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The simultaneous technique for root canal preparation with the M*two* NiTi rotary system

Vito Antonio Malagnino, Nicola Maria Grande, Gianluca Plotino and Francesco Somma describe the M*two* NiTi rotary system

M*two* endodontic instruments (VDW, Munich, Germany) are a new generation of NiTi rotary instruments recently introduced.

The standard set for this system includes four basic instruments with variable tip sizes ranging from #10 to #25 and tapers ranging from .04 to .06. (size 10/.04 taper, size 15/.05 taper, size 20/.06 taper, size 25/.06 taper).

After this basic sequence, which creates a #25/.06 shape, the system is devised to permit three different approaches to the finishing of root canal preparation. The first sequence allows clinicians to achieve enlarged apical diameters using the size 30/.05 taper, 35/.04 taper or 40/.04 taper; the second leads to a .07 taper that can facilitate vertical condensation of GP, maintaining a size #25 apical preparation; and the third allows the use of the M*two* apical files that are described further in this article (Figure 1).

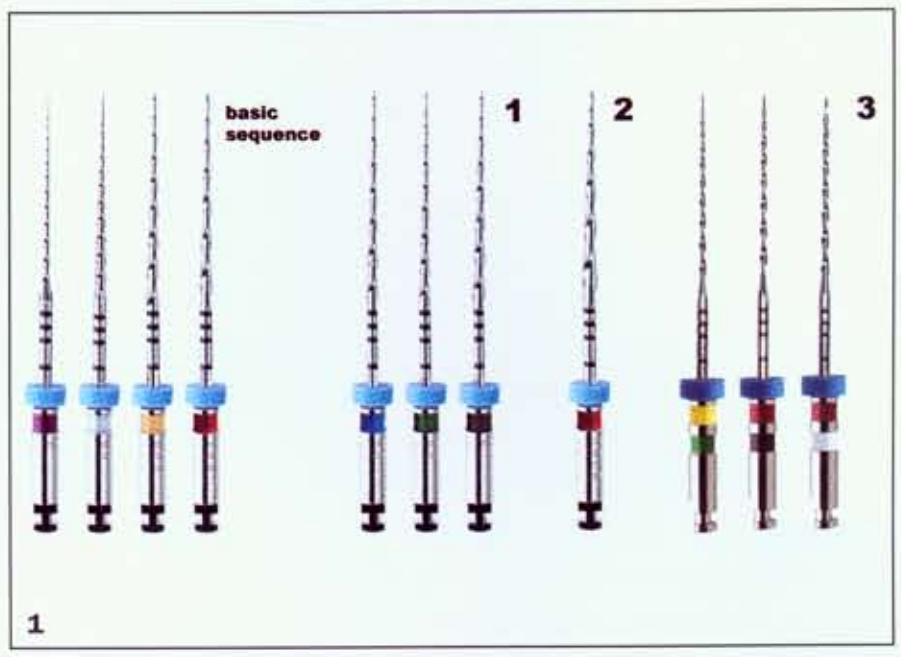

Figure 1: M*two* instruments, basic sequence and additional instruments to refine the preparation

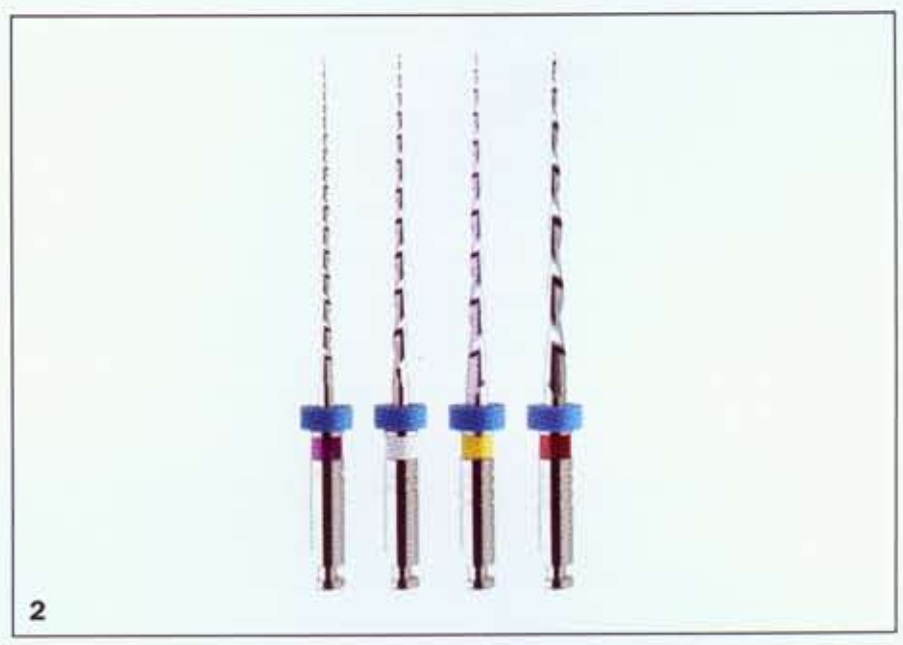

Figure 2: M*two* basic sequence with extended working length of 21mm, useful to eliminate residual interferences in the coronal part of the canal and on the access cavity walls

