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Research Article

Comparison of Incidence of Dental Defects in Oval Root Canals Prepared with Two Distinct Endodontic Rotary Files Systems: A Comparative In-Vitro Analysis.

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ABSTRACT

Objective: *The purpose of this work is to examine and contrast the creation of dentinal cracks using a scanning electron microscope (SEM) and a stereomicroscope during the root canal preparation process.*

Material and Method: *Three groups of 15 were created from the 60 extracted human mandibular premolars: two were experimental and one was controlled. The experimental groups underwent root canal therapy. Group II is the Trunatomy (TRN) file, and Group I is the Waldent walflex file. Group III, the control group, did not receive any preparations. After sectioning the roots at 3, 6, and 9 mm from the apex, the surfaces were examined with a stereomicroscope and SEM.*

Results: *The data were examined using the Chi-square test. There were no fissures in the untreated group. The area between 3mm and 6mm was where the cracks in Waldent Walflex were most evident. There was no statistically significant difference between the experimental groups at either the 6 mm or 9 mm levels ($P > 0.05$).*

Conclusion: *In conclusion, each rotary file utilized in the testing caused dentinal cracks. Compared to the Trunatomy file group, the Waldent walflex file group has more errors. The apical area of the samples had many more defects than the median and coronal regions.*

Keywords: *Dental Cracks, SEM, Trunatomy file, Waldent walflex file.*

Introduction

Successful endodontic therapy requires a precise diagnosis, treatment planning, anatomy assessment, tooth debridement, root canal shaping, and three-dimensional obturation.[1] A thorough biomechanical preparation is essential since the root canal shaping determines the outcome of the three-dimensional obturation. It is not appropriate to be overly enthusiastic or unprepared.[2.3]

The development of rotary nickel-titanium (NiTi) devices has resulted in improved root canal shaping, easier, faster, and more efficient design and concept. Crack formation can be induced by root canal shaping techniques and rotary instrumentation using NiTi tools.A crack is characterized as a flaw that has entire fracture lines that reach from the inner root canal space to the root's outer surface.[4-7]

Human dentin is viscoelastic, and rotating stresses are applied to the dentin during root canal preparation using NiTi rotary devices on the canals. By coming into contact with the dentinal walls, these rotating instruments form the canal.[8]

The root dentin experiences numerous short-term stress concentrations as a result of these interactions, which can result in craze lines or microscopic cracks. Within the root canal, tensions are created during the preparation process. The dentin's bonding is broken by the forces that are transmitted from the root to the surface.[9, 10]

These little fissures may eventually enlarge and result in a vertical root fracture. This is dependent upon several factors, including the post's placement, the tension on the obturation, and the thickness of the root dentine. These fissures allow bacteria to enter, which promotes the development of biofilm and raises the risk of reinfection. The apical region must be properly cleaned and shaped because it is crucial for instrumentation.[11]

The geometry of the cross section, designs, heat treatments, and file movement can all lead to cracks in NiTi files. Waldent Walflex files, which come from Waldent, India, are triangular-cross sectioned rotary files with sharp cutting edges that are incredibly flexible and less prone to wear out with frequent use. With an instrument composed of 0.8 mm NiTi wire that has been specially heated to make it superelastic and less likely to remember its shape, TRN is a rotational file system. There has been no research conducted to determine the frequency of dentin cracks resulting from the use of Waldent Wal flex files with TRN.[11,12,13]

Therefore, the purpose of this study was to examine and compare the amount of cracks in the dentin following root canal preparation with Waldent Wal flex files and TRN using a stereomicroscope and SEM.

Material and Method

For the current in-vitro study, 45 removed human mandibular premolars with closed apices were selected. The teeth were cleaned with a periodontal scaler to remove soft-tissue debris, and then they were disinfected for 24 hours with a 0.1% thymol solution. The roots were covered with silicone impression material (Zhermack Zetaplus, Italy) and embedded in acrylic resin to resemble the periodontal ligament. Radiographs of the teeth were taken from the buccolingual and mesiodistal sides in order to rule out the existence of a single canal and single apical foramen with a closed apex. Major morphological anomalies, fissures, bending canals, numerous roots, cavities or fillings, open apices, and resorption were all disqualified from consideration. The following teeth were excluded: those with major morphological variations, cavities or fillings, curved canals, open apices, calcified canals, resorption, and root fractures. Getting ready for a root canal the root canals were examined to ensure they were open, and the working lengths were adjusted to be 1 mm below the apex using a size #10 K-file (Mani Co, Tokyo, Japan). A glide route was created by the size #15 K-file (Mani Co, Tokyo,

Japan). To replicate a PDL, a hydrophilic vinyl polysiloxane impression material was utilized, and roots will be set in an acrylic resin that solidifies naturally.

Study groups:

Group I: Control group; No Instrumentation

Group II: Waldent Walflex files

Group III: Trunatomy (TRN) file.

