

Original Research

Assessment of dentinal cracks in root canal surface after biomechanical preparation using rotary file systems

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ABSTRACT:

Background: The aim of endodontics is to achieve a three-dimensional flawless seal of the root canal system. The present study was conducted to assess dentinal cracks in root canal surface after biomechanical preparation using rotary file systems. **Materials & Methods:** 60 extracted single canal mandibular premolars were divided into 4 groups according to the nickel-titanium (Ni-Ti) rotary file system such as group I: control group roots were left unprepared. Group II: Canals were prepared using Ni-Ti 2 Shape system up to TS2 file (#25/0.06). Group III: Canals were prepared using Ni-Ti ProTaper Next system up to X2 file (#25/0.06). Group IV: Canals were prepared using Ni-Ti RaCe system up to file (#25/0.06). Each root was sectioned horizontally using IsoMet saw into three sections as coronal, middle, and apical with a total of 120 sections and observed by stereomicroscope and scanning electron microscope to detect dentinal cracks. **Results:** The mean rank value in group I was 46.2, in group II was 58.4, in group III was 73.2 and in group IV was 60.7. The difference was significant ($P < 0.05$). **Conclusion:** ProTaper Next group showed a high percentage of dentinal crack incidence followed by RaCe, 2 Shape, and control groups.

Key words: Ni-Ti ProTaper, coronal, middle

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INTRODUCTION

The aim of endodontics is to achieve a three-dimensional flawless seal of the root canal system. Perfect designing of the canal diameter and canal form that allows us to conquer this objective is of prime importance.¹ At times, in the zeal of biomechanical preparation of the canal we inevitably end up damaging the root dentin which becomes a gateway to dentinal cracks and minute intricate fractures thereby failure of treatment.² It has been seen that these dentinal cracks and minute intricate fractures could later propagate into vertical root fracture (VRF) if the tooth is subjected to repeated stresses from endodontic or restorative procedures. Indeed, evidence of recent years concentrate on the findings that VRFs are probably caused by a propagation of smaller, less pronounced defects and not by force practiced during preparation or obturation.³

When biomechanical preparations are carried out, endodontic instruments do not act on the entire canal wall, but rather they act only on the central body of

the root canal.⁴ An instrumentation alone could produce dentinal damage in the apical region, which in turn makes the risk of crack initiation, and there is a higher incidence of production of dentinal cracks when larger files are used in root canal preparation. The more the amount of dentin removed, the more there is incidence for root fracture by the formation of more small craze lines that will later propagate to vertical root fracture if the tooth is subjected to repeated stresses from endodontic or restorative procedures.⁵

Defect is referred as the presence of craze line or microcracks or even complete crack that extends from the inner root canal space all the way to the outer surface of the root. In order to minimize the dentinal cracks and other mishaps during root canal instrumentation, different Ni-Ti rotary systems are always introduced and developed to improve the efficiency and clinical outcomes of the root canal treatment.⁶ The present study was conducted to assess dentinal cracks in root canal surface after biomechanical preparation using rotary file systems.

MATERIALS & METHODS

The present study was conducted among 60 extracted single canal mandibular premolars. Teeth were decoronated perpendicular to the long axis of the tooth leaving roots and then positioned centrally in a mold using acrylic resin. Roots were divided into 4 groups according to the nickel-titanium (Ni-Ti) rotary file system such as group I: control group roots were left unprepared. Group II: Canals were prepared using Ni-Ti 2 Shape system up to TS2 file (#25/0.06).

Group III: Canals were prepared using Ni-Ti ProTaper Next system up to X2 file (#25/0.06). Group IV: Canals were prepared using Ni-Ti RaCe system up to file (#25/0.06). Each root was sectioned horizontally using IsoMet saw into three sections as coronal, middle, and apical with a total of 120 sections and observed by stereomicroscope and scanning electron microscope to detect dentinal cracks. Results were assessed statistically. P value less than 0.05 was considered significant.