Morphological features

The colored ring on the handle identifies the tip size, according to ISO standards. The number of grooved rings on the handle identifies the instrument taper: one ring means .04 taper, two rings mean .05 taper, three rings mean .06 taper and four rings mean .07 taper. The instruments are available in lengths of 21mm, 25mm, and 31mm. These instruments are also produced with an extended cutting portion of 21mm, as well as the conventional 16mm cutting part, allowing the instrument to cut in the coronal portion of the canal, on the access cavity wall, where dentin interferences are often located (Figure 2).

The cross-section of M*two* is an 'italic S' with two cutting blades (Figure 3). The rake angle (RA) is the angle formed by the cutting edge and a cross-section taken perpendicular to the long axis of the instrument (Arens, 1996). The rake angle of M*two* is slightly negative. However it is important to note that few, if any, of the NiTi instruments on the market can have a positive rake angle, (Chow DY et al, 2005). This is probably due to the metallurgical properties of this alloy. The RA is one of the most effective ways to measure NiTi rotary instrument cutting effectiveness (Figure 4). The tip is non-cutting (Figure 5).

The helical angle (HA) or flute angle is defined as the angle formed by the instruments cutting surface and the dentin wall observed in longitudinal section (Buchanan 1996, 1998). The HA is determined by the blade pitch of the instrument: the bigger it is, the more open the HA will be. A shorter blade pitch will determine a closer HA; a longer one will result in a more open HA. The HA of an instrument is an

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Figure 3: SEM image of Mtwo instrument cross-section, showing the two blade cutting surfaces resulting in an 'italic S' design

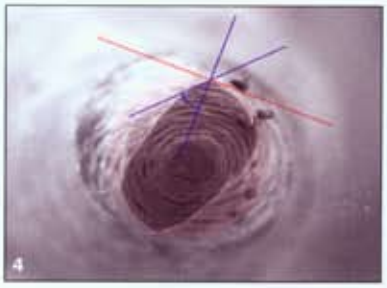


Figure 4: SEM image of an Mtwo 25 .06, the axial view shows the two cutting blade surfaces with efficient RA (200x)

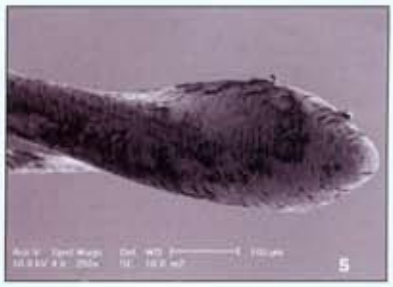


Figure 5: SEM image of the non-cutting tip of an Mtwo instrument (200x)

important parameter to determine not only the instrument's cutting efficiency, but also its mechanical resistance and its dynamic features.

The HA of Mtwo instruments is variable and specific for the different files (Figure 6). The HA is more open (greater) for the bigger sizes (less flutes for instrument length), and it decreases for the smaller sizes (more flutes). This determines a greater cutting efficiency for the bigger sizes and a greater mechanical resistance together with a tendency to advance in the canal for the smaller ones. The flutes are deeper moving from the tip to the handle, thus increasing the capacity to remove debris coronally. Moreover, for the bigger file sizes (20/.06, 25/.06) the HA is variable in the same instruments: it increases from the tip to the handle as does the spiral pitch, while it is constant for the smaller files, especially for the #10/.04, the first rotary instrument that is introduced in the root canal. The variable HA reduces the tendency of the instrument to be 'sucked down' into the canal.

The tendency to advance spontaneously in the root canal for the smaller instruments is necessary to progress in the canal, in the first phase of the treatment. The operator should tend towards a pulling-out movement, holding back the instrument in rotation, enhancing the characteristic of removing debris and the cutting efficiency. Considering that the patency of the root canal has been established with a 0.10mm tip size stainless steel file, the tip of the Mtwo #10/.04 can rotate freely without any engagement to the working length.

Mtwo A and Mtwo R

The Mtwo system has three rotary files specifically designed for apical preparation, the Mtwo A, and two files specifically designed for retreatment, the Mtwo R.

