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Original Research Article

# Comparative evaluation of the efficacy of various irrigating techniques by checking the depth of penetration of the sealer- An in-vitro study

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ABSTRACT

**Context:** Sonic irrigant activation has gained widespread popularity among general dentists and endodontists currently. It is usually seen that sonic powered flosser which we have used in our study is in use in many dental colleges by post graduate students as it is construed to be the cheaper version of Endoactivator.

**Aim:** To investigate the efficacy of sonic powered flosser with various irrigating techniques by checking the depth of sealer penetration.

**Materials and Methods:** Forty five single-rooted teeth were instrumented and divided into 3 groups of 15 teeth each, as Group 1: endoactivator; Group 2: powered sonic flosser; Group 3: manual dynamic irrigation. The samples were obturated with AH Plus sealer labelled with Rhodamine B dye. The teeth were sectioned and viewed under confocal microscope to determine the depth of sealer penetration.

Statistical analysis used: One way Anova F test was used for overall comparison among three groups and Tukey's post hoc test were used to evaluate the efficiency levels between groups. P value less than 0.05 was considered significant for all statistical test.

**Results:** The results showed that the maximum penetration was exhibited by endoactivator followed by manual dynamic irrigation and least by powered sonic flosser. The middle third showed the maximum penetration, followed by apical third in all the groups.

**Conclusion:** Sonic powered flosser and manual agitation weren't found to be as effective as Endoactivator, so in the absence of Endoactivator, sonic and manual agitation can't be relied upon for desired results.

**Key Messages:** The agitation of the irrigants is found to be most effective with endoactivator in order to achieve appreciable sealer penetration.So using sonic powered flosser will not be able to render the results as good as endoactivator.



## 1. Introduction

The sealer penetration into dentinal tubules and their adaptation to the canal walls effectively, largely depends upon how well the canals are debrided during the biomechanical preparation. Endoactivator (Dentsply) is the new armamentarium on the endodontist's table and in this study we have compared Endoactivator with a powered sonic flosser (waterpik), as we wanted to check the efficiency of both in removal of the debris from root canals and its effect on intratubular penetration of sealer. The null hypothesis of the study is that there is no difference on intratubular penetration of sealer between endoactivator and powered sonic flosser group.

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## 2. Materials and Methods

### 2.1. Sample selection

For the present study, freshly extracted forty-five human teeth were used. All tooth extractions were performed at the Department of Oral and Maxillofacial Surgery, having patients signed the appropriate informed consent form approved by the university ethics committee (ITSDCGN/PRIN/L/2021/00337). Digital periapical radiographs were performed to select only single-rooted teeth with a single straight canal and fully formed apices without calcifications, and no previous endodontic treatment. Next, teeth were kept in 0.9% saline solution at $4^oC$ until the following methodological steps.

### 2.2. Shaping and cleaning of root canal system

The teeth were decoronated with a diamond disk in a slow speed under constant irrigation, and roots were standardized to 10mm length. The working length was determined by inserting # 15 K-file (Dentsply) into the canal until it was just seen at the apical foramen and then 0.5 mm was subtracted from this length. Then depending upon the irrigation system used roots were randomly divided into two experimental groups i.e., G1: Endoactivator (Densply); G2: Powered sonic flosser (Waterpik) and one control group (G3) in which no irrigation device was performed. The roots were instrumented by using the ProTaper Universal root canal files (Dentsply) in a sequential manner from S1 till F1. Canals were then irrigated with devices between files with 2 mL of 3% NaOCl. Final irrigation was done with 1 mL of 17% ethylenediaminetetraacetic acid (EDTA) (pH 7.7) for 1 min, followed by a final rinse of 5 mL distilled water.

Group 1 (n=15): The endoactivator (Densply) was used with a Nylon tip for activation. The tip was inserted 2 mm short of the working length inside the canal and was ultrasonically activated for 20 seconds. (Figure 1 )

Group 2 (n=15): The powered sonic flosser (Waterpik) was used for activation. The tip was inserted 2 mm short of the working length inside the canal and was ultrasonically activated for 20 seconds. (Figure 2)

Group 3 (n=15): Manual agitation with gutta percha cone up and down in short 2-3 strokes.

