



Efficacy of ProTaper and Mtwo Retreatment Files in Removal of Gutta-percha and GuttaFlow from Root Canals

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ABSTRACT

Introduction: The aim of this *in vitro* study was to compare the efficacy of ProTaper retreatment (ProTaper R) and Mtwo retreatment (Mtwo R) files in removing gutta-percha and GuttaFlow from endodontically treated straight root canals. **Methods and Materials:** The root canals of 60 human mandibular single-rooted premolars were prepared and randomly divided into two groups ($n=30$). In groups A and B the root canals were obturated using lateral condensation of gutta-percha plus AH 26 and GuttaFlow, respectively. The canal orifices were temporarily sealed and the roots were incubated for 3 months at 37°C and 100% humidity. Primary cone-beam computed tomography (CBCT) images were taken after incubation period. The specimens in each group were randomly divided into two subgroups ($n=15$). ProTaper R files (D1, D2, and D3) were used in groups A1 and B1 while Mtwo R files (25/0.05 and 15/0.05) were used in groups A2 and B2. The time required to extirpate the root filling was also recorded. After retreatment, another CBCT scan was taken at the same position. The volume of remaining filling materials inside the canals was calculated before and after retreatment. The data was analyzed using the two-way ANOVA and independent t-test. **Results:** The remaining filling materials in the canals treated with ProTaper were less than Mtwo. The remaining volume of GuttaFlow was less than gutta-percha regardless of the system applied. Mtwo R files removed root fillings faster than ProTaper R. **Conclusion:** ProTaper R removed filling material more efficiently compared to Mtwo R which required less time to remove root filling material.

Keywords: Gutta-Percha; Mtwo Retreatment Files; ProTaper Retreatment Files; Root Canal Retreatment

Introduction

Post-treatment endodontic disease might occur due to persistence of bacteria in the root canal system as a consequence of insufficient cleaning, untreated canals, inadequate filling or coronal/apical leakage [1]. Non-surgical root canal retreatment is the first choice to re-establish the healthy periapical tissues. The procedure requires complete

removal of the filling material from the canal system to allow effective cleaning, shaping and re-filling [2]. Core filling material and the sealer must be removed from the canal as the first step in re-treatment of previously filled canals. An ideal root filling should be easily removed. Some researchers reported that the GuttaFlow root filling (Coltene/Whaledent, Langenau, Germany) was removed more easily from the canal in comparison with gutta-percha and AH 26 sealer [3, 4].

Several techniques can be used to remove the root filling material from the root canal system, including the use of stainless steel hand files [5, 6], Gates Glidden drills, nickel-titanium (NiTi) rotary instruments, ultrasonic instruments [7-10], heat-bearing instruments [11], lasers [12] and use of adjunctive solvents. The removal of gutta-percha using rotary instruments in the retreatment process have decreased the chair-side clinical time [13].

ProTaper retreatment (ProTaper R) (Dentsply Maillefer, Ballaigues, Switzerland) and Mtwo retreatment (Mtwo R) (VDW, Munich, Germany) files are two NiTi systems which have been designed for gutta-percha removal. The ProTaper R system consist of three flexible instruments [D1 (30/0.09), D2 (25/0.08) and D3 (20/0.07) files] which are specially designed for root filling removal from the coronal, middle and apical portions of root canals, respectively [8, 14]. Mtwo R system consists of two instruments (25/0.05 and 15/0.05) with cutting tips for efficient removal of gutta-percha fillings [14]. There is some controversy about the capability of these two rotary systems in gutta-percha removal from the root canal system.

Yadav *et al.* [14] reported no significant difference between the volume of remaining filling materials after retreatment with ProTaper R and Mtwo R files. On the other hand, Dadresanfar *et al.* [15] found Mtwo R files to be more efficient in material removal compared to ProTaper R files. In contrast, according to the study by Taşdemir *et al.* [16] ProTaper rotary instruments left less filling material inside the root canals than Mtwo rotary instruments.

Marfisi *et al.* [17] and Somma *et al.* [18] reported that Mtwo R files required less time to remove the root filling material than ProTaper R instruments. On the other hand, there was no difference between Mtwo and ProTaper instruments regarding retreatment time in another study [16].