The three apical files, Mtwo A1, A2, and A3, vary in tip size and taper. The innovative feature of these instruments is the high taper of the last apical millimeter, while the rest of the coronal portion is a 2% ISO taper (Figure 7). The A1 instrument has a tip size (D0) of 0.20mm and 15% taper in the first millimeter, thus measuring 0.35mm in D1. A2 instruments have a tip size (D0) of 0.25mm and 15% taper in the first millimeter, thus measuring 0.40mm in D1. A3 instruments present a tip size (D0) of 0.25mm and 20% taper in the first millimeter, thus measuring 0.45mm in D1. The remaining portion of these instruments, from D1 to D16, present a 2% taper. To obtain this design, the apical millimeter of the instrument is not produced in a spiral but has two straight blades (Figure 8). This design has been developed to obtain bigger preparation diameters in the apical portion of the root canals, maintaining the anatomy of the apical foramen, according to scientific evidence that the root canal diameters in the apical portion are bigger than the average root canal preparations normally used (Orstavik et al, 1991; Wu

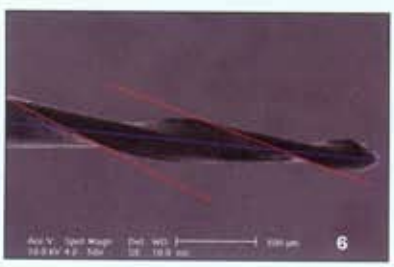


Figure 6: SEM image of an Mtwo size #25 taper .06 in lateral view: the HA increases from apex to crown (50x)

Figure 7: Mtwo A1 lateral view: showing the cutting blade surface and the unique tip design with an exaggerated taper in the last millimeter (SEM image 50x)

Figure 8: Mtwo A1 tip: showing the innovative tip of these instruments with two straight blades non spiraled in the last apical millimeter (200x)

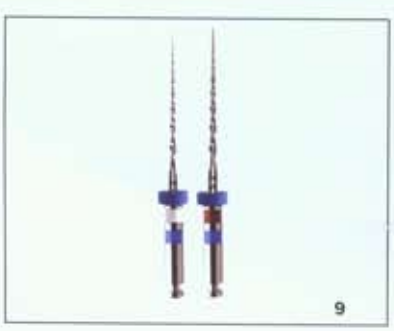


Figure 9: Mtwo R files: tip size #15 taper .05 (left) tip size #15 taper .05 (right)

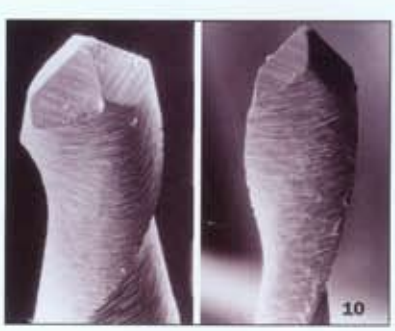
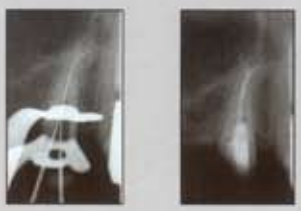


Figure 10: Mtwo R tip: showing the cutting surfaces of the tip (200x)

Figure 11: Mtwo R files: showing the constant HA (200x)

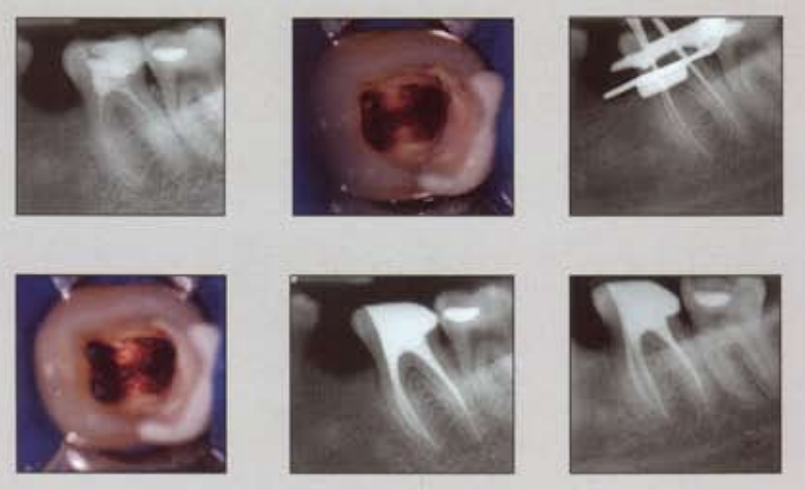
Case 1: a) Right second upper premolar with acute pulp inflammation.
b) Working Length (WL) confirmation with a stainless steel file. Abrupt curvature and a real tiny root in the apical portion are evident
c) Mtwo #20 taper.06 to the WL.
d) Obturation of the root canal system, the final preparation was performed with an Mtwo #40.04 to the WL, to obtain an adequate apical preparation. The anatomy of the delicate tiny root has been maintained even with a relatively wide apical preparation.

Case 2: a) Right second upper premolar with acute pulp inflammation.
b) Working Length (WL) confirmation with a Mtwo #15.05.
c-d) Obturation of the root canal system, after the preparation with M*two* basic sequence and M*two* A1 file to the WL (size #35 1mm short of the foramen), in two projections.

