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Original Article

Dentistry Section

Comparison of Time Required by D-RaCe, R-Endo and Mtwo Instruments for Retreatment: An in vitro Study

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ABSTRACT

Introduction: To evaluate and compare the amount of time required by three rotary NiTi instruments in removing gutta-percha from root canal during retreatment with hand file as control.

Materials and Methods: Eighty human mandibular premolars with single straight root canals were prepared and obturated by cold lateral condensation with gutta-percha and AH Plus sealer. After two weeks, the 80 teeth were divided into one control group and 3 retreatment groups (n = 20 each). Gutta-percha was removed using H-files, the D-RaCe, or the Mtwo or the R-Endo retreatment systems. Retreatment time was calculated using stopwatch.

Results: D-RaCe and Mtwo required significantly less time than R-Endo and hand file. Hand file took maximum time, which was significantly slower than all groups. However, D-RaCe and Mtwo retreatment time was statistically insignificant.

Conclusion: D-RaCe and Mtwo remove gutta-percha faster than R-Endo and Hand files.

Keywords: Endodontic treatment, Gutta-Percha removal, Rotary endodontic Files

INTRODUCTION

Recently, there is an increase in endodontic retreatment, mainly as a result of the increased emphasis on the preservation of teeth; including those cases in which endodontic therapy has failed [1]. Non-surgical retreatment success rate varies from 74-98% [2] but retreatment procedures have gained importance because of increasing demands for saving teeth and possibility of root canal treatment failure [2].

The cause of post-treatment disease is attributed to persistence of microorganisms in the root canal system after cleaning and shaping or the re-colonization of the root canal space by bacteria following coronal or apical microleakage [3]. So, the objective of root canal retreatment should be to eliminate or to substantially reduce the microbial load from the root canal [4]. It is important to remove all root filling materials, as it allows subsequent cleaning, shaping and filling of the root canal system [5].

Gutta-percha is the most commonly used material for filling the root canals, and its complete removal is required when retreatment is indicated [6]. Many procedures have been advocated for gutta-percha removal like manual, mechanical, ultrasonic or lasers but NiTi systems have been suggested for removing gutta-percha because studies have shown that they are effective and safe [7,8] with shorter working time.

The aim of this study is to compare the time required by 3 rotary NiTi systems especially designed for endodontic retreatment with that of H-files in removing gutta-percha and sealer from the root canal.

MATERIALS AND METHODS

Sample Preparation

Eighty extracted human mandibular premolar teeth were selected. Inclusion criteria were absence of a root filing, presence of a single root canal, mature apex and no caries or fracture. Soft tissues and calculus were mechanically removed from the root surfaces immediately after extraction. To eliminate residual soft tissues teeth were immersed for 24 h in 3% sodium hypochlorite. Crowns were removed at the cemento-enamel junction using a diamond disc to leave a root 14mm in length, ensuring a standardized working length. After access cavity preparation, working length was established 1 mm short of the length using size 10 K-file (Dentsply Maillefer, Ballaigues, Switzerland) inserted into the root canal until its tip was visible at the apical foramen.

Initial Shaping and Filling

The same operator prepared all root canals with K-file (Dentsply Maillefer, Ballaigues, Switzerland) till size 25 at the working length. Between each file, root canals were rinsed with 2 ml sodium hypochlorite (1%). After completion of preparation, root canals were irrigated with a final sequence of 5 ml EDTA and 5 ml NaOCl (1%) and saline and then dried with paper points.

A standardized gutta-percha master cone size 25 was fitted at WL. It was coated with AH Plus sealer (Dentsply De Trey, Konstanz, Germany) and slowly inserted into the root canal until it reached WL. Cold lateral compaction with accessory gutta-percha cones size 15 was performed until these could not be introduced more than 5 mm into the root canal. The excess gutta-percha was removed with a heated plugger. The access cavities were temporarily sealed and subsequently, the specimens were stored for 14 d at 37°C and 100% humidity to allow the complete setting of the sealer.

Root Canal Retreatment

The samples were divided into 4 groups with 20 samples each. Each group was then re-treated with a different technique.

