

COMPARISON OF CLEANING EFFECTIVENESS OF ROTARY AND HAND INSTRUMENTATION IN CURVED ROOT CANAL

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ABSTRACT:

Introduction: The aim of this study was to evaluate and compare the root canal debridement ability of ProFile rotary system and manual instrumentation technique in curved root canal using 5.25% NaOCl and 17% EDTA.

Materials and Methods: 30 moderately curved mandibular molars divided into two groups (n=10) were selected for the study. Manual filling was performed on the first group (M) using standardized K file and rotary instrumentation was carried out on the other group (P) using ProFile rotary system. A standardized irrigation protocol using 5.25% NaOCl and 17% liquid EDTA was followed. The roots were cut longitudinally and the canal walls were examined for debris and smear layer at the apical, middle and coronal level

Result: No significant difference could be found at any level. Overall less smear layer was formed on the root canal walls using the ProFile technique.

Conclusion: ProFile rotary technique overall produces cleaner root canal walls than the manual technique.

Keywords: debridement; curved canal; Profile; instrumentation; scanning electron microscopy



INTRODUCTION:

Thorough debridement is the most important aspect of cleaning and shaping of root canal treatment. [(1) (2)] After instrumentation, a layer of debris and smear layer is always formed on instrumented canal wall. [(3)] Smear layer is attached to the dentinal walls and contains organic and inorganic debris including bacteria. It is important to remove this layer, as presence of an

infected smear layer may prevent antimicrobial agents from gaining access to the infected dentinal tubules, [(4)] To facilitate the penetration of sealers into dentinal tubules and adaptation of obturation materials to the root canal walls. [(5) , (6)] Therefore it is essential to remove the smear layer on instrumented canal walls. [(7)] Thus proper cleansing of canal space is most important aspect for success in endodontics. [(8)] The introduction of rotary technique has

made significant breakthrough in mechanical root canal preparation. The manufacturers claim that these systems intend to minimize the number of steps and instruments required for effective preparation of root canals. There are numerous studies have been reported on the cleaning effectiveness of different instrumentation techniques. [(9)] In the present study we have utilized ProFile system which was compared with standardized K file. A scan through literature shows that only few studies are available, which test the efficacy of ProFile systems for canal debridement. [(10), (11)] Although one study available in literature compares manual and ProFile technique using 0.5% NaOCl. [(11)] but in our study, we followed standardized irrigation protocol using 5.25%NaOCl and 17% EDTA as a variable.

Therefore the aim of this study was to compare by means of scanning electron microscopy, the presence of a smear layer on the instrumented canal wall after preparation with ProFile and manual instrumentation techniques.

MATERIAL AND METHODS:

Thirty moderately curved (20° - 25°) mesiobuccal roots from extracted human mandibular first and second molar were selected and stored in 10% formalin. Schneider guidelines were used to estimate degree of curvature. [(2)] The teeth were randomly divided in to 2 experimental groups (n = 10). Manual group (M), ProFile group (P). Access cavity preparation was done using a high speed hand piece with an Endo access bur

(Dentsply). The optimal working length of the root canal was determined by holding the tooth in front of the table lamp with a manual 15 file introduced to a distance of 1mm from the root apex. Root canal instrumentation was performed with manual and ProFile technique. In all techniques, standardized irrigation protocol using 5.25% Naocl and 17% liquid EDTA followed by final flush with distilled water was done. For irrigation 30 gauge needles was used. Instrumentation details were as follows. In group M, instrumentation was done by step back technique, [(12)] with standardised K file (Mani inc, Japan) used in circumferential filling motion. The sequence followed was : 15.02, 20.02, and 25.02,30,02. till WL. Coronal and middle third flaring done with 1.2.3, no Gates Glidden drills. (Dentsply, Maillefer)

In group P, Profile Series (Dentsply, Maillefer, Ballaigues Switzerland) were used (as per manufacturer's instructions) in crown down manner. [(13)] with light in and out passive motion (250rpm). The sequence followed was : 25.06, 20.06, 25.04, and 20.04, till $2/3^{\text{rd}}$ of WL. 15.04, 20.04, 25.04, 30.04 till WL.

