

An All-Inclusive Quantitative Assessment Of Apical Extrusion Of Debris During Instrumentation With Three Commercially Available Rotary File Systems: An (In-Vitro) Original Study

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Abstract- Aim: The present study was conducted to quantitatively assess the apical extrusion of debris with three commercially available file systems. **Materials & Methods:** This study was conducted on forty five freshly extracted maxillary central incisors with non-traumatic methods. All 45 samples were selected carefully and segregated into three study groups based on the three commercially available file systems. Authors have ensured to study only NiTi rotary and filing systems so as to maintain standard and constancy in results. Consequently, in group I Mtwo Basic Sequence Files were used for canal preparation and shaping. In group II, ProFile GT Rotary Files were used in the sequence for accurate canal preparation and shaping. In group III, TF Adaptive Files was used for meticulous canal preparation and shaping. Preweighed glass vials (10 ml) were used for debris collection. Results thus obtained were subjected to statistical analysis. **Statistical Analysis & Results:** Statistical analysis was attempted using statistical software 'Statistical Package for the Social Sciences (SPSS)' version 21. The recorded information was subjected to appropriate statistical tests to obtain p values and mean. $P \leq 0.05$ was considered as statistically significant. Debris extrusion in group I was 0.14 milligrams, in group II was 0.23 milligrams and in group III was 0.32 milligrams. The standard deviation for group I, II and III was 0.837, 0.928 and 0.383 respectively. **Conclusion:** Within the limitations of the study the authors have concluded very significant inferences about the studied file systems. They noticed that maximum amount of root canal debris were extruded when filling was attempted by TF Adaptive Files. However, these inferences must be correlated with other clinical circumstances and operators skills. Authors also propose other studies to be conducted those include larger samples and multi-rooted teeth.

Key words: Extrusion, Debris, Mtwo Basic Sequence Files, ProFile GT Rotary Files, TF Adaptive Files

1. INTRODUCTION

As we all are aware that precise root canal cleaning and shaping are one of the most significant steps for successful root canal treatment. Root canal treatment is one of the most practiced clinical procedures in the general dental practice across the globe. Its short term as well as long term success depends on many clinical and patient related factors. Post operative complications are very frequent in these therapies usually in the form of pain or swelling. Literature has well evidenced that any apical extrusion of debris typically end up with treatment failure.^{1,2} This debris commonly contains dentinal shavings, dentinal chips, microorganisms and polluted irrigant solutions. Many of the pioneer workers have studied and compared this extrusion debris which is pushed mechanically by root canal instrumentation. Studies have also compared the quantity of debris extruded after canal shaping with different file systems and techniques. However, there is lack of perfect recommendation for this problem. None of the study has clearly shown and identifies any file system which was capable of shaping root canals without debris extrusion.^{3,4} With the introduction of rotary instrumentation technique, the methodologies of endodontics have been revolutionized. There is a visible shift from multiple/sequential file system to single file system. Such rotary single file systems were offering improved shaping capability with less extrusion of apical debris extrusion.^{5,6} Many of the pioneer workers have shown that during root canal treatment, the pain and/or swelling can happen anytime and continued even after completion of treatment as complication. It is a well established fact that bacterium easily cross the root canals and infects the peri-radicular tissues by contaminated debris.^{7,8} However, the ultimate development of clinical symptoms solely depends upon interaction between bacterium and the human immune system. Therefore, one of the major etiologies for the failure of root canal treatment is the apical extrusion of pulp tissue, bacterium and irrigants outside the apical foramen. The extrusion of debris can be influenced by normal physical factors related with the morphology of the tooth as well as mechanical factors like designing and technique of the rotary instruments. As on today, none of the present instruments and techniques can shape the root canals without mechanical extrusion of debris in to peri-radicular tissues. However, the quality and quantity of extruded debris can differ with different techniques and file systems.^{9,10} The present study was conducted to evaluate apical extrusion of debris with studied files system. Authors studied and compared Mtwo Basic Sequence Files, ProFile GT Rotary Files and TF Adaptive Files systems.

2. MATERIALS & METHODS

The present study was designed, abstracted and executed in the department of Conservative Dentistry and Endodontics of the institute. Total forty five freshly extracted maxillary central incisors were collected those removed for non-traumatic reasons. These etiologies were mostly including periodontically weakened teeth. Any type of soft and hard remains like calculi were cleaned from the outer surface of roots. This was completed by air-rotor hand piece and sophisticated scaling armamentarium. Sample exclusion criteria included multi-foramen teeth, teeth with more than one apical foramen, teeth with undeveloped root tip, endodontically treated teeth, teeth with root canal bending of more than 12°. For better handling and stability, all samples were mounted on individual self cure acrylic resin blocks of equal size and shape (cuboid). To prepare the samples, all incisal surfaces of the selected teeth were flattened with diamond rotary cutting instruments/bur. Uniform access opening cavities were made in all samples and working length. Access cavities were prepared and the working length was decided. The working length was decided by 15 no K-file to keeping 1-mm short of the actual length which was detectable at the major diameter of the apical