GROUP 1

D-RaCe retreatment instruments (FKG Dentaire, La Chaux-de-Fonds, Switzerland) were used according to the manufacturer's instructions as follows: DR1 (size 30/ .10 taper) at a speed of 1000 rpm and torque of 1.5 N cm for the cervical third and beginning of the middle third and DR2 (size 25/ .04 taper) at 600 rpm speed and a torque of 0.7 N cm at the working length.

GROUP 2

R-Endo retreatment files (Micro-Mega, Besancon, France) were also used as per manufacturer's instructions. The Rm stainless steel manual file (17 mm, 25/.04 taper) was used first to its full length. It was followed by nickel-titanium rotary instruments Re (25/.12 taper) orifice opener, R1(25/.08 taper) till cervical third, R2(25/.06 taper) till

middle third, R3 (25/.04 taper) to full working length at a speed of 300 rpm and a torque of 1.2 N cm.

GROUP 3

According to the manufacturer's instructions, Mtwo R1 (15/.05 taper) and Mtwo R2 (size 25/.05 taper) instrument (Sweden & Martina, Padova, Italy) at full working length at a speed of 300 rpm and a torque of 1.2 N cm were used.

GROUP 4

The retreatment was initiated using size 3-, 0.9-mm and then size 2-, 0.7-mm Gates- Glidden drills (Dentsply-Maillefer) to remove gutta-percha from the coronal and middle thirds. The canals were re-instrumented with Hedström file of size 25 (DentsplyMaillefer, Ballaigues, Switzerland) in a circumferential quarter-turn push–pull filing motion to remove gutta-percha and sealer until working length was achieved. During retreatment, root canals were irrigated with 2ml of 1% NaOCl solution at each instrument change and adherent debris was removed from the files. To eliminate inter-operator variability, the same operator carried out all retreatment procedures. All instruments were used with gentle apical pressure in back-and-forth motion and discarded after usage in five root canals.

Retreatment was assumed to be complete when no traces of gutta-percha or sealer were detected on any of the instrument surfaces, inside the root canal and dentinal wall. To confirm this radiograph were taken. The total time needed to complete the procedure was recorded for each sample. If the radiographs revealed the presence of remaining filling material the procedure was continued until further radiographs showed no radio-opacity in the canal. The additional time was also recorded and incorporated in the total time required for retreatment.

The same operator performed time measurements. Total retreatment time was based on the time required for instrumentation and excluded time for changing instruments, irrigation and radiographic examination and was recorded in minutes and seconds with a stop watch.

Statistical analysis was performed with one-way ANOVA and Turkey's Post Hoc Test at $P < 0.01$.

RESULTS

Retreatment time taken in each group is tabulated in minutes in [Table/Fig-1]. D-RaCe and Mtwo required significantly less time than R-Endo and hand file ($P < 0.01$). Hand file took maximum time, which was significantly slower than all the other groups. However, D-RaCe and Mtwo retreatment time was statistically insignificant ($P > 0.01$).

Group	Maximum (MIN)	Minimum (MIN)	MEAN	Standard Deviation
D-RACE	2.50	1.59	1.89	0.35
R-ENDO	5.59	4.20	4.99	0.45
MTWO	4.06	2.13	2.73	0.60
HAND	10	6	8.40	1.35

[Table/Fig-1]: Scores of Retreatment Time (Minutes) in all Groups

DISCUSSION

The present study focused on ability of D-RaCe, R-Endo and Mtwo retreatment systems to remove gutta-percha and sealer from root canals in retreatment cases as quickly as possible. At present there is scarcity of data on the effectiveness of D-RaCe retreatment files, which was recently introduced when compared to other rotary retreatment systems that are available at present.

The goal of nonsurgical retreatment should be to reestablish the health of periapical tissues in short span of time. Biomaterial-centered biofilm forms in root canal obturating material in failed endodontic cases [9], necrotic tissue and bacteria, covered by obturating material may be responsible for periapical inflammation or pain [10]. Therefore, obturating material must be removed from the canal to reduce the number of microorganisms in safe, efficient and quick manner for success [11]. After regaining access, complete removal of the root canal obturating material, again cleaning and shaping of the root canal system and final obturation was done [12].

