ORIGINAL ARTICLE

A comparative study on rotary Mtwo versus passive step back of hand K-file in preparation of extracted curved root canals

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Abstract

Introduction: The preparation of the root canal space includes debridement, shaping and apical preparation. These procedures are challenging and constitute. The recent introduction of automated techniques for canal preparation has created considerable interest. The aim of this study was to test shaping ability of one hand instrumentation (passive step-back technique) and new rotary NiTi system (Mtwo instrumentation) in curved root canals.

Materials and Methods: A total number of 40 curved molars selected for this *in vitro* study, 20 canals for each group. The mean of canal curvature in studied groups was similar. After preparation of access cavity, samples were divided into two groups. A custom made block was used for standardization of radiograph beam angel before and after preparation. In group 1, samples instrumented with passive step-back technique using stainless steel K-file, Gates Glidden and Pesso reamers. Mtwo NiTi rotary file and Endo IT power driven motor were used for instrumentation of samples in group 2. Transportation of canals curvature (loss of primary curvature) after canal preparation was assessed for each sample with the aid of AutoCAD 2007 software. Stereomicroscope provided data for measurement of changes in working length after canal preparation.

Results: The mean of changes in canals curvature (canal transportation) and mean of working length changes in group 1 (passive step-back technique) were 11.77 degree and 0.202 mm ($P<0.001$) and in group 2 (rotary Mtwo) were 5.58 degree and 0.202 mm ($P<0.001$). According to the present results, the original canal curvature was maintained significantly better with automated Mtwo files than with hand instrumentation.

Conclusion: These can be hypothesized that the instrumentation with Mtwo NiTi rotary file preserves the canal curvature adequately. **(Iranian Endodontic Journal 2008;3:24-28)**

Keywords: Hand K-file, Mtwo rotary instrumentation, Passive step back, Technique.

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Introduction

There are several variation in methods used for achieve step-back or crown-down approaches with hand instruments and engine driven rotary with nickel titanium (NiTi) instruments (1-2). In passive step-back technique, combination of hand instruments and rotary instruments used to achieve adequate coronal flare before apical root canal preparation (3).The passive step-back technique provides an unforceful and gradual enlargement of root canals in apical-coronal direction (4). Nickel titanium (NiTi) instruments represent a relatively new approach to a rapid preparation of canals with standardized taper (5). The introduction of NiTi rotary instruments led to great improvements in effectiveness and speed of root canal instrumentation even in curved root canals (5) in order to achieve the mechanical goal of instrumentation requires a uniform tapered funnel preparation with

increasing diameters from the apex to the orifice (2). Several NiTi systems can be used. A variety of NiTi rotary file systems have been developed by different manufactures. Many designs of NiTi instruments are available; all of them can be used with either conventional or special low torque controlled speed motor systems (5).

A number of studies on both extracted teeth and stimulated canals have demonstrated that the NiTi rotary instrument allow more rapid, rounded and conservative canal shaping than the stainless steel instruments (6). However, despite these positive results, manufactures introduced NiTi systems with new blade designs and tapers, claiming increased safety and ease of use.

Recently, new rotary NiTi instruments with different configuration and design marketed as Mtwo (VDW, Munich, Germany). There are varying considerably in their design (5). This instruments present positive rake angles, no radial lands, progressive blade camber (pitch) in the apical to coronal direction and a non cutting tip. The Mtwo instruments have two blades and feature a large groove between them; this design is claimed to reduce the core diameter and increase the flexibility. It is anticipated that the resistance of the instrument could not be affected because of the reduced contact with the canal walls, while the cutting action should be ensured by the active sharp angle of the blades. The blade angle is almost vertical and the helical pitch increases from the tip to the handle. These features are claimed to reduce the tendency for debris accumulation and to obtain an effective cutting action with less separation risk. Furthermore the increasing pitch should allow a more delicate cutting action at the apex and a more aggressive one in the coronal portion. The basic series of Mtwo instruments composes eight instruments with tapering between 4% and 7% and sizes from 10 to 40. According to the manufacturer, the instruments should be used in a single length technique. That means all files of the instrumentation sequence should be used to the full length of the root canal (7). Only a few studies are available using Mtwo instruments as root canal instrumentation. Foschi *et al.* on SEM evaluation of dentine wall observed no difference between Mtwo and Protaper rotary instruments on apical third canal wall contamination and presence of smear layer (8). Veltri *et al*. compared Endoflare-Hero shaper and Mtwo instruments in working length loss during preparation of curved root canals and showed no significant differences between two systems (9). Also Schafer *et al.* in a study (part 1) on the shaping ability of rotary Mtwo instruments revolved that Mtwo instruments prepared curved canal rapidly, respected original canal curvature well and were safe to use (7). The same investigator studied (part 2) the safety of Mtwo instrument and reported no instrument separation during preparation, but completely clean root canals were never observed. Mtwo instruments maintained the original canal curvature significantly better than other instruments and were remarkably faster (10). Burklein and Schafer revolved that instrumentation in stimulated canals with Endo IT automated devices were significantly faster than the Mtwo direct devices (11). Only one instrument separated during the enlargement of curved canals with Mtwo direct devices and two devices respected original canal curvature well. Sonntag *et al*. compared root canal preparation in human mandibular molar with NiTi systems (K3, Mtwo and Protaper) and found no significant differences in the preparation length, transportation or tapering between them. Mtwo showed significantly less zips than others but there were no significant differences in ledge and elbow formation (12).

