



Impact of different irrigation activation techniques with single file system on apical extrusion of debris: An in vitro study

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Abstract

Aim: This study aims to compare the amount of apical debris extrusion using different irrigation activation techniques when used with single file system.

Materials and methods: 60 single rooted extracted teeth were used in the study. After working length determination, biomechanical preparation was done using single file system. Samples were placed in Eppendorf tubes to collect debris. The specimens were randomly divided into four equal groups in terms of the irrigation activation techniques; group I, no activation; group II, manual dynamic agitation; group III, passive ultrasonic irrigation; and group IV, sonic activation. For each specimen, a total of 10 milliliters of distilled water were utilized in the irrigation process. For five days, the tubes were kept in an incubator. The extrusion quantity of debris was determined by deducting the tube's starting

weight deducted from its ultimate weight. The data distribution was looked at. applying the Wilk-Shaker test. For post-hoc group comparisons, the Mann-Whitney U-test was employed.

Results: All specimens had debris extrusion, but the no activation group showed significantly less debris extrusion than the activation groups ($P < 0.05$). No other significant differences were found between groups ($P > 0.05$).

Conclusion: Within the limitations of the present study, the PUI system considerably extruded the least quantity of debris. All irrigation activation techniques used with single file system were linked to apical extrusion of debris; nonetheless, the results are not statistically significant.

Keywords: Apical Debris Extrusion, Irrigation Activation, Manual Dynamic Agitation, Passive Ultrasonic Irrigation

Introduction

A lower incidence of debris extrusion may reduce the severity of postoperative responses and improve patient comfort following the procedure. One method that is frequently used for root canal irrigation is conventional needle irrigation [1]. The isthmus, fins, lateral, and accessory canals are among the complicated anatomy that cannot be adequately cleaned by traditional needle irrigation [2]. Different irrigation activation strategies were created for this reason in order to boost the effectiveness of irrigation solutions [3]. During activation, a gutta-percha cone that fits well is utilized repeatedly in insertion motions up to the working length for manual dynamic activation (MDA). With few strokes, the cone is applied to activate the irrigant [4]. The activation of irrigant with the passive ultrasonic irrigation (PUI) is an acceptable technique which removes debridement and provides an efficient canal disinfection [5]. This study compared the amount of apical debris extrusion after performing different irrigation activation techniques prepared with Hyflex EDM single file system.

Materials and Methods

60 extracted single rooted teeth from Department of Oral and Maxillofacial Surgery, SB Patil Institute for Dental Sciences and Research, Bidar, Karnataka were used. A size 15-K file was used to control the canal patency until the tip was visible at the apical foramen and 1 mm was subtracted from this length to determine the working length. Biomechanical preparation was done using Hyflex EDM single file system. To facilitate meticulous debris collection, 60 empty Eppendorf tubes were meticulously labelled and weighed using digital

weighing scale (Shimadzu, Kyoto, Japan). The specimens were randomly divided into four groups as follows (n=15):

1. Group I (no activation): Final irrigation was done with 5 ml distilled water without any additional agitation.
2. Group II (Manual dynamic activation): distilled water was activated with gutta percha point for one minute, 1 mm short of the working length.
3. Group III (PUI): distilled water was activated with ultrasonic device and ultrasonic tip which was placed 1 mm short of the working length.
4. Group IV (sonic activation): distilled water was activated with sonic device with tip placed 1 mm short of apex.

The remaining debris in the root canal was irrigated into the tube. The tubes were maintained in an incubator at 70°C for 5 days to evaporate the distilled water. Three consecutive weights were obtained for each tube, and the mean weight was calculated as the final weight. Finally, number of extruded debris was calculated by subtracting the initial weight from the final weight including the debris.

The Shapiro-Wilk test was used to assess the data's normal distribution, the Kruskal-Wallis test was used to compare the parameters, and the Bonferroni-adjusted Mann-Whitney U-test was applied for post-hoc group comparisons when the data's normality was compromised. P values less than 0.05 were deemed significant for all tests.

Results

All specimens had debris, however the no activation group showed considerably less debris extrusion than all activation groups ($P < 0.05$). No significant differences were identified across other groups ($P > 0.05$). Table 1 lists the mean and standard deviations for each group.

Table 1: Mean masses and standard deviations of apically extruded debris using activation methods

Groups	Mean \pm SD
Group I (NA)	0.00056 \pm 0.00031
Group II (MDA)	0.00122 \pm 0.00032
Group III (PUI)	0.00091 \pm 0.00042
Group IV (sonic activation)	0.00100 \pm 0.00034

Discussion

Postoperative discomfort and inflammation of the periapical region were linked to the extruded debris [6]. Consequently, decreased extrusion of debris may lessen postoperative discomfort [7]. Extrusion of debris can also result from irrigation methods and irrigant activation. Therefore, the purpose of this study was to assess how various irrigation activation strategies affected the extrusion of apical debris when used after biomechanical preparation with Hyflex EDM single file system. Irrigation was unable to reach 40–60% of the canal walls when the chemomechanical preparation was performed using traditional needles [8]. Similar to PUI activation, the MDA approach permits irrigation fluid to enter the dentinal tubules [9]. According to Ribeiro et al., PUI outperformed needle irrigation and MDA in terms of debris removal [10]. In order to emphasize the potential impact of the activation approaches and remove data that may be interpreted incorrectly owing to irrigant crystallization, distilled water was utilized in place of sodium hypochlorite. The MDA methodology showed somewhat greater debris extrusion in the current study when compared to other activation techniques, but the difference was not statistically significant. According to a study, MDA method resulted in more postoperative discomfort than traditional needle, PUI methods, irrigation, and sonic activation following a root canal treatment within the first twenty-four hours [11]. This finding might be explained by the increased extrusion of

debris as seen in the current study. Irrigation using a conventional needle may create an apical vapor lock which significantly limits the irrigant exchange at the apical third of the root canal system [12]. To get around this, irrigation activation mechanisms have been created. The nonactivated group had the lowest debris extrusion in the current study. This finding may be explained by the findings of other studies that indicated conventional irrigation is not sufficient to remove debris from irregularities in root canals or to adequately clean the walls of the root canals. It is to be noted that no statistically significant difference was found in all activation groups. Sonic activation of irrigant showed higher extrusion of debris when compared to PUI. The sideways movement of the sonic file will vanish when its mobility is restricted, but a longitudinal vibration will still occur [13]. Ultrasound activation is said to be more effective than sonic activation because it creates a faster fluid stream [14]. One possible explanation for PUI's better efficiency is the positive correlation between streaming velocity and frequency [13]. A greater frequency guarantees a higher irrigant flow velocity, which improves PUI's ability to eliminate microorganisms [15]. The concept of single file reduces the time consumption for cleaning and shaping of the root canal along with reduced chances of cross contamination between the patients. This system saves both the time and the cost also [16]. Hence, single file system was used in the present study. Activation approaches increased the quantity of debris extrusion, but it is important to take into account their advantages in clinical practice and the limits of using in-vitro circumstances to replicate clinical situations.

Conclusion

Within the limitations of the present study, the PUI system considerably extruded the least quantity of

debris. All irrigation activation techniques used with single file system were linked to apical extrusion of debris; nonetheless, the results are not statistically significant.

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All of the authors have read and approved this manuscript, all of the writers have satisfied the standards previously indicated in this document for authorship, and each author believes the work portrays sincere labor.

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