International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 01-05www.ijdmsrjournal.com ISSN: 2582-6018

Effect ofCalcium Hydroxide as Intracanal Medicament on Resin Sealer Bond Strength to Root Dentine

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Submitted: 04-03-2024 Accepted: 13-03-2024

ABSTRACT: Objective: Tostudytheeffect of utilizing Calcium Hydroxide $Ca(OH)_2$ as intracanal medicament on the strength of the sealer bond to dentineusingAH Plus sealer.

Materials and methods: Twenty single-rooted human teeth were prepared by ProTaper Next up to X4. The specimens were randomly allocated into two groups (n=10 teeth): the control group (without intracanal medicament) and $Ca(OH)_2$ group. After one week, the intracanal medicament was removed and the obturation was done by lateral compaction technique using AH Plus sealer. The obturated teeth were incubated for one week.A universal testing machine for the push-out test was used to determine the sealer bond strength. Data were statisticallyanalyzedbyindependentt-testandone-way ANOVA followed by post hoc Tukey at a significance level($p < 0.05$).

Results: At the coronal and apical regions, there were no significant difference in the bond strength of AH Plus sealer between the control and $Ca(OH)_2$ group($P>0.05$).At the middle region, the control group was significantly higher in the sealer bond strength than that of the $Ca(OH)_2$ group($P < 0.05$).Within both groups, the sealer bond strength at the coronal region was significantly higher than that at the apical and middle regions($P < 0.05$).

Conclusion: Under the present study conditions, the application of $Ca(OH)_2$ as intracanal medicamentreduced the adhesion of the resin sealer to root dentine.

Keywords: Calcium Hydroxide,Obturation,Push out bond strength, Resin sealer.

I. INTRODUCTION:

The three-dimensional hermetic seal of the root canal is one of the primary goals of endodontic treatment. The most popular obturation method in endodontics continues to be the combination of a core material and a root canal sealer. A sealer is primarily utilized to fill any gaps between the canal walls and the gutta percha cones due to the lack of adherence of gutta-percha[(1)].

For endodontic use, resin sealers and adhesive bonding have been developed to enhance root canal filling[(2)]. A sealer must adhere to dentine to hinder the bacterial leakage[(3)]. The nature of irrigant solutions and intracanal medicaments is one of the variables that may have an impact on this bond because they could prevent the endodontic system from being adequately sealed[(3,4)].

The most important aspects of endodontic therapyare the chemo mechanical debridement and root canal disinfection. Despite the improvements in irrigation and instrumentation,intracanal medicament is useful in enhancing root canal disinfection[(5)].Between appointments, using a biocompatible intracanal medicament with antimicrobial properties may help to eliminate bacteria in the root canaland improve the prognosis of theendodontic treatment[(6)].

The one of the most popular intracanal medicament in endodontics is $Ca(OH)_2$,which has both biocompatibility and bactericidal properties[(7)]. Various vehicles, including glycerine, saline, distilled water,local anesthetic solution, Ringer's solution camphorated monochlorophenolhave been mixed with $Ca(OH)_2$ powder[(8)].

The root canal wall dentine is affected by the medicament applicationand the various $Ca(OH)_2$ material combinations may result in various alterations in surface of the root dentine[(9)].The adhesion of thesealer to dentine may be influenced by the use of $Ca(OH)_2$ [(10)].

It may be challenging to effectively remove the intracanal medicament from the root canal[(11,12)]. Consequently, any $Ca(OH)_2$ particles adhering to the canal walls may have an impact on the sealer's setting[(13)]. This would increase the possibility of microbial (re)contaminationand fluid percolation from coronal and apical pathways(14). The push-outbond strength test is a popular evaluation method used to measure the bonding strength of the sealer(15,16).

Based on these observations, the aim of this study was to evaluate the effect of utilizing $Ca(OH)_2$ as intracanal medicament on the strength of the sealer bond to dentine using push-out bond strength test.