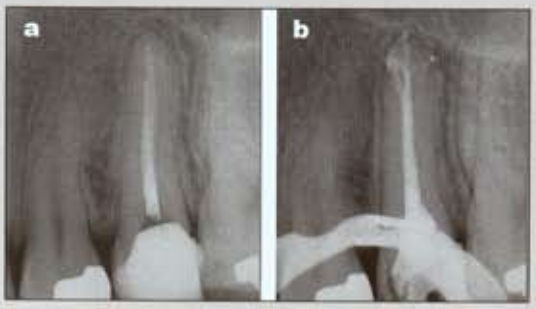


Case 3: a) First upper premolar requiring endodontic treatment, confirmation of the working length with stainless steel files.
b) Obturation of the root canal system after after the preparation with M*two* basic sequence and M*two* A1 file to the WL (size #35 1mm short of the foramen).

Case 4: a) Left second upper molar requiring endodontic treatment.
b) Obturation of the root canal system after after the preparation with M*two* basic sequence and Mtwo A2 file to the working length (size #40 1mm short of the foramen).
c) one year recall.

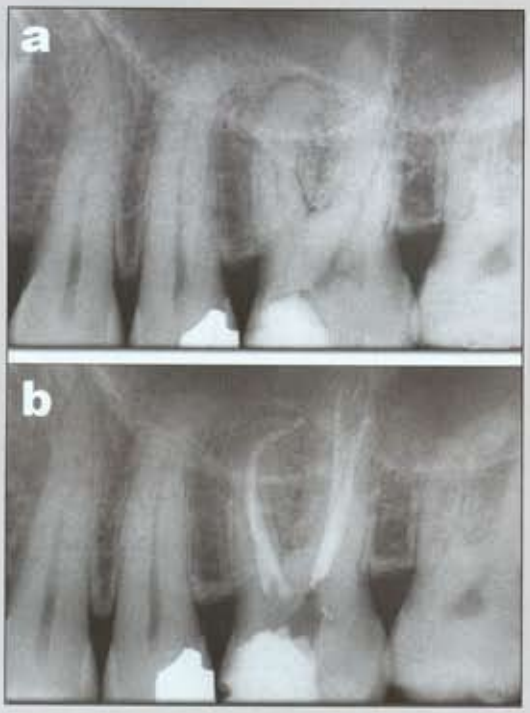


Case 5: a,b) Left first lower molar requiring endodontic retreatment.
c-d) Working length film to confirm the 'electronic length', the obturation material has been removed using M*two* R files. The Master apical file size was an M*two* #35 taper .04.
e,f) Obturation of the root canal system in two projections.



Case 6: a) Second upper premolar requiring endodontic retreatment.
b) After the shaping procedures have been completed using Mtwo R files to remove the old obturation material. Mtwo additional files have been used to enlarge the apical preparation to a Master apical size of #40. The obturation of the root canal system shows a complex anatomy in the apical area.

Case 7: a) Third lower molar with acute apical periodontitis.
b) The obturation of the root canal system has been completed after the preparation with a hybrid technique using stainless steel files and Mtwo system. The Master apical size was #25, established with stainless steel files.
c,d) Recalls at six months (left) and one year (right) showing the healing of the lesion endodontic origin.



Case 8: a) First upper molar with acute pulp inflammation.
b) The obturation of the root canal system has been completed after the preparation with Mtwo system. The Master apical file size was an Mtwo A2 in buccal canals and an Mtwo A3 in palatal canal.

et al, 2000; Card et al, 2002). The enhanced taper in the apical zone also provides a resistance form against the condensation pressures of obturation and prevents the extrusion of filling material (Serota et al, 2003).

The *Mtwo* R are instruments specifically designed for the retreatment of obturation materials. The retreatment files are *Mtwo* R 15/.05 and *Mtwo* R 25/.05 (Figure 9), presenting an active tip that allows clinicians to easily penetrate obturation material (Figure 10). The HA of the blades in these files is constant (Figure 11), which enhances the tendency to advance in obturation materials during rotation.

Mtwo R tip size .15 taper .05 should be used at 250-300rpm as the normal *Mtwo*, while the *Mtwo* R tip size .25 taper .05 in straight canals in coronal portion during retreatments can be used at 600rpm to enhance its efficiency.

Operative sequence

The basic sequence of the *Mtwo* system consist of four instruments, they are used from the smaller tip size and taper to the bigger in the following sequence: #10/.04, #15/.05, #20/.06, #25/.06.

The *Mtwo* NiTi rotary instruments are used at a speed from 250 to 350rpm. *Mtwo* R #25 taper .05 can be used at 600rpm for removal of obturation materials in the coronal and middle thirds of root canals during retreatment. Torque values that should be used with *Mtwo* instruments are higher than those used with less efficient instruments. Usually torque values higher than 200g/cm can be safely used. Using *Mtwo* dedicated endodontic motors, the torque values are preset specifically for each instrument of the series.

