dentsply Maillefer). Apical size more prominent than ISO measure 10 was prohibited from the examination. The teeth were decoronated with a diamond disc submerged water cooling to get an institutionalized root length of 12 mm. At that point, a #10 stainless steel K-record was embedded into the canal until the point when its tip was only noticeable at the apical foramen and working length was resolved as 1 mm short of this estimation. Root canal forming strategies were completed with ProTaper rotary instruments (Dentsply Maillefer) up to the F4 (size 40, .06 taper) master apical file size. The root canals were irrigated with 2 ml 2.5 % NaOCl (ImidentMed, Konya, Turkey) after utilization of each file.

Toward the finish of the shaping, the root canals were irrigated with 5 ml of 17 % Ethylene-diamine-tetraacetic acid for 1 min and 5 ml of 2.5 % NaOCl for 1 min. The root canals were dried with paper points. Then the prepared samples were randomly gathered into 3 groups (n = 6) and filled as follows:

- **Acroseal with ultrasonic activation group**

The circumference of the ultrasonic tip (size 15, 0.02 taper) was concealed with the newly mixed Acroseal sealer. The tip was put 2 mm shorter than the working length and the sealer was enacted for 10 s. The root canals were filled with gutta-percha cones which were coated with a thin layer of the recently blended Acroseal using cold lateral compaction method.

- **Adseal with ultrasonic activation group**

The recently mixed Adseal was connected around the circumference of the ultrasonic tip and after that the tip was put 2 mm shorter than the working length and the sealer was actuated for 10 s. The root canals were loaded with gutta-percha cones which were covered with a thin layer of the newly mixed Adseal using cold lateral compaction method.

- **AH plus with ultrasonic activation group**

The circumference of the ultrasonic tip (size 15, 0.02 taper) was concealed with the newly mixed AH plus sealer involved to an ultrasonic device (NSK Varios 750; Nakanishi Inc., Tochigi, Japan). The tip was put 2 mm shorter than the working length and the sealer was enacted for 10 s. The root canals were filled with gutta-percha cones which were coated with a thin layer of the newly mixed AH in addition to utilizing cold lateral compaction method. After the filling processes, mesio-distal and bucco-lingual radiographs were used to affirm complete filling. Coronal cavities were filled with glass ionomer cement. The teeth were kept in an incubator at 37° C and 100 % humidity for 2 weeks to permit whole setting of the sealer.

After the test process, every area of the examples was outwardly inspected under a stereomicroscope at 32× magnification to decide the sort of failure. Three sorts of failure were classified: adhesive failure (no sealer visible on dentine walls), cohesive failure (dentine walls totally covered with sealer) and mixed (a combination of cohesive and adhesive failure). The information of push-out bond strength of the root canal filling material to the root dentin were showed as mean ± standard error of the mean (SEM), standard deviation and minimum-maximum values. The assumptions of data normality and homogeneity of variance, which are the requirement for ANOVA, were tested with the Kolmogorov Smirnov and the Levene's tests, respectively. The incidence of failure sort between the segments was examined with the Pearson chi-square test. The level of significance was set at $P < .05$. All calculations were performed with SPSS statistical software.

The study was done after approval of ethical board of King Abdulaziz university.

RESULTS

Table 1 demonstrates the median, standard deviation and minimum - maximum push out bond strength values of groups. Kruskal Wallis test indicated that there were no statistically significant differences among the sealer groups for apical ($p = 0.149$) and middle sections ($P = 0.052$), there was statistically significant difference among the groups for coronal sections ($P = 0.029$) and Mann Whitney U test indicated that the difference was between Adseal and AH plus for coronal section ($P = 0.006$).

Table 1: Median and range push out bond strength value of sealers

Sealers	Sections	Number	Median	Std. Dev.	Min-Max
Ah Plus	apical	6	2,54	2.160	0.301-7.214
	middle	6	0,99	0.592	0.204-2.054
	coronal	6	1,97	4.327	0.140-11.87
Acroseal	apical	6	2,05	1.113	0.702-4.025
	middle	6	0,90	0.287	0.091-1.199
	coronal	6	0,08	0.649	0.001-1.877
Adseal	apical	6	1,29	1.128	0.619-4.058
	middle	6	0,45	0.612	0.001-1.895
	coronal	6	0,00	0.966	0.001-2.645

In connection with the sealer types, there were statistically significant differences between the segments of Adseal and Acroseal, the differences were among both apical-middle and apical-coronal sections ($P < 0.05$) and there was statistically insignificant difference amid middle- coronal sections for both sealers ($P > 0.05$).

