

Original Research

Evaluation of apical extrusion of intracanal bacteria with four single-file NiTi instruments

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ABSTRACT:

Background: The successful endodontic treatment must be directed toward the elimination of bacteria, their products from the root canal system, and this objective can be achieved by thorough chemo-mechanical preparation. The present study was conducted to compare apical extrusion of intracanal bacteria using four single-file NiTi instruments. **Materials & Methods:** 50 human single-rooted mandibular premolar teeth were subjected to endodontic access cavities. The samples were broadly divided into four main groups of 10 teeth. In group I, waveOne reciprocating single-file was used. In group II, Reciprocating Ni-Ti technique was used. In group III, F 360 Rotary Ni-Ti technique, in group IV, One Shape Rotary Ni-Ti technique and in group V, no instrumentation was done. After 24 hours, colonies of bacteria were counted using classical bacterial counting technique as colony-forming units. **Results:** The mean value of *E. faecalis* colony forming unit was 12.7×10^8 CFU/ml, in group II was 17.4×10^8 CFU/ml, in group III was 28.5×10^8 CFU/ml, in group IV was 39.0×10^8 CFU/ml and in group V was 35.7×10^8 CFU/ml. The difference was significant ($P < 0.05$). **Conclusion:** The reciprocating single-file systems extruded less amount of *E. faecalis* than compared to rotary single-file systems.

Key words: *E. faecalis*, waveOne reciprocating, One Shape Rotary

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INTRODUCTION

The successful endodontic treatment must be directed toward the elimination of bacteria, their products from the root canal system, and this objective can be achieved by thorough chemo-mechanical preparation.¹ Despite strict length control, almost all instruments and preparation techniques used for the root canal treatment are associated with debris extrusion, which contains dentin chips, pulp tissue, microorganisms and/or irrigants into the peri-radicular tissue. This extrusion may potentially result in postoperative flare-ups. Bacteria extruded mainly include Gram-positive,

Gram-negative bacteria, and obligate anaerobes. *Enterococcus faecalis* (*E. faecalis*) has been identified as a species most commonly recovered from the post-treatment diseases.²

Dr. Yared has introduced the Reciproc system. The single-file NiTi system consists of three files, including the R25 (ISO 25; 8%), R40 (ISO 40; 6%), and R50 (ISO 50; 5%).³ One Shape file was introduced by Micro-Mega. Directed down the glide path by three cutting edges, its flexibility assures adaptation to the new canal path and curvature. The antibreakage organize of One Shape file is a

protection bonus, i.e., the instrument will slow down to avoid division. The F360 has a cross-section which resembles a double S.⁴ The file features a unique S-curve design and a thin instrument core to deliver outstanding cutting efficiency. Wave One designated as a single file system is used to shape the root canal from start to end. The files run in a “balanced force” action.⁵ The present study was conducted to compare apical extrusion of intracanal bacteria using four single-file NiTi instruments.

MATERIALS & METHODS

The present study comprised of 50 human single-rooted mandibular premolar teeth. These teeth were extracted due to orthodontic purpose. The study was approved from institutional ethical clearance committee.

In all teeth, endodontic access cavities were prepared. Pulp chamber was accessed, and a pure culture of E.

faecalis was used to infect the root canals. Vials with rubber stoppers were selected as the test apparatus. The samples were broadly divided into four main groups of 10 teeth. In group I, waveOne reciprocating single-file was used. In group II, instrumentation was carried out using Reciproc Reciprocating Ni-Ti technique. In group III, instrumentation was carried out using F 360 Rotary Ni-Ti technique. In group IV, instrumentation was carried out using One Shape Rotary Ni-Ti technique. In group V, no instrumentation was done. All the root canals were instrumented with the size 25 instruments. 2 ml of saline was used for each root canal as irrigant. After 24 hours, colonies of bacteria were counted using classical bacterial counting technique as colony-forming units. Results of the study was subjected to statistical analysis. P value less than 0.05 was considered significant.

RESULTS

Table I Distribution of teeth

Groups	Group I	Group II	Group III	Group IV	Group V
Method	WaveOne	Reciproc	F 360 Rotary	One Shape	Control
Number	10	10	10	10	10

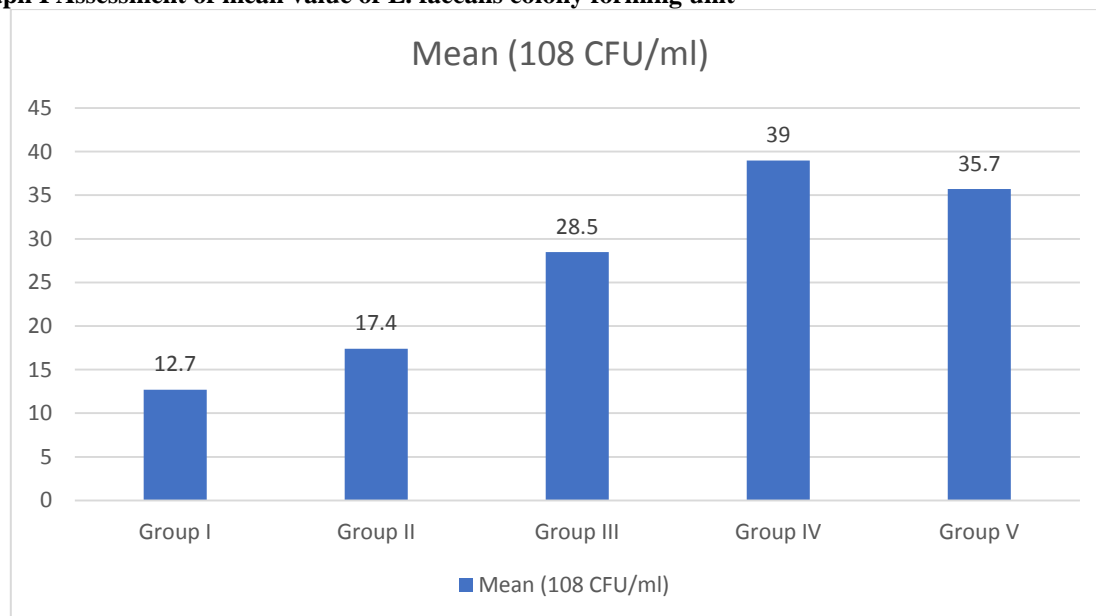
Table I shows Distribution of teeth based on method of instrumentation used.