Remaining filling debris has been assessed by various methods in endodontic research including longitudinal tooth splitting or making them transparent, radiography and digitized images [10]. Splitting is an invasive method and can spread the remaining filling materials. Radiography and digitized images provide two-dimensional information from three-dimensional structures. Computed tomography (CT) has been used for three-dimensional evaluation of the root canal system and does not require the destruction of the teeth [19, 20]. In dentistry, cone-beam computed tomography (CBCT) may be a feasible alternative for the qualitative and quantitative evaluation of retreatment procedures [14, 17].

The aim of this *in vitro* study was to compare the efficacy of ProTaper R and Mtwo R files in removal of gutta-percha/AH 26 sealer and GuttaFlow filling material from the endodontically treated teeth using CBCT.

Materials and Methods

Sixty human mandibular single rooted premolars that had been extracted for orthodontic reasons were selected. Radiographies were taken in buccolingual and mesiodistal directions to confirm full development of root, absence of root fillings, internal resorptions or calcifications. The samples were decoronated by means of a diamond disc to leave a 16-mm root section.

A #10 K- file (Dentsply Maillefer, Ballaigues, Switzerland) was placed into the canal until it was visible at the apical foramen and the working length was determined by subtracting 1 mm from this length. The root canals were prepared using step-back technique with K-files. The canals were enlarged up to a #40 file as the master apical file (MAF) and flared to #70 file by reducing 0.5 mm for each successive instrument. During preparation, each canal was irrigated with 2 mL of 5.25% NaOCl after each instrument. The canals were dried using paper points and the teeth were randomly divided into two groups ($n=30$). The roots were then obturated as follows:

Group A: The roots were obturated using lateral condensation method with the #40 gutta-percha point (Gapadent, Incheon, Korea) as master gutta-percha cone and #15 cones as accessories. AH 26 root canal sealer (Dentsply, DeTrey, Konstanz, Germany) was utilized as sealer.

Group B: The roots were obturated using the #40 gutta-percha point as the master gutta-percha cone and injection of GuttaFlow (Coltene Whaledent, Altstätten, Switzerland) according to the manufacturer's instructions. The GuttaFlow capsule was triturated in an amalgamator and inserted into the root canal by using the Canal Tip.

In order to verify the root filling quality, mesiodistal and buccolingual radiographies were taken. The canal orifices were sealed temporarily with Coltosol (Coltene, Altstätten, Switzerland) and the roots were incubated for 3 months at 37°C and 100% humidity. Primary CBCT images were taken after incubation period.

All of the specimens were fixed in 1-cm thick wax plates and placed on the chin rest of Alphard-Vega Dental CT units (110 kVp, 12 mA, Asahi Roentgen Ind. Co., Ltd, Kyoto, Japan) for image attainment. Axial, frontal and sagittal sections were obtained after adjusting the appropriate parameters for scanning with 0.2 mm voxel resolution (8 cm FOV and 40 sec for image acquisition).

The specimens in each group were randomly divided into two subgroups ($n=15$) and retreated as follows: In groups A1 and B1: ProTaper R files (D1, D2, and D3) (Dentsply Maillefer, Ballaigues, Switzerland) were used in a crown-down technique. File D3 was used to the working length. In groups A2 and B2 Mtwo R (VDW, Munich, Germany) files sizes 25/0.05 and 15/0.05 were used in a

crown-down manner. Instrument size 15/0.05 was carried to the working length. The canals in all groups were rinsed with 2 mL of 5.25% NaOCl between each instrument.

In all groups, instrumentation was performed using a 16:1 reduction gear handpiece installed on an electric motor (Marathone Endodontic, Daegu, Korea). Speed and torque were set for each instrument according to the manufacturer's instructions. In each sample, two to three drops of chloroform solvent (Golchadent, Tehran, Iran) was introduced into the canal and left to act for 1 min. The canals were rinsed with 2 mL of 5.25% NaOCl between each instrument. Retreatment was considered finished when the working length was obtained and no more filling material could be observed on the instruments. Each instrument was used to prepare a maximum of five root canals. The preparation time to complete the retreatment procedures was recorded in seconds. After retreatment, another CBCT scan of each root was taken at the same position for the initial CBCT scanning.