After instrumentation the prepared roots were split in longitudinal direction. By means of a light microscope, we selected the root half that was most suitable for SEM analysis and samples were prepared for SEM evaluation. [(11)] The entire surface and each region (apical, middle and coronal) of each canal were examined at magnification ranging from x12 to x 1500. The presence of debris and smear layer was evaluated by scanning electron

microscope at 200 x magnification, respectively.^[(14)] Canal walls were quantitatively evaluated for the amount of smear layer as follows: Smear layer 1- No smear, large open dentinal tubuli. 2- Slight smear layer, most dentinal tubuli were open. 3- Homogenous smear layer covering the major part of the surface, a few dentinal tubuli open. 4- Homogenous smear layer covering the surface, no dentinal tubuli open. 5- Thick non homogenous smear layer covering the surface. The apical, middle and coronal regions of the canal surface were assessed, graded (1-5), and recorded. Representative photos of each region taken in a pilot study were given to examiners before grading. (fig1). The grading system was performed by 3 examiners and was double blinded.

RESULTS:

The calibration exercise of the three evaluators was established and their mean value was taken. Therefore the scoring of sample was considered reliable. The mean score of smear layer recorded at coronal, middle and apical third level are listed in Tables 1, respectively. Figure A, and B are representative photomicrographs of scores 2, and 3 respectively. Statistical analysis was done using Mann Whitney test for intergroup comparison between two groups, with level of significance ($P < 0.005$). When M and P groups were compared in regards to smear layer, no significant difference ($P < 0.05$) was found in all three level. According to mean value, P group produces cleaner canal in coronal (9.40)

and middle (8.90) compared to M group. (Table 1) Apically, no significant difference was found. Overall, P group produces cleaner canal.

DISCUSSION:

The result of the present study are in support of previous studies that showed that neither instruments nor instrumentation techniques achieve complete cleanliness of root canal wall.^[(15)] The superior cleaning ability of rotary instruments over manual instruments as reported by earlier investigators was supported by this study.^[(16), (17)] In the present study, ProFile rotary system produced cleaner canal with respect to smear layer removal in comparison to the manual group with conventional hand files. These results are in contradiction to most similar studies which conclude that manual techniques produces cleaner canal.^[(11)]

Apically none of the technique produces cleaner canal. This may be due the common presence of oval canal apically.^[(18)] In this study, apical preparation is done till size #30 with coronal flaring done in both the techniques. Also size 30 apical preparation is optimum for 30 gauge irrigation needle to insert in deeper level. A study conducted by Abbasali K et al, states that minimum apical enlargement required for proper cleaning is #30 size file with coronal flare by 6% taper file.^[(19)] Although there are studies which states, #40 size apical preparation is required for penetration of irrigant to apex.^[(20)] However, instrumentation to these sizes increases the risk of

perforation, ledge, and transportation, especially in narrow and curved root canals.

Overall at the coronal and middle levels, the canals prepared with profile appeared to have less surface contamination compared with using manual instrumentation. There are several reasons that may explain why Profile have lower smear layer scores than canals shaped by manual instrumentation (especially in apical third). During instrumentation ProFile.04 and .06 taper files were used in crown down technique, which increased the chance of irrigants penetrating deep inside the canal. Manual technique was performed with stainless steel instruments(.02) used in a circumferential filling motion; using step back technique. These instruments are stiffer than nickel-titanium rotary instruments. Another possible explanation for the reduced efficiency of the manual instruments in removing the smear layer may be the less taper of Files (in compare with profile instruments). Concerning the efficacy of manual instrumentation, the results suggest that although a step-back technique was used for root canal preparation, the files when used in a circumferential motion were not totally effective in cleaning the root canal walls at the different thirds. This can be explained by the fact that that the file was not sufficiently forced towards the buccal and lingual recesses, resulting in inadequate instrumentation thus leaving debris and smear layer behind. Clearly, there is a need to determine the importance of these variables in another

study. Another important fact that needs to be emphasized is that, the efficient cleaning not only depend on the type of instrument or instrumentation technique used but also role of chemical irrigation solutions are important along with mechanical instrumentation [(21)]. Baumgartner &Mader [(22)] found that alternating solutions of EDTA with NaOCl was the most effective combination to produce clean root canal walls. Their study demonstrated the importance of using a chelating agent such as EDTA in combination with NaOCl, to effectively remove the inorganic and organic components of the smear layer. Therefore, in the present study 2.0 mL of 5.25% NaOCl and 2.0 mL of liquid 17% EDTA was used in an effort to maximize the cleansing of the instrumented canal walls. It can be argued that the use of 2.0 ml distill water as a final rinse was not necessary, at least not for this study. However, we believed that this was an important step to cleanse the canal of chemicals that had been previously used. To eliminate variables, equal volumes of irrigants were used for all teeth. We used NaOCl followed by liquid EDTA and final flush with distilled water. Our irrigation protocol was based on a recent study which shows liquid EDTA produces cleaner canal and remaining of EDTA paste in apical third area leads to incomplete cleaning.[(23)] Also one recent study utilizes ProTaper Rotary System with variable taper produces significantly cleaner canal in coronal and middle third level.[(24)]We used ProFile with constant taper of .04 and .06 taper. This may have

