Original Article

Efficacy of Two Rotary Instruments For Gutta Percha Removal During Root Canal Retreatment

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Abstract

Aim *- Evaluate the efficacy of ProTaper and ProTaper Retreatment instruments in the removal of gutta-percha during retreatment of straight root canals in comparison with Hedstrom files.*

Methodology *-The root canals of 30 Maxillary central incisors were instrumented by step back procedure and obturated with lateral condensation before the teeth were randomly divided into three groups of 10 specimens each i.e. Group 1-using H files, Group 2- using ProTaper and Group 3- using ProTaper retreatment. Radiographs were taken after the filling removal and the canal wall cleanliness was evaluated. Roots were divided into apical, middle and coronal parts and scored on a scale of 0 (no debris), 1(25-50% of walls covered with debris and 3 (>50% of walls covered with debris).Number of fractured instruments were also evaluated in each group.*

Results *-There was no significant difference (p>0.05) between the three groups in terms of the debris seen radio graphically after retreatment.*

Conclusion *- All systems evaluated ex vivo were equally effective in removing gutta percha during retreatment.*

Keywords: *Retreatment, fractured, efficacy, obturated, debris*

Introduction

Root canal therapy, despite having a high degree of success, may not lead to the desired response, and failure may occur[1-5]. When root canal therapy fails, treatment options include conventional retreatment, periradicular surgery or extraction. Whenever possible, the retreatment option is preferred because it is the most conservative method to solve the problem[6]. Nonsurgical endodontic retreatment is an attempt to re-establish healthy periapical tissues after inefficient treatment or re-infection of an obturated root canal system because of coronal or apical leakage.

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It requires regaining access to the entire root canal system through removal of the original root canal filling, further cleaning and reobturation[7]. Posts or broken instruments can be removed using specific technologies[8].

Removal of gutta-percha and sealer is an important factor in root canal retreatment. Necrotic tissues or bacteria, covered by remaining gutta-percha or sealer, maybe responsible for periapical inflammation or pain. Most frequently Enterococcus faecalis, followed by Streptococcus spp. and Tannerella forsythensis was found in poorly root-filled teeth associated with periradicular lesions[9]. Thus, as much obturation material as possible has to be removed to uncover residual bacteria. This enables thorough chemomechanical re-instrumentation and re-disinfection of the root canal system[10].

Gutta-percha removal can be achieved by several methods. One of these methods is the chemical technique, using different types of solvents, such as chloroform, eucalyptol, xylene, halothane, turpentine, or orange solvent, in combination with K-type or Hedstrom file[11-16]. Care should be taken to avoid forcing the softened gutta-percha or solvent through the apical foramen to avoid periradicular tissue irritation[17-19]. Other methods of gutta-percha removal include removing the coronal portion of gutta-percha using Gates Glidden or heat pluggers [20], then the rest can be removed by an ultrasonic technique[21,22].

Additionally, rotary instruments can also be used, such as the inflexible GPX burs [23], the canal finder [24-26], or one of the recent flexible rotary nickel-titanium (NiTi) files in a slow-speed handpiece [27, 28].

Removal of GP using hand files with or without solvents is time-consuming, especially when the filling materials are well condensed [29,30]. Nickel–titanium (Ni-Ti) rotary instruments have been used successfully in root canal cleaning and shaping. ProTaper files are characterized by progressively increasing tapers, a convex triangular cross-section, and a modified guiding tip [28,29]. Schirrmeister *et al.*[31, 32] showed no difference between the ProTaper and hand instrumentation in gutta-percha removal in straight and curved root canals. This technique yielded a high-fracture incidence of 22.7%[31].

More recently, the ProTaper Ni-Ti rotary system has been upgraded to the ProTaper Universal system, which includes shaping, finishing and retreatment instruments. The three retreatment instruments (D1, D2 and D3) are designed for removing filling materials from root canals. They have various tapers and diameters at the tip, which are size 30, 0.09 taper, size 25, 0.08 taper and size 20, 0.07 taper. The full lengths of these retreatment files are 16 mm for D1, 18 mm for D2 and 22 mm for D3. D1, D2 and D3 are recommended to remove filling materials from the coronal, middle and apical portions of canals respectively. Similar to the shaping and finishing instruments, the retreatment series have a convex cross section, however, D1 has a working tip that facilitates its initial penetration into filling materials. The purpose of the present laboratory study was to evaluate the efficacy of ProTaper Universal retreatment files in removing GP from root canals.

