

## Original Research

### Influence of irrigation on debris extrusion varying the instrumentation using rotary instruments

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#### ABSTRACT:

**Background:** To evaluate the influence of irrigation on debris extrusion varying the instrumentation using rotary instruments.

**Materials & methods:** The extracted single rooted teeth were divided into 3 groups. The apically extruded debris was collected in preweighed eppendorf tubes as per the Myers and Montgomery method. After drying, the mean weight of debris was assessed with a microbalance. The data were initially analyzed using the Shapiro-Wilk test to verify the assumption of normality. The statistical significance level was set at 5%. **Results:** The mean value of apically extruded debris for XP endo shaper was 0.016 whereas for protaper gold was 0.039. **Conclusion:** The amount of apically extruded debris registered for the different files tested was protaper gold > HEDM > XPS.

**Keywords:** Irrigation, Protaper, Hyflex EDM, XP Endo Shaper.

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#### INTRODUCTION

During the root canal preparation procedures, dentin chips, pulp tissue, microorganisms and/or irrigants may get extruded into the periradicular tissues. Though a thorough control of the working length (WL) may decrease the risk, but nevertheless extrusion of any debris may potentially cause post-operative complications such as flare-ups,<sup>1</sup> which are characterized by pain, swelling causing unscheduled visits of the patients resulting in interappointment emergency.<sup>2,3</sup>

Sodium hypochlorite (NaOCl), often used at concentrations ranging between 0.5% and 6%, is the most popular irrigation fluid used in Endodontics. In addition to its proven bactericidal action, it exhibits excellent dissolution activity of organic matter.<sup>4</sup> Because its improved biocompatibility, in addition to its antimicrobial properties, chlorhexidine (CHX) has

been recommended as an adjunct irrigant. It can be used in solution or gel form and at concentrations ranging from 0.2% to 2%. The gel form of CHX has different physical properties from the solution due to its viscosity and ability to eliminate much of the smear layer.<sup>5</sup> It is important to emphasize that despite the excellent antibacterial action of NaOCl and CHX, anatomical variations and remnants of obturation materials, in cases of retreatment, interfere with disinfection of the root canal system because they limit the access of the irrigation solution to the remaining pulp tissues.<sup>6</sup>

According to studies, apical debris is produced by almost all instrumentation procedures. The amount of debris extruded apically was first measured by Vande Visse JE and Brilliant JD.<sup>7</sup>

The multi-file system is based on a sequence of files in different sizes. The main disadvantage with these systems is that it is time-consuming because they may require multiple exchanges of file sizes.<sup>8</sup>

The reciprocating motion relieves stress on the files by special counter clockwise (cutting action) and clockwise (instrument release) movements.<sup>9</sup> In recent years, the advent of single-file systems has exceedingly simplified the multistep rotary instrumentation into a single-step procedure.

The null hypothesis was that neither the instrument nor the irrigant influenced the amount of apically extruded debris. Hence, this study was conducted to evaluate the influence of irrigation on debris extrusion varying the instrumentation using rotary instruments.

### Materials & methods

The extracted single rooted teeth were taken and disinfected in a solution of 0.1% thymol for 24 h and stored in saline until use. The crowns were sectioned such that all specimens had a length of 16 mm from the root apex. The file with a rubber stopper was then carefully introduced into each canal until it was just visible at the apical foramen. The working length (WL) of all teeth was established 1 mm short of this measurement and was confirmed with a radiograph. The samples were then divided into groups i.e Group 1 -XP Endo Shaper(FKG XP) N=10 , Group 2- Hyflex Edm (Coltene, Whaledent) N=10 and Group 3- Protaper Gold (Dentsply Sirona) N=10.

Each Eppendorf tube was preweighed by the electronic microbalance. Three consecutive weighings were conducted for each tube and their arithmetic mean was regarded as the weight of each empty Eppendorf tube. The experimental model used to evaluate debris extrusion in the present study was similar to that described by Myers and Montgomery.<sup>10</sup> Each individual tooth was held in a preweighed Eppendorf tube by a rubber stopper, and this assembly was fixed inside a glass vial. It was made sure that no possible contact was made between the Eppendorf tube and the glass vial.

The pulp chamber and the root canal were filled with 2 ml of normal saline. After three passes, the instrument flutes were cleaned with sterile gauze. The canal was irrigated with 2 ml of sodium hypochlorite followed by saline and a size 10 K file was used to maintain apical patency. These procedures were repeated until the file reached the WL and were subsequently prepared using XP Endo Shaper, Hyflex EDM and Protaper Gold.

The teeth were then removed from the Eppendorf tubes, and their roots apices were washed with 1 ml of distilled water, to collect the debris that had adhered to their outer side. All tubes were incubated at 37°C for 15 days to allow the evaporation of the remaining irrigant from the tubes. After the incubation period, each Eppendorf tube with debris was weighed. Three consecutive weights were obtained for each tube, and the mean value was calculated. The dry weight of extruded debris was calculated by subtracting the

weight of the empty tube from the weight of the tube containing debris.