Table II Assessment of mean value of E. faecalis colony forming unit

Groups	Mean (10 ⁸ CFU/ml)	P value
Group I	12.7	0.01
Group II	17.4	
Group III	28.5	
Group IV	39.0	
Group V	35.7	

Table II, graph I shows that mean value of E. faecalis colony forming unit was 12.7X 10⁸ CFU/ml, in group II was 17.4X 10⁸ CFU/ml, in group III was 28.5X 10⁸ CFU/ml, in group IV was 39.0 7X 10⁸ CFU/ml and in group V was 35.7 X 10⁸ CFU/ml. The difference was significant (P< 0.05).

Graph I Assessment of mean value of E. faecalis colony forming unit



DISCUSSION

Complete debridement and reduction of the bacterial infection from the root canal space are necessary for long-term success of endodontic treatment.⁶ However, these materials may be extruded through the apical foramen into the periapical tissues during root canal preparation. This results in postoperative complications such as a flare-up, which is described by periapical inflammation, pain, and swelling. Advancements in rotary instruments have facilitated and fastened the root canal procedures and resulted in less iatrogenic errors.⁷ One of the most significant complications that occur as a result of apical extrusion during root canal procedures is inter-appointment flare-ups, due to the release of histamines which is an undesirable occurrence both for the patient and the practitioner. The effects of apical extrusion may be related to the quantitative as well as qualitative factors. Even though the former can be controlled effectively by instrumentation techniques, the latter can never be controlled.⁸ The present study was conducted to compare apical extrusion of intracanal bacteria using four single-file NiTi instruments.

In present study, the mean value of *E. faecalis* colony forming unit was 12.7×10^8 CFU/ml, in group II was 17.4×10^8 CFU/ml, in group III was 28.5×10^8 CFU/ml, in group IV was 39.0×10^8 CFU/ml and in group V was 35.7×10^8 CFU/ml. Sarthaj A et al⁹ evaluated the apical extrusion of *Enterococcus faecalis* with One Shape, F360, WaveOne, and Reciproc endodontic single-file systems. Seventy-five human single-rooted mandibular premolar teeth were selected. Endodontic access cavities were prepared. Pulp chamber was accessed, and a pure culture of *E. faecalis* was used to infect the root canals. The results indicated that all the four single-file systems tested caused a measurable apical extrusion of debris. Statistically, significant difference was observed between One Shape, F360, WaveOne, and Reciproc in terms of *E. faecalis* extrusion, $P < 0.05$. The highest mean value was with One Shape rotary single-file system and the lowest mean value was with WaveOne reciprocating single-file systems.

Polineni et al¹⁰ evaluated the number of intracanal bacteria extruded apically after instrumentation with three different nickel–titanium rotary instruments. Forty freshly extracted mandibular premolars were selected, access cavities were prepared, and the teeth were mounted in the bacterial collection apparatus. Root canals were contaminated with a suspension of *Enterococcus faecalis* and incubated for 24 h at 37°C. The contaminated teeth were divided into four groups of 10 teeth each according to the rotary system used for instrumentation: Group 1: ProTaper universal files, Group 2: MTwo files, Group 3: ProTaper Next files, and Group 4: Control group (no instrumentation). Bacteria extruded after preparations were collected into vials. The number of colony-forming units (CFUs) was determined for each sample. The results suggested a statistically

significant difference in the number of CFUs between four experimental groups ($P < 0.001$). Least amount of bacterial extrusion was seen in ProTaper Next Group while more bacterial extrusion was seen in MTwo Group.

Abou-Rass and Piccinino¹¹ recommended the use of small diameter (27 G or 30 G) needles for irrigation because they provide sufficient volume of irrigant for efficient flushing of debris by fitting at depths just short of the physiological terminus. Various studies have shown that apical extrusion of irrigant is less when irrigation done with side-vented needles. A study conducted earlier had concluded that there was a significant reduction in CFU when the taper was increased from 4% to 8%. The higher reduction of the microbial load extruded in the present study was associated with the greater taper of 8% in reciprocating single-file systems. The present study supports the concept that the degree of the taper preparation is important for the reduction of intracanal bacterial load.¹²

CONCLUSION

Authors found that the reciprocating single-file systems extruded less amount of *E. faecalis* than compared to rotary single-file systems.

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