Materials and Methods

Thirty extracted maxillary central incisors with a single straight canal, verified radiographically, and with completely formed apices were selected. Access cavities were prepared and working lengths determined prior to the canals being prepared with a step-back technique with normal saline irrigation. The canals were enlarged with K-type files (DentsplyMaillefer, Ballaigues, Switzerland) to a size 50 at working length. The canals were obturated with a zinc oxide eugenol sealer (SS White, Rio de Janeiro, Brazil) and lateral condensation of gutta-percha. The access openings were sealed with a temporary filling material (Cimpat - Septodont, Saint-Maur-des-Fosses, France) and the teeth were stored at 37 °C in 100% humidity for 2 days.

Bucco-lingual and mesio-distal radiographs (Eastman Kodak, Rochester, NY, USA) were taken using radio-visiography (RVG) to examine the quality of obturation and, in particular, the apical extent and degree of condensation. The distance between the X-ray source (XR6010 Gnatus, Ribeirao Preto, Brazil) and the sensor (Satelec, digital xray system, sotroacteon) and the direction of the beam were the same throughout the study. The exposure time was 0.2 s. The teeth were randomly divided into three groups with 10 specimens each. The temporary fillings were removed and the root canals reopened.

GROUP A:

D1, D2 and D3 were sequentially used in a crown-down manner to reach the pre-established WL; they were manipulated in a brushing action .The rotational speed was set at 500 rpm as recommended. It was followed by cleaning of the apex with Hedstrom files up to size 50 and no circumferential filing was done.

GROUP B:

ProTaper Universal rotary shaping (S1 and S2) and finishing (F1, F2 and F3) instruments, which were used in a gentle brushing action at a speed of 300 rpm according to the manufacturers' instructions. It was followed by cleaning of the apex with Hedstrom files up to size 50 and no circumferential filing was done.

GROUP C:

Hedstrom files (DentsplyMaillefer) sizes 80, 70, 60, 50 were used in a circumferential quarter-turn push–pull filing motion to remove the root fillings from the middle and apical portions until the original WL had been reached.

When ProTaper Universal retreatment files are used to remove GP, slight apical pressure has to be exerted for file penetration. Files should be withdrawn frequently for the removal of the debris from instrument flutes before being reintroduced in the root canal system. If the rotary instruments fail to progress along the canal path, stainless steel hand files may be used to check the resistance and establish the glide path.

Retreatment was considered to be complete when gutta-percha removal stopped and no gutta-percha could be observed in the access opening. Bucco-lingual and proximal views of each retreated root were used by the observer to gauge how much debris (gutta-percha/sealer) remained; this was compared with the example radiographs and a score given.

Radiographs were recorded by the same observer 1 week later using the same method to check reproducibility.

Observers were asked to give one of the following scores for each third of the root canal: 0 = if no radio-opaque debris could be observed; 1 = <25% debris; 2 = 25 – 50% debris; 3 = >50% debris. Bucco-lingual and proximal views of each retreated root were used by the observers to gauge how much debris (gutta-percha/sealer) remained; this was compared with the example radiographs and a score given. The number of fractured instruments was recorded for each group.

Data were analyzed using a Stata Version 5.0 with significance predetermined at a level of 0.05. The Kruskal–Wallis test was used to estimate inter-observer correlation and to compare the difference between retreatment groups at the three levels. The Mann-Whitney test was done to compare the difference between the coronal apical and middle third of the canals in all the three groups.

Results

There was no significant difference between examiner's assessments at each recording session. Therefore the data were pooled.

Table-1 displaying the probability values using Kruskal– Wallis analysis to determine differences between each method of retreatment at the three levels

BL/MD	GROUP		N	MEAN	SD	MIN.	MAX.	PERCENTILE		
								25th	50th	75th
BL	PROTAPER RETREATMENT	cor	10	1.40	.516	1	2	1.00	1.00	2.00
		mid	10	1.00	.000	1	1	1.00	1.00	1.00
		api	10	1.00	.667	0	2	.75	1.00	1.25
	PROTAPER	cor	10	1.70	.675	0	2	1.75	2.00	2.00
		mid	10	1.00	.568	0	2	.75	1.00	1.00
		api	10	0.90	.816	0	3	.75	1.00	1.00
	HAND	cor	10	1.90	.568	1	3	1.75	2.00	2.00
		mid	10	1.30	.675	1	3	1.25	1.00	1.00
		api	10	1.00	.816	0	3	.75	1.00	1.00
MD	PROTAPER RETREATMENT	cor	10	1.40	.516	1	2	1.00	1.00	2.00
		mid	10	.80	.632	0	2	0.00	1.00	1.00
		api	10	.90	.568	0	2	.75	1.00	1.00
	PROTAPER	cor	10	1.40	.843	0	3	1.00	1.00	2.00
		mid	10	.90	.738	0	2	0.00	1.00	1.25
		api	10	.70	.483	0	1	0.00	1.00	1.00
	HAND	cor	10	1.50	.707	0	2	1.00	2.00	2.00
		mid	10	1.10	.316	1	2	1.00	1.00	1.00
		api	10	.70	.675	0	2	0.00	1.00	1.00

Table 1 displays the probability values using Kruskal–Wallis analysis to determine differences between each method of retreatment at the three levels. No significant difference was found between the three groups.