Mtwo instruments are used in a 'simultaneous technique' without any early coronal enlargement (Foschi et al, 2004). After a glide path has been established with a #10 stainless steel K-type file, instruments are each taken to the working length (WL) with light apical pressure. As soon as the clinician feels a binding sensation, he or she pulls the instrument away for 1mm to 2mm so that it can work passively in a brushing action to selectively remove the interferences and try to advance again towards the apex. The instruments are used with a lateral pressing movement in order to obtain a circumferential cut on

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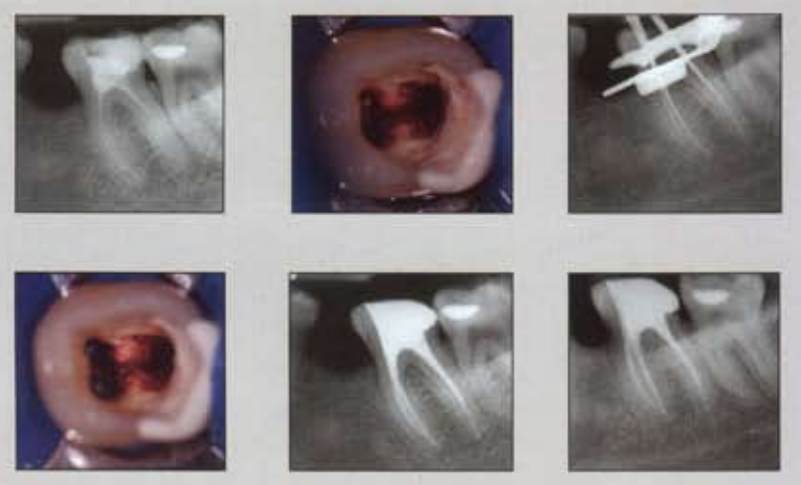
c) one year recall.



Case 5: a,b) Left first lower molar requiring endodontic retreatment.
c-d) Working length film to confirm the 'electronic length', the obturation material has been removed using M*two* R files. The Master apical file size was an M*two* #35 taper .04.
e,f) Obturation of the root canal system in two projections.

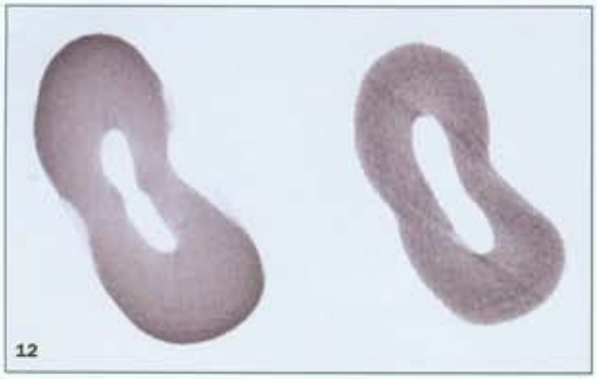


Figure 12: Pre-instrumentation (left) and post-instrumentation (right) root canal cross-section of a second upper premolar with oval anatomy obtained by means of µCT scanning and reconstruction (in collaboration with R Bedini and R Pecci – Italian National Institute of Health, Technology and Health Department, Rome, Italy)

Figure 13: Superimposition of pre- (yellow) and post- (red) instrumentation µCT three dimensional reconstruction of a second lower premolar with oval and curved anatomy prepared with Mtwo system, it is possible to note in both mesio-distal and bucco-lingual views that great part of the anatomy has been addressed by the mechanical action of the instruments (in collaboration with R Bedini and R Pecci – Italian National Institute of Health, Technology and Health Department, Rome, Italy)

Figure 14: Combined endodontic motor-EAL equipped with specific settings for Mtwo system