The Mtwo have been marketed recently and their canal shaping ability has not been completely investigated. The aim of the study was to tests shaping ability (effect on root canal curvature and changes of working length determination) of one stainless steel K-file (passive step-back technique) and new rotary NiTi system (Mtwo instrumentation) in curved root canals.

Materials and Methods

A total of 50 curved maxillary and mandibular molars extracted for different reason were used. They were stored in physiological solution and used within one month following extraction. Only

mesial roots were included in this study so other roots were cut. An access cavity was prepared in all teeth using round bur on a high-speed handpiece. The crowns were flattened to prepared definite reference point.

The specimens with open apices, crack or fractured root were excluded. Mesial root canals curvatures were measured according to Schneider method and 40 canals with curvatures more than 20 degree were selected (13). The specimens were divided randomly to create two groups for preparing with two different cleaning and shaping technique.

Each group included 20 canals. The mean canal curvature of groups was similar. Samples in group 1 were instrumented using passive step-back technique as mentioned by Torabinejad (4) with stainless steel K-file (MAF#25), Gates Glidden drill (#2-3) and Pesso reamers (#2). Mtwo NiTi rotary file (VDW, Munich, Germany) and Endo IT professional power driven handpiece (Aseptico, INC, USA) were used for instrumentation of samples in group 2 according to manufacturer's instruction including instruments #10 with tapering 0.04, #15 with tapering 0.05, #20 with tapering 0.06 and #25 with tapering 0.06, 0.07. Canals of both groups were irrigated with 2.5% NaOCl during preparation. All radiographs were taken digitally with the aid of PSP (Photo Stimulated Phosphor) sensor and a Planmeca Intra unit with 70 kVp, 8 mA (Planmeca, Helsinki, Finland). A radiographic platform was used for standardization of exposures. Changing in canals curvature (loss of primary curvature) after canal preparation was assessed for each sample with the aid of AutoCAD 2007 software. Stereo-microscope (Carl, Ziess, Germany) provided data for assessing the amount of changing in working length after canal preparation using the right angle (loss of working length).

Statistical significance of the results was determined using Independent sample T-test. Pearson correlations used for determination of equality of means of canal curvature between two groups were similar.

Results

The canal curvature of samples was ranged from 20.64 to 46.85 degree of canal curvature and the mean for two groups was similar (Pearson Correlations). There is no significant difference between mean of canal curvatures of two groups (P>0.27). Means and standard deviations of canal curvature, canal straighteningand loss of working length are summarized in Table-1.

Table 1- Means and standard deviations of canal curvature (degree), loss of canal curvature (degree) and loss of working length (mm) with two preparation techniques

	canal curvature	loss of curvature	loss of working length
Passive Step-Back	28.69* (4.3)	11.77 (3.95)	0.517 (0.223)
M two rotary	31.54 (5.28)	5.58 (4.25)	0.202 (0.118)
P value	> 0.27	<0.001**	<0.001**

*Mean (Standard Deviation), ** statistically significant

Both canal preparation technique resulted some degree of canal straightening (slight changes of canal curvature) as well as changes of canal working length after cleaning and shaping .This process is occurred significantly more severe in samples which were prepared by passive step back hand instrumentation technique (P<0.001).