foramen. Conventional root canal cleaning, shaping, enlargement and curving have been executed by three different commercially available file systems i.e. Mtwo Basic sequence Files (VDW Antreas, Munich, Germany), ProFile GT Rotary Files (Dentsply Sirona, Canada), TF Adaptive Files (NiTi twisted files; Bioggio, Switzerland). Any debris (pushed by root canal instrumentation) extruded out of root apex was judiciously collected and measured. For the study and statistical purpose, all 45 roots were classified into three groups based on the utilized NiTi system. In group I, Mtwo Basic sequence Files were used in the correct sequence. In group II, ProFile GT Rotary Files were used in the right sequence. In group III, TF Adaptive Files was used. For accurate and efficient debris collection, preweighed glass vials (10 ml) were utilized. The apical surfaces of the teeth were irrigated with distilled water to collect adhered debris. The dry weight of the extruded debris was calculated after 6-day storage in incubator at 68°C. The exact weight of the extruded debris was calculated by subtracting the weight of the unfilled vials from the weight of the vials containing debris. Results hence obtained were subjected to statistical analysis. P value less than 0.05 was considered significant.

3. STATISTICAL ANALYSIS AND RESULTS

All resulting data were sent for statistical analysis using statistical software Statistical Package for the Social Sciences version 21 (IBM Inc., Armonk, New York, USA). The finalized data was subjected to appropriate statistical tests to obtain p values, mean, standard deviation, chi- square test, standard error and 95% CI. Response assessment and study showed few very significant results. These results were expected to have clinical and research applications also. Here, authors have ensured to process the data with all precision and accuracy. Table I shows three different types of commercially available files systems classified into study three groups of 15 each. Table 2 showed fundamental statistical illustration showing std. deviation, std. error and 95% coefficient of interval. Debris extrusion in group I was 0.14 milligrams, in group II was 0.23 milligrams and in group III was 0.32 milligrams. Here, the standard deviation for group I, II and II was 0.837, 0.928 and 0.383 respectively. Standard error for group I, II and II was 0.892, 0.392 and 0.842 respectively. Pearson Chi-Square Value for group I, II and II was 1.728, 1.920 and 1.920 respectively. Level of Significance (p value) for group I, II and II was 0.01, 0.50 and 0.03 respectively. It was significant for group I and group III (table 3). Graph 1 shows mean volume of extruded debris (mgms) and standard Deviation in all three studied groups

Table 1: Allocation of sample teeth according to utilized file systems

Groups	Group I	Group II	Group III
Materials	Mtwo Basic sequence Files (VDW Antreas, Munich, Germany)	ProFile GT Rotary Files (Dentsply Sirona, Canada)	TF Adaptive Files (NiTi twisted files; Bioggio Switzerland)
Number	15	15	15

Table 2: Fundamental statistical illustration showing std. deviation, std. error and 95% coefficient of interval

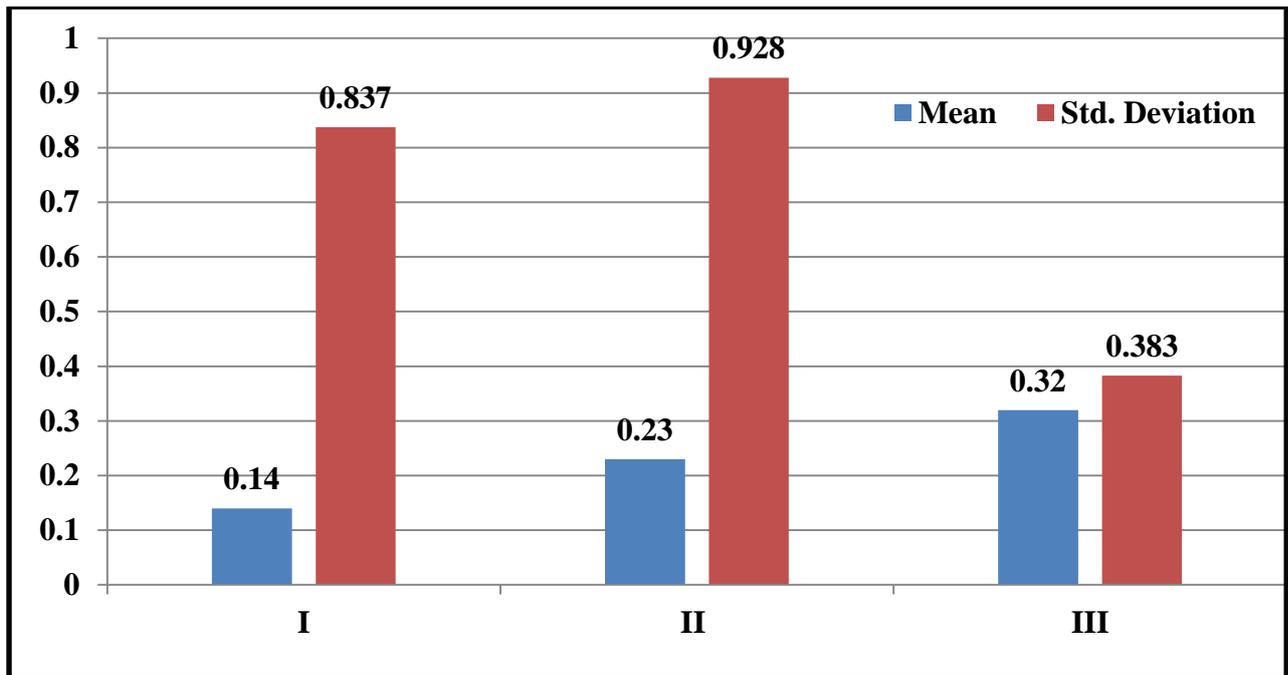
Groups	Mean (milligrams)	Std. Deviation	Std. Error	95% CI
I	0.14	0.837	0.892	1.69
II	0.23	0.928	0.392	1.60
III	0.32	0.383	0.842	1.96

