Comparison of the cleaning effectiveness of Mtwo & protaper next rotary systems in permanent molar root canals: An in vitro study

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Abstract

Aim: The aim of this in vitro study was to evaluate the presence of debris on the dentinal wall of palatal root of maxillary molars and distal root of mandibular molars after instrumentation with rotary Mtwo and Protaper Next files under stereomicroscope.

Materials and Methods: Forty freshly extracted human maxillary /mandibular molar teeth were selected for this study. Teeth were divided into two groups of 20 teeth each (group A and B). Teeth were decoronated at the CEJ, palatal and distal roots were taken. In group A, all the 20 canals were subjected to cleaning and shaping with rotary Mtwo files and rotary Protaper Next files in group B. After splitting the roots longitudinally, the dentinal debris of each root canal was evaluated at three areas (coronal, middle and apical thirds of the root) by means of numerical evaluation scale, under a stereomicroscope. The data obtained were analysed statistically using Mann-Whitney Test.

Results: There was no significant difference in the debris scores between the Mtwo group and Protaper Next group in the total canal area.

Conclusions: Under the condition of the present study, both the instruments Mtwo and Protaper Next rotary systems can be used to complete the preparation of canals. The use of Protaper Next instruments resulted in better canal cleanliness in the middle part compared with Mtwo.

Keywords: Dentinal debris; rotary Mtwo; rotary Protaper Next; and Stereomicroscope

Introduction

The elimination of intracanal microorganisms is the major goal of root canal treatment. This can be achieved with a proper chemo-mechanical preparation and is thus essential for successful endodontic treatment [1, 2]. However, currently no instrument can predictably clean the entire root canal system, especially in the apical portion of the root canals [3, 4]. Canals prepared with stainless steel instruments were only superficially cleaned and much of the pulp tissue was not removed. Stainless steel files have also been shown to create canal aberrations, such as ledges, perforations, zips and elbows [5, 6]. To eliminate some of the shortcomings of these traditional endodontic instruments, nickel-titanium (Ni-Ti) instruments have been developed. Most of the new systems incorporate instruments with a taper greater than ISO standard.02 design [6, 7]. Besides variation in taper, nickel-titanium instruments are characterized by different cross-sections and blade design [6]. Studies have shown that Ni-Ti instruments can effectively produce a well-tapered root canal form sufficient for obturation, with minimal risk of transporting the original canal [7-11]. Moreover, these investigations have shown that the different Ni-Ti instruments produce inconsistent results and this variation in the debris removal efficiency of these instruments may be due to variation in flute designs.

Mtwo (VDW, Munich, Germany) instruments have an S-shaped cross sectional design with a non-cutting tip. The two cutting edges have positive rake angle to cut dentine effectively. Moreover, the pitch length increases from the tip to the shaft. This design is claimed to eliminate threading and binding in continuous rotation, and to reduce transportation of debris towards the apex. The manufacturers claim that crown down instrumentation sequence is no longer required, since each instrument creates a glide path to the apex for the following instrument, and is used to the full working length to shape the entire length of the canal [12].
The ProTaper Next (Dentsply Maillefer, Ballaigues, Switzerland) is the successor of the Pro Taper Universal system (Dentsply Maillefer). It has an innovative off-centred rectangular cross section that gives the file a snake-like swaggering movement as it advances into the root canal. The manufacturer claims that the rotation of this cross section generates enlarged space for debris removal. These instruments are manufactured from M-wire alloy that is claimed to improve file flexibility and resistance to cyclic fatigue whilst retaining cutting efficiency [13, 14]. The ability of rotary NiTi instruments to remove dentine and pulpal debris during shaping is related to design features of the instrument, particularly the cross-sectional profile and the flutes [15]. The purpose of this study was to compare the cleaning effectiveness of the Mtwo and ProTaper Next systems, in the palatal canal of maxillary molar and distal canal of mandibular molars in human permanent molar teeth.

Materials and Methods:
A total of 40 extracted human mandibular and maxillary molar teeth with single distal and palatal root canal were used. Teeth were decoronated at CEJ and the canals were assessed for apical patency using an ISO 15 file. Teeth with intact root apices and root canal width of ISO 15 size in the apical third region were used [Fig 1]. The selected teeth were then divided randomly into two experimental groups of 20 each. In group A, the Mtwo system was used in the selected distal/palatal canal, according to the manufacturer's instructions. The instrumentation sequence employed five files, as follows: 0.04 taper ISO 10, 0.05 taper ISO 15, 0.06 taper ISO 20, 0.06 taper ISO 25, 0.06 taper ISO 30. All five instruments were used to the full working length of the canals, employing a cyclical in-out motion. Irrigation was performed after each instrument change, with 2 ml of 2.5% NaOCl and finally at the end of instrumentation with 5 ml of NaCl using syringe. Each instrument was used to prepare only four root canals in group B, the selected distal/palatal root canal was instrumented using the ProTaper Next system to the full length of the canals in the following sequence: X1 instrument. Taper 0.04, Size 17; X2 instrument. Taper 0.06, Size 25; X3 instrument. Taper 0.07, Size 30