### 2.3. Sealer preparation

AH plus sealer was mixed according to the manufacturer instructions and to allow analysis under the CLSM, sealer was labelled with Rhodamine B to an approximate concentration of 0.1% (by weight).

The rhodamine B dye–sealer mixture was placed along the entire length of the root canal with endoactivator, keeping the device 3 mm from the canal apices in all the groups.

ProTaper F1 gutta -percha cones were lightly coated with the Rhodamine B mixed sealer and placed to entire working length as the master cone. The canals were obturated with lateral compaction technique by using size 25 finger spreader and size 20 accessory cones.

Samples were then sectioned using a saw under continuous water cooling to prevent frictional heat, obtaining two slices per sample, at 2 and 5mm from the apex, with a thickness of 2mm + 0.1mm.

### 2.4. Confocal laser scanning

Slices corresponding to the middle and apical thirds were analyzed in a confocal laser microscope. For correct visualization of all images, the slices were analyzed 10$\mu$m below the surface using a $\times$10 lens. Respective absorption and emission wavelengths for rhodamine B and Fluo-3 were 545/740 nm and 494/590 nm. Images were recorded at $\times$10 magnification using the fluorescent mode to a size of 800$\times$800 pixels and a scale set to 70$\mu$m. The sealer penetration area within dentinal tubules was measured by Adobe Photoshop CS6.

Descriptive statistics including mean and standard deviation of debris removal efficiency values and inferential statistics calculated by using Statistical product and service solution (SPSS) version 21 software. Shapiro wilk test showed normal distribution of data.One way Anova F test was used for overall comparison among three groups and Tukey's post hoc test were used for multiple comparisons of efficiency levels between groups. P less than 0.05 was considered significant for all statistical test.

## 3. Results

1. The mean value and standard deviation of degree of sealer penetration in all the three groups at apical and middle third root canals are shown in Table 1.
2. In all the groups, Middle third part of root canal showed maximum degree of sealer penetration than the apical third and the difference was highly statistically significant ($p<0.001$)
3. At both levels, Group 1 showed maximum degree of sealer penetration followed by Group 3 and least in Group 2.
4. At the apical third of root, maximum degree of sealer penetration was observed in Group 1 followed by Group 3 and least in Group 2 however the difference between the groups were statistically not significant.
5. At middle third of root, statistically significant difference exists between Group 1 and Group 2 but there was no statistically significant difference between Group 3 and Group 2.

**Table 1:** hows the mean value and standard deviation of degree of sealer penetration in all the three groups at apical and middle third root canals

| S.No. | Groups | Apical Third ($\mu$m) Mean+ SD | Middle Third ($\mu$m) Mean+ SD |
|---|---|---|---|
| 1. | Group 1 (Endoactivator) | 775.67 + 190.34 | 1085.7 + 228.36$^{A}$ |
| 2. | Group 2 (Sonic flosser) | 653.77 + 143.41 | 747.39 + 119.22$^{B}$ |
| 3. | Group 3 (Manual needle irrigation) | 724.87 + 132.64 | 807.04 + 88.15 |

Same upper-case superscript letters (A and B) mean statistically significant differences.
SD: Standard Deviation, ($\mu$m): Micrometres.

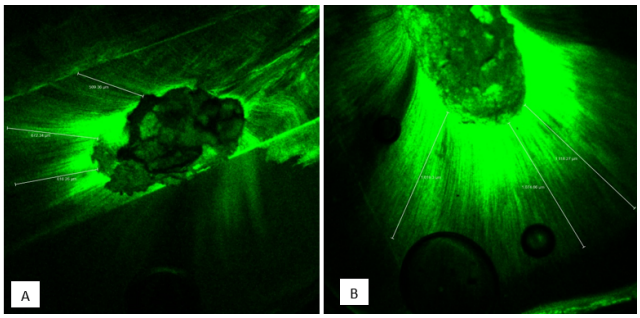


**Figure 1:** Sealer penetration in dentinal tubules using Endoactivator; **A:** At apical third; **B:** At middle third.