II. MATERIALS AND METHODS

The present study was approved by the Research Ethical Committee of Faculty of Dentistry, Mansoura University(Under protocol ID:A05071221).it was performed according to the ethical standards of the declaration of Helsinki.

Preparation of Calcium hydroxide

A pure mix of $Ca(OH)_2$ powder (Prevest Denpro Limited, Jammu, India) was prepared with distilled waterin 1:1 ratio to obtain a thick creamy consistency.$Ca(OH)_2$ was used and manipulated according tothemanufacturers' instructions.

Teeth selection

A total number of 20 freshly extracted, single- rooted human teeth wereobtained from OralSurgery Department in Faculty of Dentistry, Mansoura University. The teeth were extracted due to orthodontic and periodontal problems.

The teeth were selected following certain inclusion criteria:

1. Single straight root canal.
2. Completely formed apex.
3. Absence of calcification within the canal.

Teeth Preparation

Before canal instrumentation, the teeth were decoronated horizontally to the level of the cemento-enamel junction by using high-speed carbide bur with water coolant to obtain a standardized root length of 16 mm.

Canal patency was established for all the canals by inserting a size 15 stainless steel K-file (Mani, INC, Japan) until it's tip was just visible at the apical foramen and the length was measured. The working length (WL) was determined as 1 mm short of this measurement and recorded. A radiograph was taken to ensure that the working length was adequate.

Root canal shaping procedures were performed using the ProTaper Next rotary system (Dentsply Sirona, Charlotte NC, USA) up to the X4 (size 40/0.06) master apical file size. The files were used in a gentle in-and-out movements at a speed of 300 rpm and torque of 2 Ncm. When apical resistance was encountered, the instrument was removed and cleaned, and the canal was irrigated. Canal patency was maintained using a size 15 K-file.

All root canals were irrigated with 5.25% sodium hypochlorite (NaOCL) after use of each file via a 27-gauge side vented endodontic needle (Fanta, China). The irrigating needle was positioned 2mm shorter than the predetermined working length.

The prepared teethwereallocated into two groups (n=10) as follows:

Group 1:No Intracanal Medication (Control group).

Group 2: $Ca(OH)_2$ group.

All prepared canals were dried using # 40 paper points (Meta Biomed, Cheongju, Korea). Theintracanalmedicamentwasplaced insidethecanalby a lentulospiral(Mani,INC,Japan).

The coronal access cavity was sealed with Cavit (ESPE, Seefeld, Germany)and the sample were incubated in100% relative humidityat 37°C for 7 days. One week later, the intracanal medication was removed by 5 mL of 17% Ethylenediaminetetraacetic acid (EDTA) with passive ultrasonic activation, followed by 5 mL of distilled water and 95% ethanol as a final flush.

Lateral compaction techniquewas done using AH Plus sealer (Dentsply Sirona) and applied inside the canals using lentulo spiral. Gutta-percha cones size 40/0.04 (Meta Biomed, Cheongju, Korea) were coated with the sealer and inserted inside the canals to the full working lengththen using accessory gutta-percha cones till no space to add more accessory cones. All samples were sealed with Cavitand incubated in 100% relative humidity at 37°C for 7 days.

Push-Out bond strength analysis

Each sample was embedded in chemical cured acrylic resin inside a plastic syringe. After setting of acrylic resin, three horizontal sections (coronal, middle, apical) of 2 mm thickness were cut using water cooled diamond disk mounting with an isoMet 4000 micro saw (Buehler, USA) at a feeding rate of 10 mm/min and speed of 2500 rpm

Auniversal testing machinewas used in the test. The filling materials were loaded with a stainless-steel plunger with diameters of 0.5 mm, 0.7 mm, and 1 mm for the apical, middle, and coronal third slices respectivelywithout touching the wall of the canal. The maximum compressive loading force required to remove the filing material was recorded. After push-out test, each root section was examined and photographed.

