

Original research article***In vitro* evaluation of debris removal using various rotary file systems****¹Dr. Prachi Singh, ²Dr. Neha Rathore, ³Dr. Madhulika Yadav, ⁴Dr. Chandan Gupta**¹Associate Professor, Department of Dentistry, Rajarshi dashrath Autonomous State, Medical College, Ayodhya, Uttar Pradesh, India²Assistant Professor, Department of Dentistry, Rajarshi dashrath autonomous state, medical College, Ayodhya, Uttar Pradesh, India³Associate Professor, Department of Dentistry, Government Medical College, Kannauj, Kannauj, Uttar Pradesh, India⁴Assistant Professor, Department of Dentistry, Hind Institute of medical sciences, Lucknow, Uttar Pradesh, India**Corresponding Author:**

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Abstract

Background: A major concern in endodontics is the cleaning, shaping and disinfection of the root canal. The aim of cleaning the root canal system is to eliminate bacteria, their sub-products, degenerated pulp tissue and contaminated dentin. To compare and evaluate debris removal using three file systems. **Materials and Methods:** 60 mandibular first premolars were randomly assigned to 3 groups. The root canal treatment was done using 3 file system and the debris removed and was compared and statistically analyzed using analysis of variance and SPSS software.

Results: The mean extruded weight of debris Protaper (0.0078 g) was more when compared with the Hyflex (0.0010 g).

Conclusion: The ProTaper and Reciproc Blue rotary instruments produced significantly more debris compared with EDM HYFLEX rotary instruments.

Keywords: Rotary file system, debris, *in vitro*

Introduction

The preparation of canals during Root Canal Treatment can cause dentin chips, remnants of pulp tissue, and bacteria to be conveyed to the apical third of the canal and extruded into the periradicular tissues ^[1]. The extrusion of debris beyond the canal can cause postoperative pain, flare-ups, and even failure of apical healing ^[2], adversely affecting the clinical outcome of endodontic treatment ^[3]. The apically extruded debris during root canal shaping and cleaning is a principal reason for the failure of the endodontic treatment procedure ^[4].

The chemomechanical disinfection of root canals is defined by shaping the root canals to be appropriately irrigated. The failure of primary endodontic treatment can be attributed to various factors such as the persistence of microorganisms as a result of insufficient biomechanical preparation, inadequate obturation, or improper coronal seal ^[5]. In spite of the advancements in instruments and instrumentation technology, the inherent design limitations of the endodontic instruments leads to inadequate cleaning of the root canal system ^[4].

Pro Taper (Dentsply C Maillefer, Ballaigues, Switzerland) system exhibits progressively variable tapers of each instrument that develop a "progressive preparation" in both the vertical and horizontal directions ^[6]. The Reciproc Blue file system (VDW, Munich, Germany), which has an S-shaped cross-section with reciprocating motion and can be used for both primary and retreatment root canal procedures ^[7]. EDM HYFLEX, Coltene (Coltene/ Whaledent, Altstätten, Switzerland): Hyflex EDM files (Coltene/ Whaledent, Altstätten, Switzerland) are manufactured with CM-Wire alloy but using electric discharge machining (EDM) technology ^[8]. EDM is a thermal erosion process used with electrically conductive materials that result in a crateriform surface finish on the instrument ^[9].

Considering the limited number of studies on the extrusion of debris by using different file systems, this study aimed to compare the apical extrusion of debris following the use of three different rotary instrumentation systems *viz.* Protaper, Reciproc Blue file system and EDM HYFLEX

Material and Methods

The current *in vitro* study was approved by the institutional ethical committee. The teeth which were extracted for orthodontic purposes were included. Sixty extracted, single-rooted mandibular premolar teeth with single root canal with completely formed roots were selected and placed in 3% sodium hypochlorite for 30 minutes and then stored in normal saline. Premolars with immature roots, teeth with

root caries, fractured roots, multiple canals, root canal calcifications, or teeth with any other developmental abnormalities were excluded from the study.

The root surfaces were cleaned by a scaler, carious lesions and restorations were removed, and an access cavity was prepared using a round bur with high-speed hand-piece under air and water spray. After endodontic access cavity preparation, the canal orifices were located and confirmed with a #10 K-file (VDW). In addition, it was determined with a #15 K-file (VDW) that the size of the apical foramen of the teeth was not greater than 0.15 mm. The #10 K-file was advanced within the canal until the tip was seen through the major apical foramen, and the working length was determined by subtracting 1 mm from this length.