Discussion

Instruments used for preparation of root canal (hand K-file versus rotary Ni-Ti) may be varied in blade design, cross section, tapering and manufacturing. The blade designs are usually grouped in two categories: active cutting angel and radial landed design. Instruments included in the first category have sharp blades projecting from the middle of the shaft; on the contrary radial landed blades have flat surfaces at the blade margin. Instrument differs in their cross section views which affect their contact area with the canal walls and the residual core of the instrument (14). When a positive blade rake angle is present, the cutting action enhanced (5) and the torsional load of the instruments decreased (15). The minimal amount of the residual core improves the flexibility of the instruments and consequently it is possible to increase the taper of the NiTi instruments (14).

Another parameter that can be altered is the

helical angle and the blade pitch. By balancing these two parameters along the blade length, the cutting action, removing debris from the blades and screwing prevention can be adjusted (14). Finally, the majority of the instruments have guiding tips that should follow the canal curvature (5).

Other differences between NiTi systems are in their tapers. The instruments with increased taper are of prime because they shape the canal in its final conical outline more easily than the cylindrical instruments. Furthermore, when a system features instruments with different tapers are used, each of them engages a smaller portion of the canal with less torsional load and consequently reduces failure risk (9).

The use of hand instruments is the most common approach for cleaning and shaping. These hand instruments may be used alone or in combination with engine driven instruments such as Gates Glidden drill and Pesso reamers (2). The principle of having a hand held mach automatically driven intracanal instrument is attractive. This instrument would have the potential of being faster and less tedious than manipulating files with hands. Also special armamentarium would be required (7). More complexity in canal including location, size, curvature, and abnormal anatomy prevents complete removal of root canal contents and more incidence of procedural accidents such as lodging, canal transportation and perforation of the canal system (1). Limited flexibility and increased rigidity of large stainless steel hand instrument are the main causes of procedural accidents (4). To alleviate iatrogenic procedural errors, rotary nickel titanium (NiTi) instruments have been recently introduced. There have been many reports on the effectiveness of these instruments when shaping either in curved root canals. These in vitro studies confirm the ability of rotary NiTi instruments to maintain the shape of severely curved canals (1-14).

The use of irrigants and varying degrees of coronal flaring at different stages of root canal preparation play significant role in preventing procedural errors. Coronal flaring of root canals before apical preparation allows easier access for irrigation solution to the apical region of the root canal system and removal of more debris. Cervical flaring provides straighter line access to the apical foramens and reduces the risk for procedural accidents (4).

Although there are a few reports at hand on Mtwo system to confirming the ability of these instruments (6). Mtwo sequence has fewer instruments than other rotary instrumentation; and with brushing action. The progression of the Mtwo instruments was easy to control.

This study designed to compare the ability of two techniques to preserve the root canal curvatures. The angulations of radiograph beam taken before and after canal preparation were the same. This step enabled a comparison between the pre and post operative angles of curvature without probable differences in radiographic angulations. Although the use of a two dimensional radiograph for evaluation of straightening canals in a three dimensional system may have resulted some inaccuracy.

According to results of this study, the original curvature was maintained significantly better with rotary Mtwo than with hand instruments using passive step-back technique. The average of straightening and changes of working length during preparation of canals for group 1 (passive step-back technique) were 11.77 degree and 0.202 mm ($p<0.001$) and for group 2 (rotary Mtwo) were 5.58 degree 0.202 mm ($p<0.001$). This showed that preservation of canal curvature with Mtwo instrumentation was significantly better than hand preparation. This is in agreement with some other studies (7-10). The hand instruments produced a more pronounced straightening of the curved canals.

In this study Endo IT automated devices were used and only one instrument separated during the enlargement of curved canals with rotary Mtwo instrumentation. This finding corroborates the result of several authors that represent the safety of rotary Mtwo instrumentation and Endo IT automated devices (10-11).

The working length changes during instrumentation with rotary NiTi instruments were lesser than hand instrumentation but not significant . This finding was also similar to results of other research in this field (10).

Conclusion

The findings of this study indicated that in preservation of canal curvature, Mtwo instrumentation with automated hand piece system is superior or more efficient than standard hand techniques.

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