Statistical analysis

The data were statistically analyzed by GraphPad Prism (Version 10.0; GraphPad software, San Diego, California, USA). Intergroup comparison was performed by independent t-test. The intragroup comparisons between (Coronal, Middle and Apical) regions were performed by one-way analysis of variance (ANOVA) followed by the Tukey post hoc.

III. RESULTS

The push out strength [MPa] in the control and $Ca(OH)_2$ groupsat different regions is shown in table (1).

- **Intergroup comparison:**

At the coronal and apical regions, no significant difference was observed in the sealer bond strength between control and $Ca(OH)_2$ groups (P>0.05). At the middle region, the control group was significantly higher in the sealer bond strength than that of the $Ca(OH)_2$ group (P < 0.05).

- **Intragroup comparison:**

In the control group, the push-out bond strength at the apical and middle sections significantly greater than that at coronal section.
In the $Ca(OH)_2$ group, the bond strength at apical section was significantly higher than that at coronal and middle sections.

Table (1): Mean ± Standard deviation of push out strength [MPa] of the control and calcium hydroxide groups at different regions.

Region	Control Group	Calcium Hydroxide Group	P-Value
Coronal	$7.14^{Aa} \pm 1.29$	$5.7^{Aa} \pm 2.21$	**0.093**
Middle	$10.13^{Ba} \pm 4.01$	$6.17^{Ab} \pm 0.9$	**0.007**
Apical	$10.05^{Ba} \pm 1.16$	$8.78^{Ba} \pm 2.03$	**0.104**
P-Value	**0.019**	**0.001**	

*Values with different superscript lower-case lettersindicatesignificancein the same row (P<0.05)andvalues with different superscript upper-case lettersindicatesignificance in the same column (P<0.05)

IV. DISCUSSION

One of the most crucial characteristics of root canal sealers is adhesion. The root canal filling material should adhere to root dentine and it should be resistant to the microleakage and also should have the strongest possible bond with the root canal dentine[17]. A resin-based sealer (AH Plus) was investigated due to its excellent biocompatibility, minimal apical leakage, good radio-opacity and insolubility in tissue fluid.

Differences in root canal dentine properties across specimens at various sites of the same root such as variances in tube density, the existence of accessory canals and areas of resorption, may affect the adhesive features of endodontic sealers to dentine[18].Due to its clarified antimicrobial efficacy against the majority of strains found in intracanal infections, the $Ca(OH)_2$ is the most commonly used intracanal medicament in endodontics.

Using 5 mL 17% EDTA with passive ultrasonic activation and followed by 5 mL distilled water then final rinse with 95% ethanol for intracanal medicament removal.This in a line with**Stevens et al.**whoexamined thesealerpenetration and leakage in smear-free dentin and discovered that this approach improved sealer penetration and decreased leakage(19).So far, none of the methods have been successful in completely removing $Ca(OH)_2$ from the root canals.

The push-out test is one of the most popular tests tomeasurethe shear stress between dentine and sealer, similar to that produced in clinical conditions(20,21). Even when the bond strength is minimal, this procedure is effective, repeatableandmeasurable(20-22).At the apical, middleand coronal third slices, loads were delivered using flat-tip plungers with diameters of 0.5 mm, 0.7 mmand 1 mm, respectively. The bonding strengthinfluencedbythe sealing ability of the sealer to dentine, diameter of the plugger, the sample thickness and the orientation of the specimens(20).

The study's findings showed that when compared to the $Ca(OH)_2$ group, The mean push-out bonding was the higher in the control group and also concluded that $Ca(OH)_2$ residue may decrease bonding between the sealer and the dentine. This is in line with Guiotti et al.who demonstrated that $Ca(OH)_2$ had a detrimental impact on AH Plus sealer bonding strength(23).Furthermore, the root canal dentine's structure can be badly affected by calcium hydroxide high alkalinity, which may also interfere with the sealer bond strength(24-26).

V. CONCLUSION

Under the present study conditions, placement of $Ca(OH)_2$ reduced the sealer bond strength with root dentine.

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