For AH plus, there was a statistically significant difference among apical-coronal sections ($P < 0.05$) and there were statistically insignificant differences for both apical-middle and middle-coronal sections ($P > 0.05$). The chi-square test showed that there were statistically significant connection for occurrence of failure types in apical middle and coronal sections and there were statistically insignificant difference between the groups in terms of failure types in Acroseal, AH Plus, and Adseal (Table 2).

Table 2: Incidence analysis and Chi-square test outcomes for failure type

		Adseal		Acroseal		Ah plus		P-Value
	Failure type	Frequency	%	Frequency	%	Frequency	%	
apical	ADHESIVE	1	5,6%	1	6,0%	1	6,0%	0.00
	COHESIVE	2	11,1%	1	6,0%	1	6,0%	
	MIX	3	16,7%	4	22,2%	4	22,2%	
middle	ADHESIVE	1	5,6%	1	6,0%	1	6,0%	0.00
	COHESIVE	4	22,2%	1	6,0%	3	16,7%	
	MIX	1	5,6%	4	22,2%	2	11,1%	
coronal	ADHESIVE	0	0,0%	1	6,0%	1	6,0%	0.00
	COHESIVE	2	11,1%	1	6,0%	2	11,1%	
	MIX	4	22,2%	4	22,2%	3	16,7%	
P-Value		0.168		0.879		0.684		

DISCUSSION

The impact of ultrasonic enactment of a sealer on bond strength was examined in the present investigation. The null hypothesis was that there would be no distinction between the groups regarding the push-out bond strength. As indicated by after effects of the current examination, there was no statistically significant difference between the push-out bond strength estimations of epoxy resin based sealers in the apical and middle segments. In this way, the null hypothesis was incompletely accepted. The outcomes of the current examination demonstrated that the difference between the failure types amid the sections for groups were statistically significant .The infiltration of the sealer into the dentine tubules of the root channel changes as per the kind of sealer, the water system frameworks and arrangements [17, 21]. Ultrasonic gadgets are generally used to expand the adequacy of the inundating arrangements [18, 22].

Duarte *et al.* [23] assessed the impact of ultrasonic enactment of calcium hydroxide pastes on pH and calcium discharge in simulated outside root resorptions was carried out (23). They found a higher pH level when the calcium hydroxide paste was actuated with ultrasound. They indicated that this result was potentially because of the constructive outcome of ultrasonic actuation on the infiltration of calcium hydroxide particles within the dentinal tubules. In our examination, irrigation solution and irrigation systems were institutionalized. On the other hand, the sealer was actuated ultrasonically whereas the root canals were being filled.

Marciano *et al.* [24] stated that there were statistical insignificances in relations to percentage of voids, adaptation, solubility and flow among the epoxy resin based sealers (Adseal, Acroseal and AH Plus)(24) . More lately, additional study by **Guimaraes *et al*.** [21]assessed the influences of ultrasonic activation on the filling quality (intratubular sealer infiltration, interfacial adaptation and presence of voids) of four epoxy resin based sealers and determined that ultrasonic activation of epoxy resin based sealer encouraged more dentinal sealer infiltration and decreased the occurrence of gaps. In addition, they found a significant increase in infiltration for Acroseal, AH Plus, and Sealer 26 at the 4-mm level, and the AH Plus and Sealer 26 at the 6-mm level when the sealers were actuated ultrasonically. The influence of ultrasonic activation on the push-out bond strength of epoxy resin based sealers was assessed in the current study.

Accordingly, the findings of our study cannot be directly compared with the findings of the aforementioned study. Present study outcomes show that apical section has the highest push out bond strength values than middle and coronal sections for epoxy resin based sealers.

For the reason that the taper of master apical file is 0.06 and the taper of ultrasonic tip is 0.02, in apical section the distance amid dentin wall and ultrasonic tip is shorter than middle and coronal sections of root. Consequently the ultrasonic activation can be more effective in apical section.

CONCLUSION

Inside the limitations of this study, apical sections for all groups have higher push out bond strength values than middle and coronal sections. Several epoxy resin based sealers activated ultrasonically presented comparable bond strength in oval shaped root canals.

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