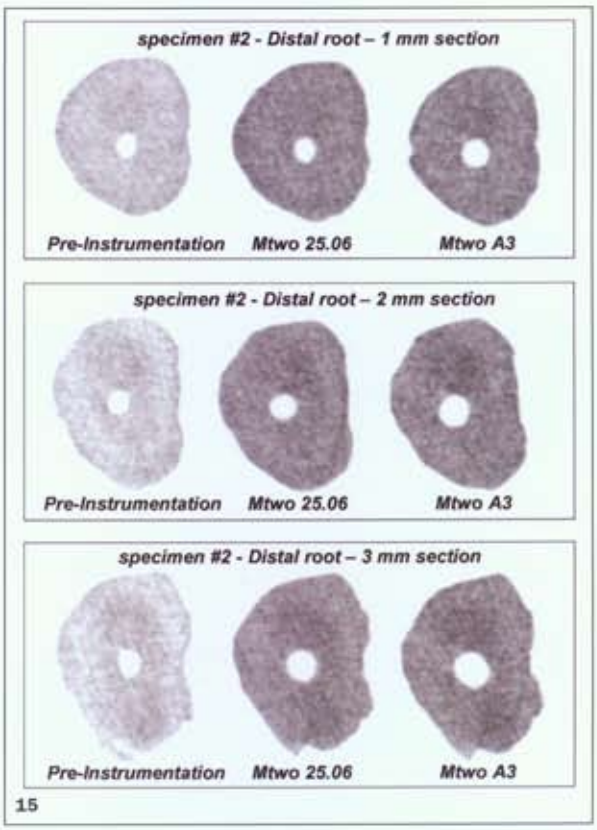


Figure 15: Micro-computed tomography analysis with three sections at 1,2 and 3 millimeters from the apical foramen of a distal root of a first upper molar after the preparation with the Mtwo basic sequence to size #25 taper .06 and after the use of Mtwo A2 to the working length. The additional enlargement in this area is clearly seen by the Apical file (in collaboration with R Bedini and R Pecci – Italian National Institute of Health, Technology and Health Department, Rome, Italy)

the root canal walls (Plotino et al, 2007a; Grande et al, 2007) (Figures 12 and 13). Considering that the files are each taken to the working length from the initial phases of the operative procedure, it is strongly recommended to determine the working length before starting the mechanical preparation. It's possible to use an electronic apex locator (EAL) and confirm this measurement with a radiograph. EAL of the latest generation can be considered extremely precise in the determination of working length, with an accuracy of more than 95%; even the best information on working length are from EAL's, knowledge of apical anatomy, prudent use of radiographs and other practical tips based on tactile sense and paper point observation are still useful in assisting practitioners to achieve predictable results (Gordon and Chandler 2004; Plotino et al, 2006a). The use of an EAL directly connected to the endodontic motor or a combined EAL-motors (Figure 14) could be a practical and helpful tool using the simultaneous technique, because they permits work without measuring the length on the file and take into account possible length variations during the shaping procedure (Schroeder et al, 2002; Davis et al, 2002).

Apical preparation

After this basic sequence has been completed the apical diameter of the preparation is 0.25mm; this size of preparation is considered insufficient to obtain debridement and cleaning with sufficient bacterial reduction of the apical portion of the root canals (Card et al, 2002; Rollison et al, 2002; Iqbal and Ku 2007; Mickel et al, 2007). For anterior teeth, single rooted premolars and roots of molars with oval root canals (distal lower, palatal upper) an enlargement of the apical zone to a diameter of at least 0.40mm is suggested; while for first upper premolars and narrow root canals in molars (mesial lower, distal upper) the enlargement should be limited at a diameter of 0.30/0.35mm in some cases.

Upon analyzing the data from a unique study that examined the mesio-distal and bucco-lingual root canal

Figure 16a: Mesio distal view of pre-instrumentation and post-instrumentation µCT three-dimensional reconstruction of a first lower molar prepared with M*two* system (in collaboration with R Bedini and R Pecci – Italian National Institute of Health, Technology and Health Department, Rome, Italy)

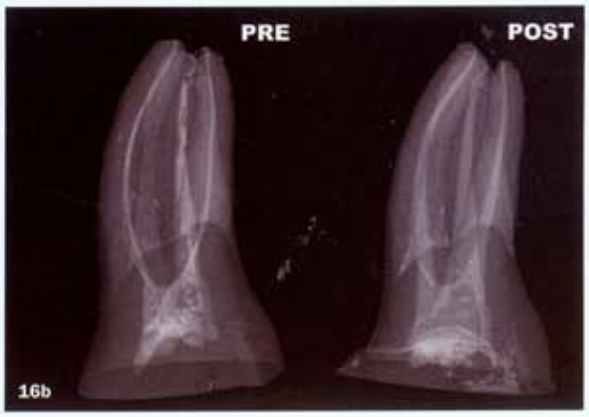


Figure 16b: Bucco lingual view of pre-instrumentation and post-instrumentation µCT three-dimensional reconstruction of a first lower molar prepared with M*two* system (in collaboration with R Bedini and R Pecci – Italian National Institute of Health, Technology and Health Department, Rome, Italy)

diameters of all roots groups at 1mm from the main apical foramen (Wu et al, 2000), it was noted that if two root canals, present in a single root, merge the apical portion tends to be wider than when there are two separate 'portals of exit'.

All these considerations must be taken into account when establishing the final size of the apical preparation. The traditional guidelines for apical preparation as enlarging the apical areas by apical gauging or on binding have been demonstrated as inconsistent (Wu et al, 2002; Baugh and Wallace 2005; Kfir et al, 2006) and so clinicians should take into account all the possible information and evaluate the ideal apical diameter of preparation case by case.

Apical preparation with the M*two* system

After the basic sequence described, it is possible to achieve apical preparation using the additional file sequence that consist of instruments of size #30/.05 taper, #35/.04 taper and #40/.04 taper; these files are used with a simultaneous technique, taking each file directly to the working length with a passive action, without brushing. The reduced taper of files with wider apical diameters facilitate their progression even in most curved root canals (Clinical Case 1).