The root canals were instrumented according to the manufacturers’ instructions using the ProTaper, Reciproc Blue file system and EDM HYFLEX, Coltene instruments. The canals were then irrigated using bidistilled water. The debris that was extruded apically was collected in preweighed eppendorf tubes and assessed with an electronic balance and compared.

Data was collected and entered in MS Excel and then analyzed using SPSS version 2. One-way ANOVA along with Tukey posthoc was use to compare the significance between groups with level of significance at 0.05.

Results

A total of 60 teeth were enrolled. The mean extruded debris weight of the three groups were included. The mean extruded weight of debris in ProTaper (0.0078 g) was more when compared with the EDM Hyflex (0.0010 g). Reciproc Blue file (0.0054 g) and ProTaper was significantly more when compared to EDM Hyflex (P < 0.05).

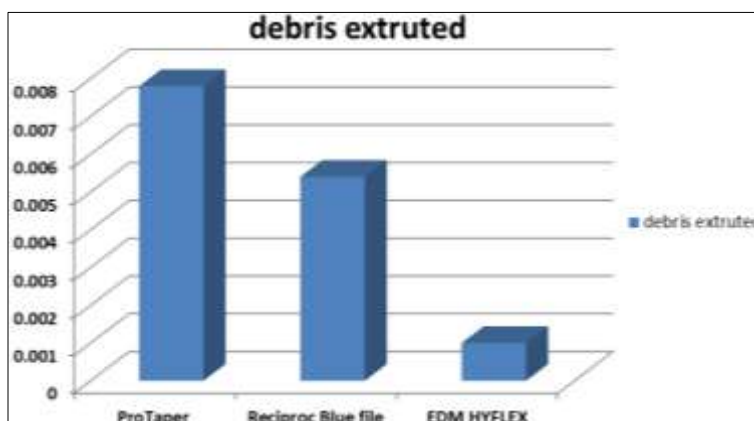


Fig 1: Mean debris extruded from three different file system

Table 1: Comparison of debris extruded in three file system

File system	Mean ± Standard deviation	F- value	P-value
Pro Taper	0.0078±0.0027	1.1273	0.000 (hs)
Reciproc blue file	0.0054±0.0013		
Edm hyflex	0.0010±0.0004		

Anova: Analysis of variance, p≤0.05- Significant

Dependent variable	Comparison Variable	Difference	Sig.
Pro Taper	Reciproc Blue	.0028	.001
	EDM HYFLEX	.0070	.000
Reciproc Blue file	ProTaper	-.0028	.001
	EDM HYFLEX	-.0053	.000
Edm Hyflex	ProTaper	-.0070	.000
	Reciproc Blue	.0053	.000

Discussion

A major objective of root canal therapy is to obtain a clean root canal system. Debris such as dentine chips, necrotic pulp tissue, microorganisms and irrigants may be extruded into the periradicular tissue during canal instrumentation which leads to endodontic flare-up^[10]. Under the conditions of the study, all systems that were used resulted in extrusion of apical debris. Full-sequence rotary instrumentation was associated with less debris extrusion compared with the use of reciprocating single-file systems^[11]. File designs, rotational speed, different sequences of instrumentation and surface conditioning of the instruments is important factors for efficient instrumentation in root canals. All endodontic instruments create debris and smear layer as a consequence of their action on the root canal walls^[12].

The present *in vitro* study investigated for the first time the amount of apically extruded debris using 3

new NiTi files (ProTaper, Recipro Blue, EDM Hyflex) during root canal preparation. According to the results of this study, all files caused some degree of extrusion of debris from the apex, which is similar to the results obtained by previous studies reporting that all file systems used for root canal preparation, operated both in continuous rotation and reciprocation and also including hand instrumentation, can cause different degrees of apically extruded debris^[13,14].

A study by Surakanti JR *et al*, the ProTape rotary instruments produced significantly more debris compared with Hyflex CM rotary instruments. Under the conditions of the study, all systems that were used resulted in extrusion of apical debris^[15]. Full-sequence rotary instrumentation was associated with less debris extrusion compared with the use of reciprocating single-file systems. Study conducted by Uslu *et al*. showed that single-file reciprocating systems extruded less debris compared to their counterpart rotary systems^[16].

Different results from all of the studies on apically extruded debris may be caused by the use of different files and methodologies, and because there was no research on this topic in the literature related to the instruments investigated in the present study, a direct comparison could not be made with other studies.

The main limitation of the current *in vitro* study was that the variation in micro-hardness values of dentin may affect the results of the study. The teeth with lower hardness may extrude debris readily into the periapical tissues.

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