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Original Research

Comparative Evaluation Of Fracture Toughness Of Roots Instrumeneted With Reciproc, Wave One And One shape Rotary File:An in vitro study

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ABSTRACT:

Objective: The purpose of this study was to evaluate fracture toughness of root instrumented with three file system-reciproc,wave and one shape rotary file. **Materials & methods:** 60 mandibular premolar teeth were selected and sectioned at or below cementoenamel junction to obtain roots of 13mm length. The roots were balanced with respect to buccolingual and mesiodistal diameter and weight. Four groups were formed out of this 3 were experimental group and 1 control group with no instrumentation. Each group has 15 mandibular teeth.Instrumentation was done with Reciproc rotary file (R25, VDW, Munich, Germany), Wave One Primary rotary file (Dentsply Maillefer, Ballagues, Switzerland) and One Shape (Micro-Mega, Besancon, France) rotary file. One week later, a vertical load was applied to the specimen's canal until fracture occurred. Data were statistically analysed using 1-way analysis of variance (P = .05). **Results:** Mean fracture load were calculated and for control group it was 414 ± 70 Newton(N) for reciproc group it was396 ± 70N, for wave one group it was 372 ± 62N and for one shape group it was 331 ± 68N.The data was evaluated statistically but data were not statistically significant(P> 0.05).But when compared between control group and one shape group data were statistically different(P=0.012). **Conclusion:** Fracture resistance of the roots instrumented with WaveOne and Reciproc file systems were similar to the control group whereas it was observed that OneShape rotary file systems enhance the fracture strength of standardized curved roots when compared with the control group.

Key words: Fracture Strength, instrumentation, vertical root fracture

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INTRODUCTION

Vertical root fracture (VRF) is a challenging complication that has potential impact during or after root canal treatment.[1-2]. Various factors such as loss of tissue, dehydration of dentin, undesirable effects of irrigation solutions, and excessive pressure during filling procedures physical trauma, repetitive heavy and stressful chewing have been found to be causative factors in the development of VRFS (vertical root fracture) coronal and radicular tooth structure loss predisposes endodontically treated teeth to fracture, due to prior pathology or endodontic and/or restorative treatment procedures.[3-6] Recently, it has been reported that root canal filling procedures may also propagate cracks in the apical region. The reciprocating single file systems such as Reciproc (VDW, Munich, Germany) and WaveOne (Maillefer, Ballaigues, Switzerland)

provides more flexibility of the M-wire Ni-Ti alloy, greater resistance to cyclic fatigue and better handling of narrow and curved canals than the traditional Ni-Ti instruments and they are widely used in endodontic treatment.[7-10] These file systems use reciprocating movements in the preparation of root canals.[11] Another single file system is OneShape file (Micro-Mega, Besancon Cedex, France), which is used in a traditional continuous rotating motion. Rotary Ni-Ti instruments facilitate root canal treatment, whereas they can weaken the tooth structure particularly in curved canals.[13]

The aim of this *in vitro* study was to assess the effect of single file systems on the fracture strength of mandibular premolar.

MATERALS & METHODS

In total, 60 extracted, intact, human mandibular premolars with single straight root canals were selected and stored in distilled water. The coronal portions of all teeth were removed by using a diamond-coated bur under water cooling, leaving roots approximately 13 mm in length. The teeth were examined with a stereomicroscope under10x magnification to detect craze lines or cracks. Teeth with such findings were excluded from the study and replaced by similar teeth. To ensure that roots with standardized dimensions and weights were used, the buccolingual (BL) and mesiodistal (MD) dimensions of the root canals were measured using a digital caliper. Subsequently, the BL and MD diameters were multiplied. The weights of the roots were measured with a sensitive precision balance. We evenly distributed the roots to each group in an active sense based on their weights and the homogeneity of the groups. This parameter was by using the analysis of variance test. The roots were evenly distributed to three experimental groups and one control group (n = 15), based on their weights and the homogeneity of the groups. This parameter was assessed using the analysis of variance (ANOVA) test (P = 0.322 for the weights and P = 0.837 for the products of the BLs and MDs).

CONTROL GROUP: NO INSTRUMENTATION OR OBTURATION

The root canals were not shaped or filled. These were used as the control.

GROUP 2: INSTRUMENTATION WITH RECIPROC SYSTEM

In the Reciproc group, R25 (25.08), (VDW, Munich, Germany) using Silver Reciproc reciprocating engine in a reciprocating motion in "Reciproc all" mode (VDW, Munich, Germany). The flutes of the instruments were cleaned after three pecking motions.

GROUP 3: INSTRUMENTATION WITH WAVE ONE FILES AND OBTURATION

The root canals were shaped with The canals were prepared with up Root canals were prepared with wave one file (Dentsply Maillefer, Ballagues, Switzerland) The canals were prepared with up to master apical file size of D2 (#25/8%taper) in slow in-and-out pecking motion until reaching the full working length according to the manufacturer's instructions. The flutes of the instrument were cleaned after 3 in-and-out-movements (pecks). Apical patency was maintained by passing #15 Kfile(Mani co. India) through the apical foramen between files.

