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Comparative Evaluation of Dentinal Microcrack Formation by Single Reciprocating File Systems

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I. INTRODUCTION

Vertical root fracture (VRF) is one of the frustrating complications of root canal treatment. The root fracture might occur as a result of a microcrack or craze line that propagates with repeated stress application by occlusal forces. These dentinal microcracks are clinically difficult to diagnose and treat, progressing to VRF and ultimately tooth loss.1,2 Root canal shaping procedures and rotary instrumentation have the potential to induce microcrack formation, which can extend to complete fractures under functional load. Several factors of nickeltitanium (Ni-Ti) files such as different heat treatments, designs, cross-sectional shape, and kinematics may influence the generation of cracks.Advances in Ni-Ti instruments and their kinematics allowed the possibility to shape root canals with single-file systems activated in rotary or reciprocating motion, focusing on the concept "Less Is More," thereby requiring less time than full-sequence rotary systems. The reciprocating movement is claimed to relieve stress on the instrument by special counterclockwise (cutting action) and clockwise (release of the instrument) movements, and it is assumed that this movement reduces the risk of cyclic fatigue caused by tension and compression.13,14 Reciprocating movements could also reduce the screw-in effects, thus preventing the unintended overextension of instrument beyond the apical foramen. Reciproc (REC) (VDW, Munich, Germany), WaveOne (WO) (DentsplyMaillefer), and the recently marketed WaveOne Gold (WOG) (DentsplyMaillefer) and Reciproc Blue (RCB) (VDW, Munich, Germany) are the main examples of commercially available singlefile reciprocating systems. Several studies using these reciprocating Ni-Ti systems showed better canal centring ability, uniform canal preparation, and better debris and smear layer removal when compared with continuous rotary Ni-Ti instruments.15–17 However, there are only few studies in the literature regarding the occurrence of microcracks using these single-file systems. Thus, the purpose of this study was to investigate the formation of microcracks after canal preparation with these different single-file systems.

II. MATERIALS AND METHODS:

Seventy-five extracted mandibular premolars were randomly selected. A total of 15 teeth were left unprepared and served as control, and the remaining 60 teeth were divided into four groups. WaveOne files, Reciproc files, WaveOne Gold files, and Reciproc Blue files were used to prepare the canals. Roots were then sectioned at 3, 6, and 9 mm from the apex and the cut surface was observed under the scanning electron microscope (SEM) for the presence of dentinal microcracks.

Group I: No preparation (Control)

- Group II: WaveOne (WO, Primary)
- Group III: Reciproc (REC, R25)
- Group IV: WaveOne Gold (WOG, Primary)
- Group V: Reciproc Blue (RCB, R25)

Sectioning and Microscopic Examination

All roots were sectioned perpendicular to the long axis at 3, 6, and 9 mm from the apex with a hard tissue microtome under water coolant. All the sections were then gold sputtered and viewed under a scanning electron microscope (SEM) (IsoMet 5000 linear precision saw) for the presence of microcracks. A total of 45 sections were examined in each group. "No defect" was defined as root dentin devoid of any craze lines or microcracks originating from the canal lumen. "Defect" was defined if any craze lines, microcracks, or fractures were present originating from the root canal lumen.18 The statistical analysis was done using the one-way ANOVA test. The p value < 0.05 was considered as statistically significant.

III. RESULTS:

The control group were not associated with microcracks, while all the single file systems tested resulted in dentinal microcrack formation. Among the groups, tooth prepared with WaveOne Gold and Reciproc Blue files showed fewer cracks than other experimental groups; however, no significant difference was found between them ($p > 0.05$).

IV. CONCLUSION:

Root canal preparation with reciprocating files resulted in dentinal microcracks. WaveOne Gold and Reciproc Blue files caused less microcracks than WaveOne and Reciproc files. Heat-treated instrument produced less microcracks than M-wire instruments.

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