The canals were disinfected with an X-Smart Plus, Dentsply, Switzerland, to the manufacturer's recommended torque and speed. Group II (Waldent Wal flex files) used W1 (17/0.08), W2 (19/0.02), W3 (20/0.04), W4 (20/0.06), and W6 (25/0.06) in order. With speed of 300 rpm and 1.8-3 Ncm torque. Up to the working length, Group 2 employed TRN Prime (26/0.04), TRN glider (17/0.02), and TRN orifice modifier (20/0.08). A single file was utilised to create instruments for a single canal. A complete rotation was performed for the instrumentation, with mild pecking in and out. The control group made no preparations at all. Before changing instruments, the canals were cleaned with two millilitres of 3% sodium hypochlorite (Vishal 5 Dentocare Pvt. Ltd., India), five millilitres of saline (Eurolife, Pirmeera Healthcare Pvt. Ltd., Pune, India), and five millilitres of 17% ethylene diamine tetraacetic acid (Dentwash, Prime Dental, Bhiwandi, India). After the last rinse, 2 mL saline. A diamond disc (Addler, Golden Nimbus, Mumbai, India) that was cooled underwater 16 mm from the tip was used to adorn the teeth. Using a stereomicroscope (Leica M60; Leica Microsystems GmbH, Wetzlar, Germany) adjusted to 2.5, each sample was initially examined. After that, the samples underwent gold sputtering to prepare them for examination, and a scanning electron microscope was used to view them. 45 teeth with a single root, a single patent canal, and a closed apex were selected for this investigation. Dentinal crack assessment Perpendicular to the teeth's long axis, a diamond disc was used to cut all the samples into three mm apical, six mm middle-, and nine-mm coronal slices starting at the root apex.

To examine the slices, SEM were employed. A defect is anything that develops in the inner root canal space and spreads to the tooth's surface. All other defects, such as craze lines, which were not regarded as cracks, were not due to the canal wall. i) The root surface (inner and exterior) of the dentin has no flaws or crazelines. ii) Defects: every line and fracture that was seen, and they even reached the external root surfaces.

All data were tabulated and analyzed using the Chi-square test. The level of significance was set at $\alpha = 0.05$. Statistical Package for the Social Sciences (22.0) software was used to analyse the data using the Chi-square test on an Excel sheet (MS Office 2010). (IBM, Chicago, IL, USA).

Result

Group 1: The Waldent walflex file displays 11 cracks in total (3 mm = 9 and 6 mm = 3). Group 2: A total of 5 cracks were shown by the trunatomy (3 mm = 3 and 6 mm = 2). Under SEM, neither group revealed any cracks at 9 mm, while the control group did not exhibit any cracks at 3, 6, or 9 mm.

Table 1: Frequency and percentage of cracks under SEM

Groups	3 mm	6 mm	9mm	Total number of specimens presenting defects (%)
Group I Control Group	0	0	0	0
Group II: Waldent Walflex files	9	3	0	11 (80.0%)
Group III: Trunatomy (TRN) file.	3	2	0	5 (33.33%)
P Value	0.001	0.001		

Discussion

According to Singh et al.,[14] adequate and proper biomechanical preparation is the most crucial step in endodontics because it greatly aids in achieving uniform hermetic three-dimensional obturation of the root canal system and prevents bacterial reinvasion, which could occur during cleaning and shaping and result in the formation of biofilms on the root surface and eventual failure of the entire endodontic treatment procedure.[15,16]

According to Peter et al., [17] 35% or more of the canal surface, including lateral canals, deep apical regions, and other abnormalities, remain intact and uninstrumented after the instrumentation operation. Thus, they offer bacteria a perfect habitat in which to grow and lead to the root canal treatment's failure.[18]

Given that mandibular premolars have a high prevalence of VRF, as demonstrated by Rivera et al., newly extracted mandibular premolars were examined for dentinal abnormalities in this investigation. This is due to the possibility that thinner and smaller dentinal walls will be more affected by instrumentation forces. Recently extracted teeth were employed in the investigation to minimize interference with the process of fracture formation.[19,20]

Researchers examined the effects of Waldent Wal flex files and TRN files on dentin fracture formation in this study. According to prior research, every technique that was tested in the study resulted in dentin cracks. [11, 13]

In this investigation, the experimental groups' dentin was discovered to have cracks, whereas the control groups did not. Consequently, the null hypothesis is not possible. It is impossible to replicate the appearance of a tooth in the mouth in vitro. Despite best efforts, scientists are unable to eliminate the impact of extraneous variables from clinical situations in the lab.[21,22]

To check for cracks, the teeth in this investigation were sectioned at various heights. Cracks may appear when specimens are sliced into pieces. On the other hand, there were no fractures in the control group. This indicates that sectioning is not the source of the dentin cracks; rather, preparation is. The apical segment had a higher number of cracks than the middle and coronal sections in every experimental group. This is consistent with the findings of investigations conducted by Nishad[23], Chole et al.[24], Bhavsar BA[11], and Karataş et al.[22]

Study Limitation

The use of elastomeric material to replicate the periodontal ligament was one of the study's drawbacks. Elastomeric material may collapse and allow direct tooth-acrylic contact, according to Adorno et al.[25] Additionally, the clinical situation is more complicated since the presence of periodontal ligament affects how pressures are distributed. Because bias was not taken into consideration in the study's design, future research should consider it when deciding how to standardize results. The file systems employed in this study have varying requirements for speed and torque, which limits the scope of this investigation. The outcomes of relevant studies were discussed, and standardizing torque and speed is essential for cross-study comparisons. However, bias is always a possibility with this component and cannot be eliminated. One possible explanation for the study's second flaw is that the instrumentation force might have differed based on the file system in use.

Conclusion

It is evident, given the limitations of the study, that samples instrumented with Waldent walflex files revealed more cracks than samples instrumented with Trunatomy files. Therefore, we may conclude that the most reliable and efficient engine-driven NiTi equipment for root canal instrumentation is Protaper Next.

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