GROUP 4: INSTRUMENTATION WITH ONESHAPE SYSTEM

In the OneShape group, root canal preparation was performed with OneShape rotary file No. 25.06 (Micro-Mega, Besancon, France) using a low-torque motor (VDW Silver, Munich, Germany) at a constant speed of 400 rpm and 400 gcm torque.

During the preparation, after each instrument the root canals were irrigated with 2 ml of 2.5% NaOCl solution. After instrumentation, a final flush was done using 5 ml 17% EDTA for 1 minute, 5 ml 2.5% NaOCl for 1 minute followed by 5 ml distilled water.

MOUNTING OF ROOTS AND FRACTURE MEASUREMENT

Mounting of roots in acrylic resin block and fracture measurement by using instron testing machine. Acrylic resin blocks were prepared using cylindrical plastic molds (25mm high and 10mm in diameter). Self-cured acrylic resin (Imicryl, Konya, Turkey) was used to prepare the blocks. The apical root ends were embedded vertically in 4 mm of the acrylic resin, exposing 9 mm of the coronal portion of each root. The roots were kept wet with a wet towel to prevent dehydration until they were ready for strength testing. Tesing of samples - Instron testing machine (Instron, Canton, MA) running at a crosshead speed of 1 mm/min was used to fracture the roots. A steel conical tip (tip diameter = 1.0 mm, tapered at 60º) was mounted and aligned with the center of the canal orifice parallel to the long axis of each specimen. The load necessary to fracture were recorded and expressed in N.

RESULTS

The fracture loads of the roots and other variables in the four groups are shown in Table 1. Statistical analysis approved the standardization of roots among the groups according to weight, BL, and MD diameter, multiplication of the BL-MD diameter and fracture load. Failure load was applied until all of the roots fractured vertically in the labiolingual direction during testing. The mean fracture load was 414 ± 70 N for the control group, 396 ± 70 N for the Reciproc group, 372 ± 62 N for the WaveOne group and 331 ± 68 N for the OneShape group. In this study, all of the roots were fractured vertically in the labiolingual direction during testing. The fracture load differences among Reciproc, WaveOne and OneShape were not statistically significant (P > 0.05). Whereas, the difference between the fracture loads of control and OneShape groups was statistically significant (P = 0.012).

Table 1: Cross-sectional diameters, multiplication of the bl-md diameters, weights, and fracture loads of the roots

Group	No. Samples	Bl(mm)	Md(mm)	Multiplication of the bl-md diameters(mm^2)	Weights(g)	Fracture load(n)
Control	15	5.88	3.93	5.88 x 3.93	433 g	414 ± 70
Reciproc	15	6.07	4.19	6.07 x 4.19	406 g	396 ± 70
Wave One	15	6.02	4.08	6.02 x 4.08	448 g	372 ± 62
One Shape	15	6.05	4.02	6.05×4.02	442g	331 ± 68

DISCUSSION

Standardization of the samples is an important factor in mechanical testing. Dimension variations of the roots, extraction time, and storing conditions might affect the results of a study[4]. In previous fracture load studies (4, 15, 21, 22). BL and MB dimensions were measured, but the weights of the roots were omitted. In the current study, the same procedure was followed by to eliminate dimension variations as potential confounding factors. The weight and crosssectional diameter of the roots were tested statistically, and no significant differences were found between groups. According to the present results, the weights of the roots have a medium correlation with fracture loading. However, multiplication of the BL-MD diameter has a low correlation with fracture loading. These results corroborate those of Ertas¸ et al[16] however,this may not have been enough to standardize these samples. This was a limitation of our study although further studies could be conducted to clarify this issue. Thus, the findings of this study can compared with studies in which the fracture resistance of the roots has been evaluated. Hend Mahmoud Abou El Nasr et al 2014[17] found that Waveone instruments induced the least amount of cracks and exhibited greatest resistance to fracture compared with Protaper F2 files. Because of using Waveone file for instrumentation is to reduce the number of instruments inside the canal helps in less amount of dentin removal therefore reciprocating motion is claimed to be safer for dentin than conventional rotation.

Bilge Gulsum Nur et al in 2015[24] investigated that fracture resistance of the roots instrumented with WaveOne and Reciproc file systems were similar to the control group and it was observed that OneShape rotary file systems enhance the fracture strength of standardized curved roots when compared with untreated specimen.

One Shape file has an asymmetric cross-sectional geometry, which has a tip size of 25 and constant taper of 0.06 and a rotational speed of 400 rpm, whereas Wave One and Reciproc files have a taper of 0.08 over the first 3 mm from the tip which caused significantly less cracks than the OneShape file and a rotational speed of 300 and 350 rpm respectively.[14] Liu *et al*.[20]compared three single file systems regarding the incidence of root cracks at the apical root surface and/or in the canal wall after canal instrumentation (OneShape, Reciproc and Self-Adjusting File) and they found that OneShape caused cracks in 35% whereas Reciproc files caused cracks in 5% of teeth only. This finding may be related with the differences in cross-sectional design of files or the reciprocating motion causing less dentinal damage than the continuous rotation motion.

CONCLUSION

Within the limitations and standardization conditions of this study, it can be concluded that fracture resistance of the roots instrumented with Wave One and Reciproc file systems were similar to the control group whereas One Shape rotary file system enhance the fracture strength of roots compared with the control group.

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