Comparative Assessment of Damage to Radicular Dentin during Retreatment Procedures using Different Retreatment Systems

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ABSTRACT:
Aim: The purpose of this study was to assess the effect of retreatment procedure on dentinal damage to the root canal walls.
Materials & Methods: Sixty single rooted premolars were divided into 4 groups. All groups were prepared with ProTaper files and obturated with Gutta percha. Group 1 was kept filled (control). In Groups 2, 3 and 4, filling was removed with H-files, ProTaper retreatment files and R Endo retreatment files respectively. Then root sectioning was done at apical, middle and cervical third level. Sections were observed under stereomicroscope to assess defects.
Results: Least defects were observed in Group 1. No significant difference was found in the appearance of defects when the filling material was removed with any of the files. When compared within groups, there was no statistically significant association between the defects at apical, middle and cervical thirds for all the 4 groups. Though the difference was not statistically significant R Endo retreatment system showed slightly more defects than ProTaper or H-files.
Conclusion: Retreatment procedures can produce defects in the root canal dentinal walls.

Keywords: Defect, Dentine, Fracture, Retreatment.

INTRODUCTION:
"Primum non nocere" is a Latin phrase that means, “First, do no harm” This serves as a guiding principle to physicians that, whatever the intervention or procedure, the patient’s well being is the primary consideration. Needless to say, this applies to dental clinicians & procedures too. With the tsunami of newer technologies, it is a herculean task for the dental surgeon to analyze and segregate those, which are beneficial to the patient v/s, those that are not.

In Endodontics, treatment options for failed root canal treatments include conventional non-surgical retreatment, periradicular surgery, or extraction as the last resort. The non-surgical orthograde retreatment option is usually preferred; being the most conservative approach. The primary objective of non-surgical retreatment is to remove all the obturated material from the root canal and to regain access to the apical foramen.
Making the root canal “Gutta percha-free” is a tedious process. Several techniques
can be used for this purpose including H-files, nickel-titanium (NiTi) rotary instruments, heat bearing instruments, ultrasonics, and solvents. Novel techniques seek improved results through NiTi rotary instruments and operating microscope. Amongst the newer file systems, ProTaper Universal system for retreatment (Dentsply Maillefer; Ballaigues, Switzerland) and R Endo (Micro Mega) retreatment systems can be efficiently used to remove root canal fillings.\textsuperscript{1,2,3} Studies have revealed that rotary instrumentation can lead to dentinal damage of root canals.\textsuperscript{4,5} The remaining dentin thickness (RDT) is important as it gives resistance to fracture of root canal treated teeth. Because retreatment requires more mechanical manipulations and further preparations of the root canal, it could be that more damage to the root canal wall is caused after these procedures. The purpose of this study was to assess the influence of retreatment procedures, i.e. removal of filling material from the root canal, on the appearance of defects on the root canal walls. Thus, this study was conducted to assess the damage to radicular dentin during retreatment procedures viz. removal of gutta-percha using H-files and rotary retreatment files – ProTaper retreatment files (Dentsply) and R Endo retreatment files (Micro Mega).

**MATERIALS AND METHODS**

**Sample selection:**
60 extracted intact, permanent, single rooted and single canal mandibular premolars were selected and stored in purified filtered water for the study. Soft tissue and calculus were mechanically removed from root surfaces. Teeth with fractures, immature apex and root caries were excluded.

**Cleaning and shaping:**
The crowns were removed by using a low-speed saw with water cooling; leaving roots approximately 15mm in length. In all the teeth, canal patency was established with size 20 K-file. Thereafter, canals were prepared with ProTaper rotary instruments (Dentsply Maillefer) by using a torque control motor (X-smart, Dentsply Maillefer). The full sequence of ProTaper rotary files was used at 300rpm to prepare the canals till size F3. Each canal was irrigated with 3% solution of sodium hypochlorite between each instrument. After completion of the procedure, canals were rinsed with 2ml distilled water. All roots were kept moist throughout the procedure.

**Root Canal filling:**
Canals were dried by using absorbent points (Sure-endo). Zinc Oxide Eugenol sealer was introduced into the canal by means of a lentulo spiral. Standardized F3 gutta percha cones (Dentsply) were coated with sealer and placed into the root canal to the working length. Obturation was done with lateral compaction technique. The coronal gutta-percha was seared off with a heated plugger. Temporary restoration was placed. Teeth were kept in 100% humidity conditions at room temperature for 1 week. One group of teeth (n=15) was left filled, and no retreatment was performed.

