Mittal N. Apical Extrusion of Debris & Irrigants by different Irrigating Needles.

**Original Article**

**Comparative Evaluation of the Amount of Debris and Irrigants Extruded Apically by Different Irrigating Needles - An in vitro study**

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**Abstract:**

Introduction: The main goal of the successful endodontics is the complete sterilization of the root canal space. During preparation, irrigants and debris such as bacteria, dentin fillings and necrotic debris may be extruded into the periradicular region leading to periapical inflammation and post-operative flare-ups. Several instrument designs and irrigation techniques have been developed to prevent this. Material and methodology: Forty non carious extracted single rooted mandibular premolar teeth were divided into four groups of ten samples each depending upon the type of irrigating needles used i.e tip vented needles, side vented needles, ultrasonic tips & a control group with no irrigation used during instrumentation with K-files. The apically extruded debris and irrigating solution were collected in an apparatus made by using Myers and Montgomery technique and were measured quantitatively. The results were compared using a one-way ANOVA. A post hoc Tukey analysis and repeated measure test were used for multiple comparisons. Results: The mean weight of the extruded debris and irrigants for the three experimental groups was highest for the tip vented needles followed by side vented and then the ultrasonic tips. Conclusion: All the irrigation systems extruded the irrigating solution and debris. However, ultrasonic irrigating tips showed least apical extrusion.

Key words: Apical Extrusion, Side-vented needles, Tip-vented needles, Ultrasonic tips.

**INTRODUCTION**

Cleaning and debriding the root canal system involves the removal of organic and inorganic debris. The organic debris includes the vital and necrotic pulp tissue, microorganisms, salivary or tissue fluids, endotoxins and other foreign components that have entered the root canal system. In contrast, the inorganic debris includes the minerals that are deposited in the canal system and debris deposited on the canal walls subsequent to instrumentation. The irrigation of root canals with antibacterial solutions is considered an essential part of chemomechanical preparation. Root canal irrigation is the key to cleaning and disinfecting the areas where the instrument cannot reach. Irrigation with a syringe and a needle remains the most commonly used procedure. In vitro studies have demonstrated that when root canals are instrumented and irrigated with patent apical terminations, extrusion of irrigants beyond the apical constriction is routine, which can be associated with pain, swelling, and tissue damage. An improved irrigation delivery system is highly desirable for effective root canal...
debridement. Such system should have adequate flow of irrigant to working length without forcing the solution into periapical tissues.[12] To increase the safety and efficiency of irrigation, different needle types, irrigation techniques and activation systems have been developed. Among these, new irrigation and activation systems, passive ultrasonic irrigation and apical negative pressure irrigation have been shown to promote an effective removal of debris and reduction of intracanal bacteria.[13] De Gregorio et al. [14] compared both systems and found that Apical Negative Pressure delivered the irrigant predictably to working length while Passive Ultrasonic Irrigation caused significantly more penetration of irrigant into lateral canals but not till working length. Studies have shown less extrusion with sonic or apical negative pressure devices compared with syringe and side-port needle.[2]

To understand the dynamics of apical extrusion of debris and irrigants from the root canal, various studies have been conducted in which different experimental set – ups simulating the clinical condition have been designed. The most commonly used method in various studies is the one proposed by Myers and Montgomery in 1991. The apparatus consisted of an instrumented root secured with a rubber stopper into a glass vial of 15x 45 mm which was placed into a glass flask with a rubber stopper fitted tightly on the mouth of the flask. A 25- gauge needle was placed alongside the stopper during the insertion to equalize the pressure inside and outside of the flask. The flask was then held securely in a rubber – jawed vise. The amount of extruded debris and irrigants is achieved by subtracting the weight of the collection vials after instrumentation and prior to it. To measure the amount of extruded irrigant specifically, the vial with the extruded material was placed next to a calibrated vial with 0.5ml increments of the irrigant used. The dry weight of the irrigants was calculated by placing the vials in a dessicator with CaCl$_2$ crystals.[15]

This in vitro study was aimed to compare the amount of debris and irrigating solution extruded apically by using the tip-vented needle, Side-vented needle and Ultrasonic tips.

**MATERIAL AND METHOD**

Fourty extracted human single-rooted mandibular premolar teeth were used in this study. The criterias for inclusion were: noncarious teeth, completely formed apices, single canal with single apical foramen, non-calciﬁed canals, and canal curvature less than 20 degrees, which were determined according to Schneider’s method.[15] The root end was inspected under magnification (X 20) to verify closed apices and the absence of root resorption or visible cracks. The teeth were radiographed from bucco-lingual and mesio-distal views to ensure that there was single canal and one orifice in each tooth. The teeth were then stored in saline till the experiment was started. Teeth were decoronated with a diamond disc to get equal length of root in all the samples (14mm). Forty samples were divided into four groups (n=10) depending on the irrigating needle used:

- **Group A**: No irrigation (control group, no irrigant used)
- **Group B**: Tip vented needles (NaviTip; Ultradent)
- **Group C**: Side vented needles (Calasept)
- **Group D**: Ultrasonic tips (woodpecker)