The data were initially analyzed using the Shapiro-Wilk test to verify the assumption of normality. The statistical significance level was set at 5%.

### Results

The mean value of apically extruded debris for XP Endo Shaper was 0.016 whereas for Protaper Gold was 0.039. All files caused some degree of extrusion of debris from the apex. The mean value of apically extruded debris for Hyflex EDM was 0.026.

Table-1 shows the median, minimum, and maximum values of the amount of apically extruded debris for each group ( in mg)

Group	N	Mean	Minimum	Maximum
XP Endo Shaper	10	0.016	0.00	0.05
Hyflex EDM	10	0.026	0.00	0.06
Protaper Gold	10	0.039	0.01	0.06

### Discussion

Postoperative pain and swelling are usually associated with instrumentation procedures, such as a host immune response to extruded irrigating solutions and/or microorganisms, over instrumentation, and foreign body reactions to root canal filling materials. Cleaning and shaping of the root canals may trigger an inflammatory reaction by forcing the contents of the root canals such as dentin particles, necrotic pulp tissues, or microorganisms to the periapical region.<sup>11</sup> All instrumentation methods, whether manual, continuous rotation or reciprocation motions led to the extrusion of apical debris, regardless of the irrigation solution used, thus corroborating the results obtained in previous studies.<sup>12</sup> The null hypothesis was rejected on the assumption that the irrigation solutions used had no influence on the amount of debris extruded.

In the present study, the samples were divided into 3 groups. The mean value of apically extruded debris for XP Endo Shaper was 0.016 whereas for Protaper Gold was 0.039 i.e among the instruments

tested, the XPS group extruded a significantly less amount of debris and ProTaper Gold resulted in the greatest amount of debris (P<0.001). There were significant differences in the amounts of residue among the different groups (P<0.001). On the contrary, studies conducted by Bürklein and Schäfer and Nayak et al. showed that single-file reciprocating systems extruded higher debris compared to their counterpart rotary systems.<sup>13</sup> Variation in tooth, length, diameter, and volume of tooth instrumented could be the reason for such differences among studies.<sup>14</sup>

The differences between the groups may be due to (i) the canal preparation technique, (ii) the cross-sectional design of the instruments, (iii) the different tapers of the instruments and (iv) the type of irrigation system used.

HyFlex EDM (HEDM; Coltene/ Whaledent, Switzerland) and XP-endo Shaper (XPS; FKG Dentaire SA, La Chaux-de-Fonds, Switzerland) files are single-file systems used with a continuous rotary movement. HEDM files are produced with the controlled memory alloy using electrical discharge machining technology.<sup>15</sup> The file has 3 different horizontal sections along the working part: quadratic in the apical part and trapezoidal and triangular in the middle and coronal parts. XPS has an apical diameter of 0.30 mm and a fixed taper of 1%. Because of the MaxWire alloy (FKG Dentaire SA), the martensite phase of the file at room temperature converts to the austenite phase at body temperature, and the taper of 1% reaches 4% because of a “snake” shape which may contribute to less extrusion of debris.

ProTaper Gold (PTG) (Dentsply Maillefer, Ballaigues, Switzerland) system, which uses a traditional continuing rotation motion, has a convex triangular cross-section, variable progressive taper, and rotary action. It is claimed that PTG is manufactured with professional metallurgy. It has a continuously tapered shape for more efficient and safer cutting action along with reportedly increased elasticity and impedance to cyclic fatigue.<sup>16</sup> Despite the design and other features, ProTaper Gold resulted in the greatest amount of debris ( $P < 0.001$ ).

A study conducted by Shetty et al. concluded that ultrasonic irrigation extruded lesser debris in comparison with conventional syringe irrigation.<sup>17</sup> Open-ended needles generate positive pressures in excess of central venous pressure.<sup>18</sup> A study by Boutsoukis *et al.* concluded that, there is an increased mean pressure at the apical foramen during open-ended needle irrigation, indicating increased risk of extrusion toward the periapical tissue.<sup>19</sup>

In the present study, straight root canals with a single canal were chosen for standardization. Mature teeth were included in this study, while excluding teeth with incomplete root development as dentin mineralization is less intense in young teeth as compared to mature teeth, making them more susceptible to wear, resulting in increased extrusion.<sup>20</sup> Needles of 30G were used for irrigation as the design allows it to freely fit to a point just short of the physiologic terminus facilitating efficient irrigation. Open-ended needles were used in the present study, as they have better irrigant replacement. They were placed 2 mm short of the WL to ensure adequate irrigant exchange and high shear stress against the root canal wall.<sup>21</sup>

Apical extrusion of debris is not the only quantifying factor involved in the postoperative flare-ups. Further in vivo research is needed to evaluate the postoperative complications caused by the chosen file systems. Considering the limitation of the study that the crown was resected for standardization, this is not representative of the true clinical situation as the presence of the clinical crown can affect the amount of debris extruded. Also, gravity may have played a crucial role in carrying the irrigant out of the canal due

to the lack of backpressure in this study. Therefore, the results of this study are to be assessed with caution as the clinical scenario could not be replicated.