impacted on non-significant value when compared to manual technique at all level. Although overall ProFile produces cleaner canal than manual instrumentation. In this respect, irrigating solutions and procedures appear more critical than instrumentation techniques.

CONCLUSION:

Within the limitation of the present study neither of the instrumentation techniques

achieved total debridement of the root canal. In the present study, the ProFile technique showed better results compared to manual instrumentation using 5.25% NaOCl and 17% liquid EDTA. There seems significant role of irrigant and different irrigation techniques, recently introduced instruments. Therefore further studies required in this aspect.

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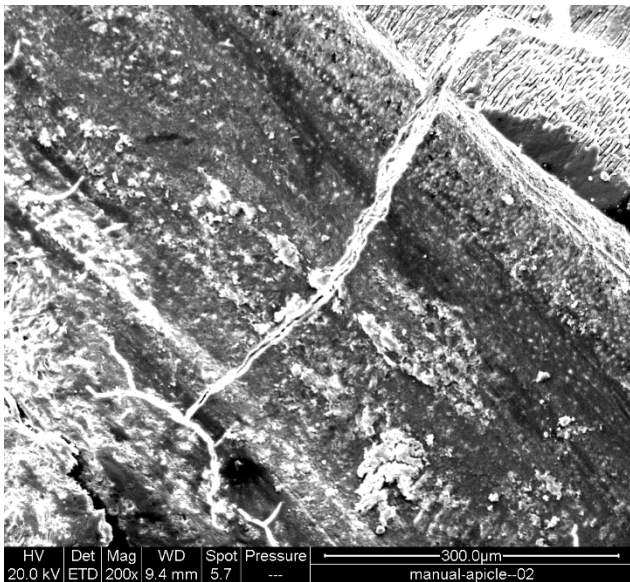
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TABLES:

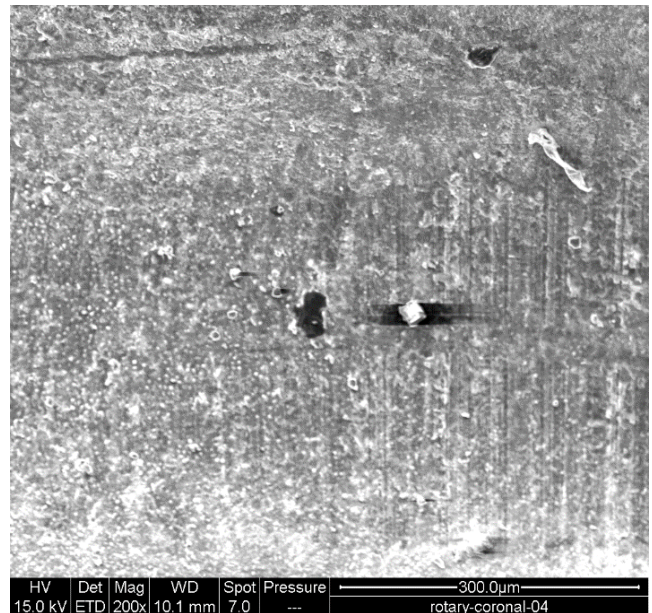
Table 1: Statistical Analysis (Mann Whitney Test) of Mean Smear layer and P value of the tested group

Smear layer Technique	coronal		middle		apical	
	Mean	p value	Mean	p value	Mean	p value
Manual profile	11.40 9.40	(.39)	12.0 8.90	(.22)	10.50 10.50	(1.0)

FIGURES:



(A)



(B)

FIGURE 1 (A) A scanning electron microscopic photomicrograph of a representative specimen of manual instrumentation in apical region with score of 3.note homogenous smear layer covering the major part of the surface, a few dentinal tubuli.(B) A scanning electron microscopic photomicrograph of a representative specimen of rotary instrumentation in coronal region with score of 2 ,Slight smear layer, most dentinal tubuli were open.