CBCT data were imported to Simplant software (Materialise Dental NV, Leuven, Belgium) version 17. The volume of filling materials inside the canal was calculated before and after retreatment. The percentage of filling material on canal walls was analyzed using the two-way ANOVA and independent t-test.

Results

Both retreatment rotary systems used in this study left some filling materials inside the root canals. There were statistical differences between two rotary systems regarding the removal of gutta-percha filling material ($P < 0.001$) and GuttaFlow ($P < 0.001$). The mean volume of remaining filling materials in the canal was less with ProTaper R files compared to Mtwo R. The remaining volume of GuttaFlow was less than that of gutta-percha/sealer regardless of the retreatment system applied (Table 1).

The mean operating time required to remove the filling materials is reported in Table 2. Mtwo R files were faster than ProTaper R system in extirpating root fillings.

Table 1. The mean (SD) of remaining filling material in each group

Group	GuttaFlow	Gutta-Percha	P-value
ProTaper R	8.89 (1.13)	11.75 (1.77)	<0.001
Mtwo R	14.43 (1.96)	19.01 (1.94)	<0.001

Table 2. The mean (SD) of time (sec) required to remove the filling material

Group	GuttaFlow	Gutta-Percha	P-value
ProTaper R	236.60 (14.58)	274.07 (27.51)	<0.001
Mtwo R	190.33 (18.44)	231.80 (27.35)	<0.001

Discussion

The success of nonsurgical root canal retreatment depends on the complete removal of the infected filling material such as gutta-percha and sealers from root canals to allow effective cleaning, shaping and refilling of the root canal [2, 11].

The results of the present study showed that some filling materials remained in root canal after using Mtwo R and ProTaper R instruments. Previous studies concluded that all techniques left some amount of gutta-percha and sealer remnants on root canal walls [7, 21].

We used CBCT scanning as a non-invasive method which allows visualization of morphological features in detail [22]. This method is simple, efficient and sensitive enough to identify small areas of residual filling materials on the canal walls. CBCT scanning allows three-dimensional evaluation of the root canal system and does not require destruction of the teeth. This method offers reproducible data and allows the assessment of endodontic retreatment by comparing the amount of filling material inside the root canals before and after retreatment procedures [23].

The CBCT evaluation found significant differences between Mtwo R and ProTaper R systems in the removal of filling material. The mean volume of remaining filling materials in the canals were less with ProTaper R system compared to Mtwo R. This means ProTaper R system removed filling materials more efficiently compared with Mtwo R. The better concert of ProTaper R instruments may be attributed to the three progressive tapers and length design of D1, D2 and D3 files [21]. Our study concurs with Taşdemir *et al.* [16] who stated that ProTaper R left significantly less gutta-percha and sealer than Mtwo R instruments.

Mtwo R files required significantly less time to remove gutta-percha and GuttaFlow than ProTaper R. This result is consisted with previous studies by Somma *et al.* [18] and Marifis *et al.* [17].

It seems that some special characters in design of Mtwo retreatment files compared to ProTaper cause better performance of these files in removing root filling material. Mtwo R files have positive rake angle with two cutting edges, an increasing pitch length in the apical-coronal direction and S-shaped cross-section. As they have sharp blades, it is feasible to cut obturation material and reach the apical end-point by passing through the canal [14, 24]. Also, unlike the ProTaper R instruments, Mtwo R files do not require a crown-down instrumentation sequence [14].

GuttaFlow was removed significantly better from the canal walls than gutta-percha and AH 26 sealer regardless of the rotary instrument system used. This result is corresponded with previous studies [3, 16]. It seems that more homogenous filling in the GuttaFlow group might have enabled the filling to be removed as a whole.

Conclusion

Both of Mtwo R and ProTaper R instruments left filling material inside the root canal. ProTaper R system removed filling material more efficiently compared to Mtwo R. GuttaFlow was removed significantly better from the canal walls compared to Gutta-Percha. Mtwo R required less time to remove root filling material.

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Conflict of Interest: 'None declared'.

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