Table 3: Level of significance evaluation by pearson chi-square test and level of significance (p value)

Groups	Mean (milligrams)	Pearson Chi-Square Value	df	Level of Significance (p value)
I	0.14	1.728	1.0	0.01*
II	0.23	1.920	2.0	0.50
III	0.32	2.542	1.0	0.03*

*p<0.05 significant

Graph 1: Mean volume of extruded debris (mgms) and standard Deviation in all three studied groups



4. DISCUSSION

As we all have studied that the history of endodontics has always been identified by the search for rapid, safer and more proficient techniques which can perform root canal shaping and disinfection. In clinical scenarios, closely packed and highly angulated root canals cause problem. This issue is obvious even if a skilled clinician is attempting it.^{11,12} One cannot guarantee of not breaking the instrument or generating an iatrogenic anomaly in the tooth. Recent advancements in endodontic instrumentations have shown high clinical success of files made up of a new metal alloy i.e. nickel titanium. With the introduction of nickel titanium alloy, the whole scenario of rotary endodontics has been revolutionized.^{13,14} Conventionally, stainless steel was employed for making the armamentarium for biomechanical preparation. However, it showed several procedural complications resulting in a diminished success rate for root canal treatment. The key principle behind such systems is that Ni-Ti rotary instruments help in hassle free, rapid and proficient cleaning and shaping. Nonetheless, a lot of instrumentation related factors might cause post-treatment complications, were not eliminated completely even in these rotary file systems and apical extrusion is one of them. As we all know that while performing bio mechanical preparation, dentin chips, remnants of pulpal tissue, irrigating solutions, and microorganisms and their by-products are frequently transported in the course of the apical foramen and introduced into the periapical tissues causing postoperative inflammation or infection, pain, flare-ups, and consequently, delay apical healing. Root canal preparation is an important step in endodontic treatment, and it plays a key role in treatment success. Many of the classic research papers and researchers have shown that the endodontic therapy is one of the oldest dental procedures for the treatment of deep caries involving dental pulp.^{15,16,17} Pain and swelling are common post operative complications when mechanical extrusions of debris happen out of the root apex during instrumentation. Furthermore, endodontic therapy is a process which is very frequently practiced by general dental practitioners and endodontists to rehabilitate infectious root canal and to conserve the natural tooth.^{18,19} With the newer inventions and advancements in the technologies in the field of dentistry, many of the NiTi based rotary file systems have been emerged. However, literature explorations showed very less studies that compares these

advanced file systems. In this study, authors have genuinely assessed the apical extrusion of debris with three commercially available file systems i.e. Mtwo Basic Sequence Files, ProFile GT Rotary Files and TF Adaptive Files systems.

5. CONCLUSION

Within the limitations of the study the authors have drawn very crucial remarks about the studied file systems. They concluded that maximum amount of root canal debris were extruded when filling was attempted by TF Adaptive Files. Mtwo Basic sequence Files showed minimum amount of extruded root canal debris. So, Mtwo Basic sequence Files has been shown to offer optimal clinical responses with minimum post operative complications. However, these implications should be correlated with other clinical circumstances and operators skills. Authors also recommend other studies to be conducted those involve larger samples and multi-rooted teeth. Our study results must be considered as suggestive for determining prognosis in similar clinical conditions.

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