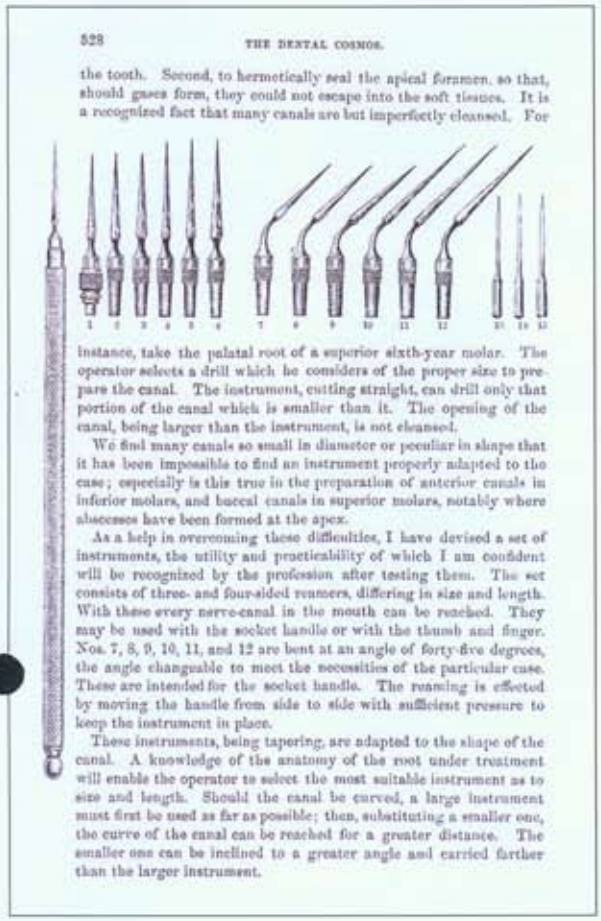
The other choice after the M*two* basic sequence is to choose one of the M*two* apical files and reach an apical preparation of 0.35mm (A1), 0.40mm (A2) and 0.45mm (A3) 1mm short of the foramen using only a single instrument, A1 for root canals earlier described as narrow and A2 and A3 for root canals described as wider. The .02 taper in the coronal portion of the M*two* A files makes them work only in the last three millimeters. During their use the operator will feel resistance to advancement only 2-3mm before reaching the working length established, and it will be possible to reach the working length using two to three strokes with a light touch 'pecking motion'. The enlargement determined by M*two* apical files will maintain the foramen as tight as possible, while creating an enlarged apical diameter 1mm from the apical foramen. The impact of M*two* A files apical preparation after a #25/.06 taper preparation in molars using microCT scan at different distances from the foramen has been investigated in a recent study (Leoni et al, 2007) (Figure 15). M*two* apical files effectively enlarged the apical three millimetres of root canals in maxillary molars after preparation using a size 25/.06 taper file, creating a round preparation that could increase the effectiveness of decontamination and facilitate obturation filling procedures. It must be appreciated that all the studies conducted on apical diameters describe the sizes at least 1mm from the foramen (Wu et al, 2000; Kerekes & Tronstad 1977a,b). Only one study has been conducted analyzing the dimension of the foramina from the outer surface of the roots in molars (Marroquin et al, 2004). In this study the 'foramen diameters' were found smaller than the inside root canal dimensions determined by sectioning the roots. The mean of the narrow and wide physiological foramen diameters in molars were as follows:

- 0.20 to 0.26mm in mandibular molars
- 0.18 to 0.25mm in the maxillary mesiobuccal and distobuccal root
- 0.22 to 0.29mm in the maxillary palatal root.

This observation gives us the rational basis to enlarge the root canals 1mm from the apex leaving at 0.25mm the 'foramen' preparation, as completed with a single instrument using M*two* A files.

Discussion

The operating sequence suggested for these instruments is a crown-down technique, whereby the apex is reached at each step by every NiTi instrument. This means that this is a technique from the crown to the apex, but it first uses smaller instruments before using bigger ones, as is done in the step-back technique. The inventor defines this as a 'simultaneous technique', as the entire length of the canal is approached at the same time. The instrument does not have to be forced in; as soon as the clinician feels a binding sensation, he or she has to back the instrument away for 1mm to 2mm so that it can work passively to create the space necessary to go to the apex (Figures 16a and 16b). Using the instruments with a lateral pressing movement (brushing, milling) (Grande et al, 2007); the tendency to progress automatically in the canal (a sensation of being 'sucked down') increases its efficiency. The high flexibility and fatigue resistance (Grande et al, 2006) of the M*two* instruments permits the use of this approach in severely curved root canals with an efficient and safe action (Veltri et al, 2005; Schafer et al, 2006a, 2006b) (Clinical Cases 2, 3 and 4). The use



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the tooth. Second, to hermetically seal the apical foramen, so that, should gases form, they could not escape into the soft tissues. It is a recognized fact that many canals are but imperfectly cleansed. For

instance, take the palatal root of a superior sixth-year molar. The operator selects a drill which he considers of the proper size to prepare the canal. The instrument, cutting straight, can drill only that portion of the canal which is smaller than it. The opening of the canal, being larger than the instrument, is not cleansed.

