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TO ASSESS & COMPARE DEPTH OF PENETRATION OF AN EPOXY AMINE BASED RESIN SEALER IN SIMULATED LATERAL CANALS AFTER MANUAL, SONIC & ULTRASONIC AGITATION- *AN IN VITRO STEREOMICROSCOPIC STUDY*

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ABSTRACT

Objectives The aim of this study was to evaluate the efficacy of sonic and ultrasonic activation of epoxy-amine resin-based root canal sealer on penetration of the sealer into lateral canals compared to non-activated filling.

Materials and method Thirty-six single-rooted human anterior teeth were decoronated and prepared, using the ProTaper rotary system (Dentsply Maillefer, Ballaigues, Switzerland) to F4. After the completion of the clearing procedures, lateral canals were created at 3 mm from the working length. The specimens were randomly divided into a control group (manual agitation) and two experimental groups that received a sealer application with either sonic or ultrasonic activation. The root canals were filled using cold lateral compaction and imageswere obtained from each lateral canals at 40× magnification using a stereomicroscope. The sealer penetration was evaluated using a four-grade scoring system. The data were evaluated statistically using the Mann–Whitney U tests with a 95 % confidence level (P = 0.05).

Results The ultrasonic activation resulted in a better sealer penetration compared with the non-activated and sonically activated groups (P < 0.001). Sonic activation also resulted in better sealer penetration compared to the non-activated group (P < 0.001).

Conclusions The use of the ultrasonic activation of an epoxyamine resin-based sealer promoted greater sealer penetration into the lateral canals. Sonic activation was not effective as ultrasonic.

KEYWORDS :

INTRODUCTION

The primary aim of endodontic treatment is to eliminate the microorganisms within the root canal system and prevent recontamination. This can be achieved by thorough shaping, cleaning, disinfection & 3 dimensional sealing of root canal system. However, root canal presents with various anatomical challenges such as presence of lateral canals, apical deltas, accessory canals etc. limiting the ability of clinician in achieving these goals.[1,2]

The prevalence of lateral canals have been shown to be in range of 8.3 to 45% & is maximum in apical 3mm of the tooth.[3] According to Weine untreated & unfilled lateral canals can retain enough irritants in a protected sanctuary high enough to cause endodontic treatment failure.[4] This emphasizes the importance of cleaning & sealing of these anatomical variations.

Root canal sealers along with Gutta-percha helps in achieving a complete 3 dimensional seal by penetrating into these anatomical variations and the dentinal tubules of the root canal system.[5] Meta Ad seal, an epoxy amine based resin sealer offers excellent biocompatibility, hermetic sealing ability & radiopacity. They are also known to be insoluble in tissue fluids & are non staining to the tooth.[6,7]

Use of sonic & ultrasonics to activate irrigant in the canal has shown to be a clinically proven and an efficient adjunct for thorough cleaning & disinfection of root canal system.[8] Likewise, activation of root canal sealers may favour its penetration inside the dentinal tubules and lateral canals thus, enhancing the seal. Nikhil V et al in their study concluded that Ultrasonic activation of pseudoplastic sealers can significantly increase its percentage and depth of penetration of sealers in the dentinal tubules.[9]

This study aims to assess & compare the depth of penetration of Meta AD seal sealer in simulated lateral canals after sonic & ultrasonic agitation.

MATERIALS & METHODS

A total of 36 single-rooted, non-carious, freshly extracted, maxillary human anterior teeth with fully formed apices were collected, stored & handled using CDC & OSHA guidelines. Bucco-lingual & mesio-distal radiographs were taken to ensure the presence of single root canal without calcification. The teeth with root canal curvature more than 10° were excluded from the study. The specimens were then stored in distilled water at room temperature until use. Specimens were decoronated with a diamond disc under water coolant to obtain a standardized root length of 15 mm. Root canal shaping procedures were performed with ProTaper rotary instruments (Dentsply Maillefer, Ballaigues, Switzerland) up to F4 (size 40, 0.06 taper). Irrigation was done with 2 mL 5.25 % NaOCl (ImidentMed, Konya, Turkey) between instrument changes. A final flush was done using 5 mL of 17%EDTA for 1 min followed by normal saline. The root canals were then dried with paper points. The specimens were then cleared using the modified technique described by de Gregorio et al. The teeth were submerged in 5 % nitric acid for 36 h, and the solution was renewed every 8 h. Samples were than cleared with tap water for 3 min, and lateral canals were created by inserting a 08 K-file from the buccal to the lingual wall at 3mm from the working length perpendicular to the external surface. Samples were dehydrated in ascending grades of ethyl alcohol and submerged in 99.9 % methyl salicylate for clearing and rehardening . The root surfaces were coated with wax to obtain a closed end channel. The root canals were rinsed with distilled water and dried using paper points. Then, the specimens were then divided randomly into three groups (n = 12)

Group A :- Agitation by lentulo spiral (control group)
Group B:- Agitation using indirect ultrasonics
Group C :- Agitation using Endoactivator

The Meta AD Seal sealer (Meta Biomed, Cheongju, South Korea) was mixed according to manufacturers instructions, applied on canal walls using size 40 gutta percha and was agitated with one of the technique mentioned . The activation in **Group A** was performed using a lentulo spiral for 10 sec**. Group B** a size 'A' nickel-titanium finger spreader (Dentsply Maillefer) adapted into an ultrasonic device (Jet-Sonic Four Plus; Gnatus, Ribeir~ao Preto, SP, Brazil) in