Figure 1: Group B Group C Group D
Test Apparatus: Empty gutta percha tubes were pre-weighed on a digital weighing machine (Mettlar PJ 3600) along with sponge piece. Two coats of nail varnish was applied on the external surface of roots except at the apical 2mm of the root. Each tooth sample was embedded on empty gutta percha tube with the help of stopper and wax leaving 2 mm of the coronal portion outside the stopper. A 22 gauge needle was bend and forced alongside the rubber stopper to keep the balance between the air pressure inside and outside the tubes. (Figure 2)

![Test Apparatus](image)

Figure 2: Test Apparatus

Root canal treatment: Debris and irrigant extruded from the apical foramen during instrumentation were collected using the Myers and Montgomery technique. The working length (WL) of each sample was determined by inserting a K-file size #15, which was observed to extend beyond the apical foramen and then subtracting 1 mm from the length of the file. BMP was done using crown down technique using ProTaper hand files and apex was prepared till size F3. In all the groups, 1ml of 5.25% sodium hypochlorite irrigant was used between the consecutive files, except for control group in which BMP was done without irrigant. On completion of the root canal preparation, the canals were dried with paper points, and the teeth were removed from the tubes. Full procedure was performed by a single operator.

Apical extrusion evaluation: After removing the tooth each gutta percha tubes were again weighed on the digital weighing machine after completion of instrumentation. (Figure 3) The amount of extruded debris and irrigating solution was then measured by subtracting the post-instrumentation weight from the pre-instrumentation weight and put to statistical analysis.

![Weighing of the gutta percha tube after instrumentation](image)

Figure 3: Weighing of the gutta percha tube after instrumentation

STATISTICAL ANALYSIS: The extend of apical extrusion of irrigants and debris by three different irrigating techniques was compared using a one-way ANOVA. A post hoc Tukey analysis and repeated measure test were used for multiple comparisons. The level of statistical significance was set at P<0.001.

RESULTS

In the control group (no irrigant used) there was no difference in weight of the gutta percha tubes before and after instrumentation. All teeth in the three experimental groups were included in the extrusion analysis to calculate the mean weight difference for the extruded debris & irrigant. The mean weight of the extruded debris & irrigant for the three experimental groups was highest for the tip-vented group (0.038 ± 0.00753) followed by the side-vented group (0.15 ± 0.00837) and then the ultrasonic tip group (0.0017 ± 0.00408). Statistical analysis showed a significantly higher extrusion for the tip-vented and side-vented irrigation systems compared to the ultrasonic tip (p<0.01). The Tip-vented group also had a significantly higher extrusion compared to the side-vented group.
Table 1: Comparison of extruded debris & irrigant apically

<table>
<thead>
<tr>
<th>Group</th>
<th>Apical Extrusion Mean ± SD</th>
<th>ANOVA</th>
<th>Inter Group Comparison</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group B</td>
<td>0.0383 ± 0.00753</td>
<td>F = 43.256;</td>
<td>Group B vs C</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Group C</td>
<td>0.0150 ± 0.00837</td>
<td>P &lt; 0.001**</td>
<td>Group B vs D</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Group D</td>
<td>0.0017 ± 0.00408</td>
<td>Group C vs D</td>
<td>0.012*</td>
<td></td>
</tr>
</tbody>
</table>

#Post-Hoc Tukey; * p < 0.05; Significant; **p < 0.001; Highly Significant
Group A was Control group

Graph 1: Weight (Mean ± SD) for the extruded debris & irrigant for the tip-vented, side-vented and ultrasonic tips.

**DISCUSSION**
This in vitro study was conducted to evaluate the extrusion of debris and irrigant in the apical area of the root with an ultrasonic tips compared to the tip-vented and side-vented needle irrigation systems. In the present study maximum apical extrusion was with tip vented needles followed by side vented and least by ultrasonic-tips.

The main objective of root canal therapy is to prevent and treat periradicular inflammation by eliminating microorganisms from the root canal system and preventing subsequent reinfection.\[^{16}\] It has been shown that the root canal curvature and length can influence the amount of apical extrusion of debris. Therefore, in the present study only straight root canals (curve between 0–10) with similar lengths were used.\[^{17}\] To simulate periapical tissue which may pose resistance to apical extrusion of debris, a piece of sponge was used.\[^{15}\]

According to the results of the present study the tip vented needles showed highest amount of apical extrusion this may be due to increased amount of mean pressure exerted by these tips on the apical foramen thus leading to increased apical extrusion. Ultrasonic irrigation causes least amount of apical extrusion of debris and better canal cleanliness because ultrasonic activation causes agitation of the irrigation solution against canal walls and minimum amount of the pressure is exerted on the apical foramen.\[^{18}\]
The side-vented group in our study produced less amount of apical extrusion & cleaner canals compared to the tip-vented group. The reported superior performance of the side-vented needle has been attributed to turbulence effect and greater distribution of irrigating solution because of their design. [19,20]

CONCLUSION
Within the limitations of the present study, all the irrigating systems extruded the debris and irrigants apically. Ultrasonic irrigating tips showed least apical extrusion of debris and irrigants followed by tip vented needles.

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