**Filling removal:**
Teeth were divided in four groups (n=15). Group 1- Obturated and no gutta-percha removal done (Control Group)
Group 2- Gutta-percha removal done with H-files
Group 3- Gutta-percha removal done with Universal ProTaper retreatment files
Group 4- Gutta-percha removal done with R Endo files (Micro Mega)
In Group 2, the canal filling was removed with Hedstrom files; 3 coronal mm of the root canal filling was removed by Gates Glidden burs 2 and 3. A drop of RC Solve (Prime Dental Products) was introduced into each canal to soften the gutta-percha. Few additional drops were applied as required to reach the working length. Hand instrumentation was carried out with H-files sizes 25, 30, 35 in a circumferential quarter-turn push-pull filing motion to remove gutta percha and sealer from the canal walls.

In Groups 3 and 4, root canal fillings were removed with full sequence of ProTaper and R Endo retreatment files respectively. In both cases, a torque – controlled motor (X smart, Dentsply) and solvent RC solve was used. To standardize procedures and avoid variables during specimen preparation, only one operator conducted the experiments.

**Examination of roots**
The roots were rendered clean when no filling debris was observed on the instrument flutes. Roots were sectioned horizontally at 3, 6, and 9 mm from the apex with a low-speed saw under water cooling. Slices were then viewed through a stereomicroscope and images were taken.

**Assessment of dentinal damage**
The observations were divided in four categories; 1) Defect 2) No Defect 3) Fracture and 4) Fracture & Defect. No defect was defined as root dentin devoid of any lines or cracks where both the external surface of the root and the internal root canal wall had no defects. Defects were defined as all lines observed on the slice that extended either from the outer surface into the dentin or from the root canal lumen to the dentin. Fracture was defined as a line extending from the root canal space to the outer surface of the root. (Figure 1, 2, 3, 4)
Statistical analysis was carried out using Pearson Chi-Square test and Fisher’s Exact Test.

RESULTS
Graphs 1, 2 and 3 show the comparison among Groups at apical, middle and cervical third of the root. It was observed that there was no significant association between Groups and defects at different levels.

Graph 1: Comparison of defects and fractures in the apical third

Graph 2: Comparison of defects and fractures in the middle third

Graph 3: Comparison of defects and fractures in the cervical third

When comparing within groups, Graphs 4, 5, 6 and 7 show that in all groups there was no association between defects at apical, middle and cervical third of the root. However, from Table 1, it was observed that percentagewise, maximum ‘no defect’ was seen in Control group 1 (73.33%) followed by ProTaper retreatment group 3 (64.44%) and H-file group 2 (53.33%). Rendo group 4 showed least ‘no defect’ at 48.89%. Thus Group 1 showed least defects and Group 4 showed overall maximum dentinal cracks/fractures.

DISCUSSION
Modern technologies bring enhanced quality, successful outcomes, ease of work
A solvent was used to remove gutta percha as solvents aid in faster and easier filling removal.10-13 Each root was sectioned at 3, 6 and 9 mm from apex. This sectioning method enabled direct inspection of the root canal wall at cervical, middle and apical third of the root, observing not only cracks, but also fracture lines.5

Results of the current study showed that there is no statistically significant difference in the appearance of defects when all the 4 groups were compared. Also when comparison was done within the group there was no significant
difference in defects at apical, middle and cervical thirds. This implied that the level of the root and the remaining dentine thickness did not influence the appearance of dentinal fractures and defects. However, group 1 (control) showed least defects and fractures indicating that retreatment procedures by any instrument, be it H-files, ProTaper retreatment files or R Endo retreatment system can cause damage to root dentin. A similar study on damage to root dentin during retreatment procedures was carried out by Shemesh et al. which concluded that retreatment procedures could significantly damage the root and result in cracks and fractures.14 Another study concluded that all rotary retreatment techniques decreased fracture resistance and caused root weakness.15 Also, R Endo retreatment system showed more defects/fracture than H-files and ProTaper retreatment files though the difference was statistically insignificant. This could be due to the fact that the R endo system has more number of files (5) than ProTaper Retreatment (3) thus more manipulations in the root canal. Also, the maximum taper for R endo is 12% as compared to ProTaper Retreatment (8%) and H files (2%). This increased taper may cause more removal of tooth structure, leading to more defects.

CONCLUSION
Within the limitations of this in vitro study following conclusions can be drawn: Retreatment procedures cause more dentinal damage than initial endodontic treatment. No statistically significant difference was found between defects caused by H files, ProTaper retreatment files and R endo retreatment files. However, percentagewise, R endo retreatment files showed slightly more defects than H files and ProTaper retreatment files. The region of the root viz. apical, middle and cervical third did not influence the appearance of dentinal defects.

REFERENCES
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