The same cyclical in-out motion and irrigation protocol was used as with Mtwo instruments. Each instrument was used to prepare only four root canals. After preparation, all the root canals were flushed with 5ml NaCl and dried with absorbent paper points and roots were split longitudinally [Fig 2] with water-cooled double-faced diamond disk operated at low speed and then examined under a stereomicroscope with 20x magnification. [Fig 3]

Presence of debris was evaluated with the 5-score index [16]. The cleanliness of each root canal was evaluated at three different areas [apical, middle, coronal third of root]. [Table 1]

Score 1: clean canal wall, only very few debris particles. [Fig 4]
Score 2: few small conglomerations. [Fig 5]
Score 3: many conglomerations; less debris than 50 % of the canal wall covered. [Fig 6]
Score 4: more than 50% of the canal wall covered. [Fig 7]
Score 5: complete or nearly complete covering of the canal wall by debris [Fig 8]

The data were recorded and analysed statistically using Mann-Whitney Test for comparison of the two groups. The level of statistical significance was set at P<0.05.

Results
There was no significant difference in the scores between the coronal third and apical third between group A and group B. However there was statistical difference in the scores at the middle third level between the groups [Table 2]. There was no significant difference in scores between Mtwo group and the Pro taper Next group in the total canal area [Table 3].

Discussion
The removal of vital and/or necrotic pulp tissue, infected dentine and dentine debris to eliminate most of the microorganisms from the root canal system is still one of the most important objectives during root canal instrumentation [17]. Debris have been used as criteria in this study to assess the cleaning efficiency of the different instruments, because debris comprises dentine chips, residual vital or necrotic pulp tissue attached to the root canal wall that is considered to be infected in many cases [18].

Considering the major objective of the present study (to compare the cleaning effectiveness of the different instruments), a simple irrigation protocol with only NaOCl was used, avoiding any influence of different irrigation solutions, as justified in detail in several previous studies [19, 20, 21]. Thus, it should be accentuated that the cleaning efficiency of the instruments evaluated in the present investigation might be enhanced using a combination of NaOCl and EDTA as a chelating agent. In the present study, the cleaning efficiency was examined on the basis of a numerical evaluation scheme for debris, by means of an Stereomicroscope -evaluation of the coronal, the middle and the apical parts of the canals [22]. The present results confirm previous observations that cleanliness decreased from the coronal to the apical part of the root canal.

Therefore, sufficient disinfection and copious irrigation are essential to improve root canal cleanliness [23, 25]. In the coronal third and middle third of the canals, instrumentation with Protaper Next resulted in significantly less remaining debris compared with Mtwo. A possible reason for this could be their cross sectional design. ProTaper Next files have a unique swaggering motion which is attributed to unique patented off-centred rectangular cross section. This swaggering motion means that at all times the file is only contacting with the canal in two places which allows a greater space for removal of debris, optimises canal tracking and reduces binding [26].

In the apical third of the canals, Mtwo resulted in less remaining debris compared with Pro taper Next but there is no significant difference. The greater taper of ProTaper next (size 30, taper.07) compared with Mtwo (size 30, taper.06) might be reason for the increased amounts of residual debris especially in the apical portion of the canals because it might be assumed that ProTaper Next instruments are less flexible at their tip region compared to the less tapered Mtwo files [27, 28].

A comparison of the results obtained in previous studies under similar experimental conditions with those of the present study reveals that all instruments used displayed a relatively good cleaning ability. The mean overall score for debris was in the range from 2.03 for protaper next to 2.36 for Mtwo. Thus, according to the average score for debris obtained in the present study, it can be concluded that both the instruments can be used to complete the preparation of canals.

Conclusion
Under the condition of the present study, both the instruments Mtwo and Pro taper Next rotary systems can be used to complete the preparation of canals. The use of Pro taper Next instruments resulted in better canal cleanliness in the middle part compared with Mtwo.
Table 1: Summary of scores for debris

<table>
<thead>
<tr>
<th></th>
<th>Coronal third</th>
<th>Middle third</th>
<th>Apical third</th>
<th>Total score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instrument</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Mtwo</td>
<td>8 8 4 0 0</td>
<td>3 7 4 6 0</td>
<td>2 9 5 1 3</td>
<td>13 24 13 7 3</td>
</tr>
<tr>
<td>Protaper Next</td>
<td>9 9 2 0 0</td>
<td>5 12 3 0 0</td>
<td>1 9 5 4 1</td>
<td>15 30 10 4 1</td>
</tr>
</tbody>
</table>