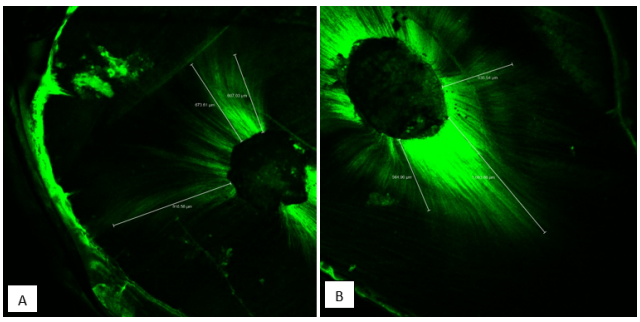


**Figure 2:** Sealer penetration in dentinal tubules using Sonic powered flosser; **A:** At apical third; **B:** At middle third.

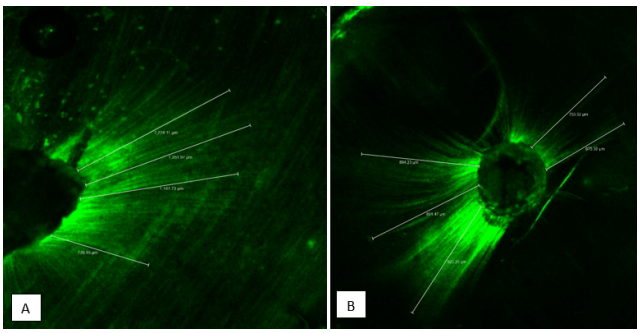


**Figure 3:** Sealer penetration in dentinal tubules using manual dynamic irrigation; **A:** At apical third; **B:** At middle third.

## 4. Discussion

Sealer penetration into dentinal tubules seems to be a positive outcome to control bacterial penetration and colonisation in the tubules as it works as a blocking agent, that also enhances filling material retention within the root canal, thanks to mechanical interlocking between sealer and root dentin, and entomb remaining bacteria within dentinal tubules. Therefore, sealer penetration into dentinal tubules is considered clinically relevant.[1–3]

In the present study the null hypothesis was rejected as there was significant difference in sealer penetration among the groups using different irrigation devices.

In all the three groups maximum depth of penetration was observed in middle thirds than in apical thirds of root canal. This can be explained by the fact that the dentinal tubules in middle third are present in greater quantity with large diameters than those in apical area (Hachem & others, 2018).[4]

Amongst all the three devices that were used in this study, Endoactivator showed the maximum sealer penetration, as this accomplishes hydrodynamic activation of the irrigants that is capable of cleaning the root canals and their irregularities, such as lateral canals. Endoactivator is a device which sonically activates irrigant solutions using frequencies in the range of 2–3 khz.[4–8] The results obtained with the present study were similar with the other studies that has been already done in the past, that is, higher depth and percentage of sealer penetration was seen at the apical and middle-third with EndoActivator. The possible reason of higher sealer penetration at middle and apical third can be attributed to greater smear layer removal and more irrigant reaching at these inaccessible areas by using EndoActivator as compared to manual conventional irrigation technique.[4,9–13]

In this study we have used powered flosser as we wanted to check whether it is as efficient as endoactivator in removal of debris from root canals. The powered battery flosser also works on the principles of Sonics, as Endoactivator, but because of its affordable cost it's been widely used by many post graduate students in many dental schools.[14] However in this study, endoactivator polymer tip was used instead of the tip that was available with powered flosser.

In the present study, manual agitation showed greater sealer penetration than sonic powered flosser however the difference was statistically insignificant. Khaord P & others (2015)[15] in their study found manual agitation group to show better smear layer removal than passive ultrasonic irrigation and sonic irrigation group.

To the best of our knowledge, the effect of powered sonic flosser on sealer penetration in root canals have not been studied so far. Though, powered sonic flosser also works on the principles of Sonics but still Endoactivator showed better result, this could be due to the difference in sonic frequency between the Endoactivator and Powered sonic flosser. So

based on this study we would like to conclude that the use of powered sonic endo flosser should be avoided when removal of smear layer is intended to achieve maximum sealer penetration.

## 5. Conclusion

Within the limitation of the study, we can conclude that

1. Between middle and apical thirds of canal, middle third showed maximum sealer penetration into dentinal tubules in both experimental group as well as control group.
2. The depth of sealer penetration using endoactivator irrigation system was significantly better than the other groups at 2mm and 5mm of root canal length.
3. Manual dynamic irrigation group showed greater degree of sealer penetration than battery powered flosser, however the difference was not statistically significant.

## 6. Source of Funding

None.

## 7. Conflict of Interest

None.

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