Advantages of rotary files includes maintenance of canal shape, reduced working time and reduced operator fatigue whereas disadvantages includes higher incidence of file separation [11,12], extrusion of obturating material and debris through the apical foramen, alterations of root canal morphology [10], but this study utilized only one parameter which is time required for retreatment procedure as criteria for evaluation.

The result demonstrated that rotary retreatment system were significantly faster than manual instrumentation which is in accordance to most previously published studies [8,13]. The reason behind this observation is suggested to be gutta-percha plasticization due to rotary instrumentation [8], which results in easier and quick penetration and retrieval of softened gutta-percha [7].

D-RaCe retreatment system was the fastest among all the system tested. Although no comparable data are available for D-RaCe instruments, the conventional RaCe instruments required less time to reach working length as shown in other studies [12]. This finding may be attributed to the alternating cutting edges which eliminate the undesirable screwing effect and the smooth instrument surface created by a special electrochemical treatment, which might also contribute to the superior sharpness of these instruments. It is also possible that the gutta-percha adhered less to the flutes so that the file had a better cutting efficiency [10].

The D-RaCe retreatment system comprises of 2 files (DR1-DR2). DR1 has 15.8 mm length, cutting tip of 30 no., taper 10% and used at 1000 rpm for cleaning coronal 1/3 while DR2 has 25.16 mm length, cutting tip of 25 no., taper 4% and used at 600 rpm for cleaning apical 2/3 [14]. DR1 has active tip which helps in easy and rapid penetration in the gutta-percha.

The cross-section of Mtwo instruments is S-shaped with increasing apical–coronal pitch length which results in positive rake angle with two cutting edges, to cut dentine effectively [15]. They have cutting tip and a constant helical angle, which ensures instrument's easy progression into the gutta-percha filling, without the need to exert pressure. R-Endo instruments have cross-section which is characterized by three equally spaced cutting edges and has neither radial lands nor an active tip [16].

The probable reason behind D-RaCe and Mtwo taking significantly less time than R-Endo should be the presence of the active cutting tip which helps in initial penetration and progression into gutta-percha. Study [5] has showed that Mtwo retreatment instrument takes less time in removing gutta-percha from root canals than R-Endo instruments though it was statistically insignificant.

Teeth were decoronated to obtain standardized WLs, and an identical protocol for root canal preparation was applied. Although decoronation does not reflect the clinical situation and may improve the outcome of treatment by facilitating root canal access, it allows specimen standardization by eliminating some variables, such as crown anatomy and root canal length, thus providing a more reliable comparison of the proposed retreatment techniques [17].

The root canals were filled using lateral compaction of gutta-percha and sealer, because this technique has been used in many similar studies [13,16]. Nevertheless, it was impossible to standardize completely the shape of each root canal system.

The limitation of present study design was that retreatment was considered complete only when no evident of obturating material on instruments and radiographs. Though previous studies has

shown that the lack of obturating material on the instruments and radiographs is not a valid criterion to demonstrate complete removal of obturating material from canal walls, radiographic images were chosen because radiographs are the most common clinical method to evaluate the remaining obturating material during retreatment [11].

Other methods which have been used for checking complete removal obturating material includes longitudinal sectioning [18], cleared teeth [10,16], cone-beam computed tomography (CBCT) [19] and micro-computed tomography (CT) [1]. Radiographs and cleared teeth have problem of overlapping areas of remaining material. Longitudinal cleavage method does provide direct visualization of the filling material but splitting may lead to loss of gutta-percha. It is questionable that micro-CT or CBCT analyses perform better in revealing residual material [20]. It is a known fact that regardless of the technique, it is difficult to completely remove all traces of gutta-percha and sealer [21].

CONCLUSION

It can be concluded from the present study that mechanical rotary retreatment systems are more rapid than manual instrumentation. D-RaCe is fastest of all the systems, which was statistically similar to Mtwo. R-Endo is faster than hand files but slower than D-RaCe and Mtwo.

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