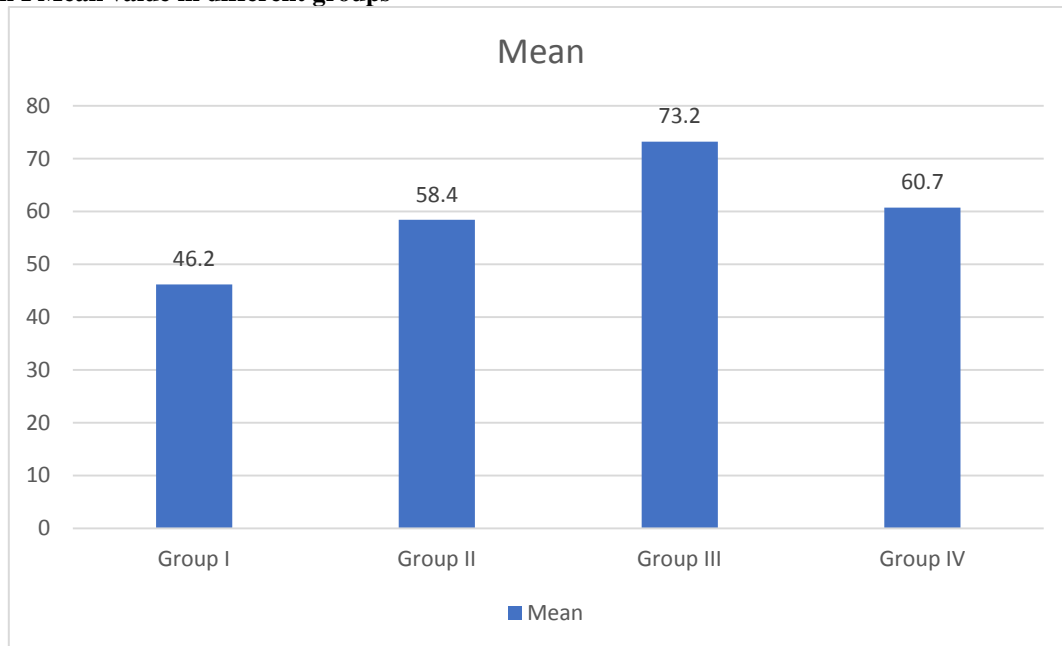
RESULTS

Table I Mean value in different groups

Groups	Mean	P value
Group I	46.2	0.05
Group II	58.4	
Group III	73.2	
Group IV	60.7	

Table I, graph I shows that mean rank value in group I was 46.2, in group II was 58.4, in group III was 73.2 and in group IV was 60.7. The difference was significant (P< 0.05).

Graph I Mean value in different groups



DISCUSSION

Hand instrumentation which was the milestone of endodontic practice in the past though has lost its popularity, still remains integral part of canal preparation.⁷ In the last decades, many new NiTi rotary instruments have been developed and introduced by various manufacturers.⁸ Most clinicians prefer these systems because of their advantages such as saving time and better cutting efficiency. Nevertheless, some functions of NiTi rotary systems such as cleaning ability increased stress, and the inability to adequately prepare oval canals are still controversial.⁹

system by enlarging the diameter of the original canal anatomy to a more desirable canal shape to obtain a proper coronal and apical seal.¹⁰ In the last decade, there is a huge advancement in Ni-Ti rotary systems with various files differing in their design features such as cross-section, flute depth, and rake angle. Therefore, these variables may affect dentin removal in the biomechanical preparation leading to cleaning and shaping mishaps as different craze line formation and crack generation.¹¹

The aim of endodontic treatment is to completely remove microorganisms, pulp tissue, and debris and achieve a three-dimensional seal for the root canal

The present study was conducted to assess dentinal cracks in root canal surface after biomechanical preparation using rotary file systems.

In present study, mean rank value in group I was 46.2, in group II was 58.4, in group III was 73.2 and in group IV was 60.7. Elnazzer et al¹² evaluated dentinal

cracks in root canal surface after biomechanical preparation using rotary file systems such as ProTaper Next, 2 Shape, and RaCe. Forty extracted human single canal mandibular premolars were decoronated perpendicular to the long axis of the tooth leaving roots (12 ± 1 mm) and then positioned centrally in a mold using acrylic resin. There are more dentinal cracks in the ProTaper Next group than in the 2 Shape, RaCe, and control groups as there was a statistically significant difference present ($p < 0.05$). There was no statistically significant difference between the apical, middle, and coronal sections ($p = 0.536$).

Garg et al¹³ compared the incidence of dentinal defects induced by Hand Files, HyFlex CM, ProTaper Next (PTN), and One Shape during canal preparation. One hundred and fifty extracted mandibular premolar teeth with single root canal were selected. Specimens were then divided into five groups with thirty specimens each. Group I: Specimens were prepared with hand instruments. Group II: Specimens were prepared with HyFlex CM rotary files (Coltene) using a crown-down technique according to the manufacturer's instructions. Group III: Specimens were prepared with PTN rotary files (Dentsply) using a crown-down technique according to the manufacturer's instructions. Group IV: Specimens were prepared with One Shape Single file rotary system (MicroMega) using a crown-down technique according to the manufacturer's instructions. Group V: Specimens were used as a control and left unprepared. All roots were cut horizontally at 3, 6, and 9 mm from the apex. Sections were then viewed under stereomicroscope and dentinal defects were registered as "no defect," "fracture," and "other defects." Results were expressed as the number and percentage of defected, partially defected and roots with no defects in each groups. Hand files and One Shape file system caused less root defects compared to PTN and HyFlex file systems.

CONCLUSION

Authors found that proTaper Next group showed a high percentage of dentinal crack incidence followed by RaCe, 2 Shape, and control groups.

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