Table-2 showing the results of Mann-Whitney test showing significant difference between coronal and middle third of the canals in all the three groups

BL/MD	GROUP		COR-MID	COR-API	API-MID
BL	PROTAPER RETREATMENT	Z	-2.000(a)	-1.633(a)	0.000(a)
		Asymp. Sig (2 tailed)	.046	.102	0.000
	PROTAPER	Z	-2.828(a)	-2.333(a)	.447(c)
		Asymp. Sig (2 tailed)	.005	.020	.655
	HAND	Z	-2.161(a)	-2.460(a)	-1.732(a)
		Asymp. Sig (2 tailed)	.034	.014	.083
MD	PROTAPER RETREATMENT	Z	-2.449(a)	-1.899(a)	-.577(c)
		Asymp. Sig (2 tailed)	.014	.059	.564
	PROTAPER	Z	-2.236(a)	-2.333(a)	1.414(c)
		Asymp. Sig (2 tailed)	.025	.020	.157
	HAND	Z	-1.633(a)	-2.530(a)	-2.000(a)
		Asymp. Sig (2 tailed)	.102	.011	.046

Table 2 showing the results of Mann-Whitney test shows significant difference between coronal and middle third of the canals in all the three groups. Significant difference was also seen in coronal and apical third of the canals in group B and group C. All of these showed more debris in the coronal third as compared to the apical and middle third. Only 1 instrument fractured in group B unlike Group A and Group C where no instrument fracture was observed.

Discussion

Complete removal of pre-existing filling material from canals is a prerequisite for successful nonsurgical root canal retreatment[32]. This procedure can uncover residual necrotic tissues or bacteria that may be responsible for persistent periapical inflammation, and allow further cleaning and refilling of the root canal system [33,34]. Remaining filling debris has been assessed by radiography[34,35], splitting teeth longitudinally[36, 37]or making teeth transparent [31, 32, 34, 38]. Radiographs are limited to two-dimensions. Ideally, three-dimensional visualization of the root canal system would provide a better understanding of the distribution of the debris after retreatment. Micro-computed tomography may be a viable alternative for the qualitative and quantitative evaluation of retreatment procedures[39]. The radiographic technique produced magnification with good resolution that would be impossible by conventional dental radiography. By examining the teeth from two views at right angles to each other an overall impression of the amount of debris remaining could be obtained.

As it has been shown in the literature, it was impossible to remove all traces of GP/sealer from root canals with any retreatment technique, regardless of single or combined action [29,40,41]. This was also demonstrated in the present study, as none of the specimens was free of GP/sealer remnants.

All the retreatment procedures in this study left more debris coronally than apically. This might be because the use of Gates Glidden drills is a well known technique for gutta-percha removal from the coronal and middle parts of the root canal and these files have not been used in this study. Just the use of any of the file systems could not clean the coronal area completely. This is contrary to previous studies which show that apical area is most difficult to clean especially in curved canals [42].

This study was performed on endodontic teeth with straight root canals. Therefore, the conclusions of this study could not be directly extended to teeth with curved root canals. However, more ProTaper files fractured during retreatment of curved canals compared with straight canals. Clearly, more studies are needed to evaluate the efficacy, maintenance of original canal morphology, and safety of rotary Ni-Ti instruments during retreatment of teeth with complicated root canal anatomy.

It was only possible to make a semi quantitative evaluation of the amount of debris remaining. Evaluation was subjective, and observer performance is known to be variable in many cases where diagnosis is required.

Prior to the introduction of ProTaper Universal retreatment files, ProTaper rotary finishing files had been used for GP removal (27, 38). This technique yielded a high-fracture incidence of 22.7% (38). Procedural errors including instrument fracture were not noted in the present study, demonstrating the safety of ProTaper Universal retreatment instruments in endodontic retreatment. As a general rule, Ni-Ti rotary instruments should be used with great caution.

Conclusion

It should be kept in mind that the clinical outcome of endodontic treatment is significantly affected by pre-operative diagnoses but not by the specific choice of an instrumentation system. The results of the present study suggest that all systems evaluated ex vivo were equally effective in removing gutta percha during retreatment.

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