"endo" mode (50% potency) using a no. A-120 insert (Gnatus) was used and as the ultrasonic oscillates in a single plane, the spreader was activated for 20 seconds in the buccolingual direction and another 20 seconds in the mesiodistal direction of the root canal. For **Group C** the activation was done using Endoactivator device (Dentsply Maillefer) with a tip size 35/04 for 10 sec. Next, a 40.06 gutta-percha cone (Dentsply Maillefer) was inserted to the full working length, and the root canal obturation was completed using the lateral compaction The cervical portion of the specimens was sealed using a provisional filling material .The specimens were stored in 100% humidity at 37°C for 1 week to allow the sealer to set. images at 40× magnification were obtained for each lateral canal using a stereomicroscope (Novex, Arnhem, Holland). The images were coded to avoid identification of the specimens. The sealer penetration into the lateral canal was scored using the following scoring system:

0: Lateral canal was empty.
1: Sealer was present in less than half of the lateral canal.
2: Sealer covered more than half of the lateral canal.
3: Lateral canal was completely filled with sealer

36 photographs were evaluated by the blinded examiner 1 week later. The differences in the sealer penetration scores among the different groups were analyzed with Mann–Whitney U tests. Testing was performed with the 95 % confidence level (P = 0.05). All statistical analyses were performed using IBM® SPSS® Statistics 20 software (IBM SPSS Inc., Chicago, IL, USA).

RESULTS

36 lateral canals were visualized by an observer who was blinded about the method used for agitation of sealer. The score for each canal was noted and data was subjected to statistical analysis using Mann–Whitney U test. The mean value for ultrasonic group(GroupIII) was found to be higher i.e. 2.46 compared to other two groups and was statistically significant with p value less than 0.001 as shown in the table. The mean value for sonic group (GroupII) was found to be higher i.e 2 than manual agitation group (GroupI) i.e 1.46. Thus, the study results shows that the ultrasonic activation resulted in a better sealer penetration compared to the non-activated and sonically activated groups (P < 0.001)

GROUP	MEAN	S.D	S.E.	Kruskal wallis test value	p value, Significance
Group 1 (manual)	1.41	0.50	0.083	143.225	P< 0.001, highly significant Statistical difference
Group II (Ultrasonic)	2.46	0.50	0.084		
Group III (Sonics)	2	0.55	0.092		

DISCUSSION

The main goal of endodontic treatment prevention and treatment of lesions of endodontic origin. Successful endodontics is based on triad i.e. correct diagnosis, biomechanical preparation and three-dimensional obturation. Most of the failures of the root canal treatment occur due to inadequate cleaning and improper obturation of the root canal system. Both these factors are limited by the presence of anatomical challenges like lateral canals, apical ramifications, fins, isthmus.[10] **Ricucci D et al**[11] showed that lateral canals can serve as potential pathway through which bacteria or their products from the necrotic root canal might reach the periodontal ligament and likewise, bacteria from periodontal pockets might reach the pulp. Similarly, **Weine et al**[4] showed that untreated lateral canals can be the cause for endodontic treatment failure. Thus, complete cleaning & sealing of this anatomical irregularity is of prime imortance. Endodontic sealers penetrate into canal irregularities such as lateral canals, providing a hermetic seal which determines long term success of endodontic treatment.[12] **Marciano et al**[13] evaluated the properties of three different epoxy resin based sealers and concluded that all sealers provided similar root canal adaptation, solubility & flow. **Patel DV et al**[14] & **Gharib SR et al**[15] compared Resin based sealers with Conventional sealers & concluded that resin based sealers shows a better depth of penetration of into root canal dentin. Meta Adseal root canal sealer is an epoxy amine based sealer that offers excellent biocompatibility, flow and a good hermetic seal. It is known to be insoluble in tissue fluids and does not cause tooth staining.[6,7] The use of various irrigation protocols & activation of irrigants using sonic and ultrasonic devices have been evaluated previously & are known to increase the efficiency of irrigating solution providing a thorough debridement of complex root canal anatomy.[16,17] Recently, **Duarte et al**[18] evaluated the influence of ultrasonic activation of calcium hydroxide pastes on pH and calcium release in simulated external root resorptions. They found that the pH level was found to be higher when the calcium hydroxide paste was activated with ultrasound. They stated that this finding possibly due to the ultrasonic activation having favored a greater penetration of calcium hydroxide particles inside of the dentinal tubules. However, there is limited data about the effect of these activation devices on penetration of endodontic sealers into dentinal tubules & lateral ramifications of root canal system. In the present study it was found that application of Ultrasonics for activation led to significantly more depth of sealer penetration. This can be attributed to the fact that ultrasonic devices act at a higher frequency than sonic devices thus, transmiting the acoustic microstreaming energy which results in greater depth of sealer penetration.[19] **Guimares et al**[5] in their study also concluded that use of ultrasonics for activation of various epoxy resin based sealers promoted greater sealer penetration and less presence of voids.

CONCLUSION

Within the limitations of study it was seen that the use of ultrasonic activation of Meta Adseal sealer promoted greater sealer penetration into the lateral canals. Sonic activation was not as ef fective as ultrasonic activation, but was more effective than manual activation group.

Limitations of study:

1. The extracted teeth show degrees of variation though all care was taken to maintain them by proper and recommended storage.
2. Since this was an in vitro study, the exact simulation of the oral conditions was not possible. Therefore, the results cannot be directly extrapolated to the clinical situation.
3. Making standardized lateral canals using k-files do not represent exactly the irregular anatomy of lateral canals in vivo. Thus, the creation of simulated lateral canals might result in an overestimation of the removal efficacy of irrigation systems.

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