## Conclusion

Under the experimental conditions of the present study, it can be concluded that all the instrumentation systems led to apical debris extrusion. However, the amount of apically extruded debris registered for the different files tested was in the order: Protaper Gold > HEDM > XPS.

## References

1. Seltzer S, Naidorf JJ. Flare-ups in endodontics: I. Etiological factors. *J Endod.* 1985;11:472–8.
2. Harrington GW, Natkin E. Midtreatment flare-ups. *Dent Clin North Am.* 1992;36:409–23.
3. Walton R, Fouad A. Endodontic interappointment flare-ups: A prospective study of incidence and related factors. *J Endod.* 1992;18:172–7.
4. Young GR, Parashos P, Messer HH. The principles of techniques for cleaning root canals. *Aust Dent J.* 2007;52(1 Suppl):S52–63.
5. Gomes BP, Vianna ME, Zaia AA, Almeida JF, Souza-Filho FJ, Ferraz CC. Chlorhexidine in endodontics. *Braz Dent J.* 2013;24(2):89–102
6. Garcia A, Fernandez R, Arias A, De Gregorio C. Efficacy of Different Irrigation Protocols for Removing Gutta-Percha and Sealer Remnants in Artificial Un-instrumented Areas. *Eur Endod J.* 2017;2(9):2–7.
7. Preethy NA, Jeevanandan G, Govindaraju L, Subramanian EM. Comparative evaluation of apical debris extrusion upon use of rotary files and hand files for root canal instrumentation in primary teeth. *J Clin Diagn Res.* 2019;13(2):23-26.
8. Silva EJNL, Carapiá MF, Lopes RM, Belladonna FG, Senna PM, Souza EM *et al.* Comparison of apically extruded debris after large apical preparations by full-sequence rotary and single-file reciprocating systems. *International Endodontic Journal.* 2016; 49(7):700-705.
9. Chapman CE, Collee JG, Beagrie GS. A preliminary report on the correlation between apical infection and instrumentation in endodontics. *International Endodontic Journal.* 1968; 2(1):7-11.
10. Myers GL, Montgomery S. A comparison of weights of debris extruded apically by conventional filing and canal master techniques. *J Endod.* 1991;17:275–9.
11. Ruiz-Hubard EE, Gutmann JL, Wagner MJ. A quantitative assessment of canal debris forced periapically during root canal instrumentation using two different techniques. *J Endod* 1987;13:554–8.
12. Koçak MM, Çiçek E, Koçak S, Sağlam BC, Yılmaz N. Apical extrusion of debris using ProTaper Universal and ProTaper Next rotary systems. *Int Endod J.* 2015;48(3):283–6.
13. Nayak G, Singh I, Shetty S, Dahiya S. Evaluation of apical extrusion of debris and irrigant using two new reciprocating and one continuous rotation single file systems. *J Dent (Tehran)* 2014;11:302–9.
14. Zhang C, Liu J, Liu L. The influence of proTaper and waveOne on apically extruded debris: A systematic review and meta-analysis. *J Conserv Dent.* 2018;21:474–80.
15. Pedull\_a E, Savio FL, Boninelli S, et al. Torsional and cyclic fatigue resistance of a new nickel-titanium

- instrument manufactured by electrical discharge machining. *J Endod* 2016;42:156–9.
16. Arias A, Singh R, Peters OA. Torque and force induced by ProTaper universal and ProTaper next during shaping of large and small root canals in extracted teeth. *J Endod*. 2014;40(7):973-6. doi: 10.1016/j.joen.2013.11.019.
  17. Shetty VP, Naik BD, Pachlag AK, Yeli MM. Comparative evaluation of the amount of debris extruded apically using conventional syringe, passive ultrasonic irrigation and endoIrrigator plus system: An *in vitro* study. *J Conserv Dent*. 2017;20:411–4.
  18. Khan S, Niu LN, Eid AA, Looney SW, Didato A, Roberts S, et al. Periapical pressures developed by nonbinding irrigation needles at various irrigation delivery rates. *J Endod*. 2013;39:529–33.
  19. Boutsoukis C, Verhaagen B, Versluis M, Kastrinakis E, Wesselink PR, van der Sluis LW, et al. Evaluation of irrigant flow in the root canal using different needle types by an unsteady computational fluid dynamics model. *J Endod*. 2010;36:875–9.
  20. Tanalp J, Güngör T. Apical extrusion of debris: A literature review of an inherent occurrence during root canal treatment. *Int Endod J*. 2014;47:211–21.
  21. Kishen A. Irrigation dynamics in root canal therapy. *Dent Trib Middle East Afr*. 2016;1:22–3.