We find many canals so small in diameter or peculiar in shape that it has been impossible to find an instrument properly adapted to the case; especially is this true in the preparation of anterior canals in inferior molars, and buccal canals in superior molars, notably where abscesses have been formed at the apex.

As a help in overcoming these difficulties, I have devised a set of instruments, the utility and practicability of which I am confident will be recognized by the profession after testing them. The set consists of three- and four-sided reamers, differing in size and length. With these every nerve-canal in the mouth can be reached. They may be used with the socket handle or with the thumb and finger. Nos. 7, 8, 9, 10, 11, and 12 are bent at an angle of forty-five degrees, the angle changeable to meet the necessities of the particular case. These are intended for the socket handle. The reaming is effected by moving the handle from side to side with sufficient pressure to keep the instrument in place.

These instruments, being tapering, are adapted to the shape of the canal. A knowledge of the anatomy of the root under treatment will enable the operator to select the most suitable instrument as to size and length. Should the canal be curved, a large instrument must first be used as far as possible; then, substituting a smaller one, the curve of the canal can be reached for a greater distance. The smaller one can be inclined to a greater angle and carried farther than the larger instrument.

Figure 17: E.S. Talbot article, dated 1880, where the crown-down technique was first described. It is a report illustrating the instruments used at the time

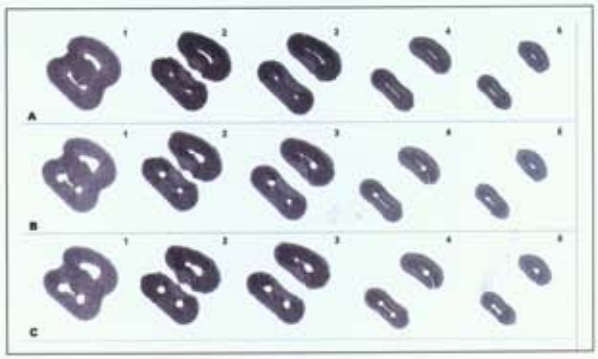

Figure 18: Micro-computed tomography analysis with five sections in coronal (N° 1,2 and 3) middle (N° 4) and apical (N° 5) portions of a first lower molar. In line A the pre-instrumentations sections are illustrated, in line B are illustrated the sections after the preparation of the mesial canals with two different NiTi rotary systems: the mesio-buccal canal (top-left) with M*two* #10.04 and M*two* 15.05 used to the working length, the mesio-lingual canal (bottom-right) with the orifice shapers #2, #3 and #4 used in crown down to 5mm over the orifice. It's evident that with the simultaneous approach, using just the first two instruments of M*two* basic sequence, the enlargement of the coronal and middle thirds has been performed. In line B the final preparations with M*two* basic sequence to size #25 taper .06 and with ProFiles to size #25 taper .06 shows uniform tapered, round preparations along all the root canals. The distal canal has been prepared with a NiTi rotary techinique not included in the experiment (in collaboration with R Bedini and R Pecci – Italian National Institute of Health, Technology and Health Department, Rome, Italy)

of brushing action for NiTi rotary instrument has been an innovation introduced in recent years (Clauder and Baumann 2004; Ruddle 2005). The old generation of NiTi rotary files can only be used in a passive reaming-like rotary action, remaining centered in the root canal and avoiding any lateral pressing movement (Ruddle 2002). The impact of the brushing action on the fatigue resistance of M*two* NiTi rotary files has recently been investigated (Plotino et al, 2007a). Each file was used to clean and shape 10 root canals in molars, considered as difficult cases with and without brushing action. All the files were successfully operated without fracture and the reduction in the fatigue life of the files used with brushing action was slight, demonstrating that M*two* NiTi rotary instruments can be used safely in clinical practice with lateral brushing movement. In another study (Plotino et al, 2006b) the effect of a controlled clinical use on the fatigue resistance of M*two* rotary instruments was evaluated. Analyzing the data obtained in this study, the use of each M*two* files in 10 root canals of molar teeth can be considered safe.

An important consideration regarding the proposal for a simultaneous approach using NiTi rotary instruments concerns differing points of view about the crown-down concept. Crown-down can be defined as a root canal preparation technique in which the coronal portions of the root canals are enlarged before the apical ones. In the NiTi era, the crown-down concept has been instead associated with the use of bigger instruments (such as tip diameter, taper) for the shaping of the coronal portion, followed by smaller instruments to advance toward the apex (Ruddle, 2002). The first crown-down technique described in literature is dated 1880 by Talbot. In this paper E.S. Talbot wrote: 'Should the canal be curved, a large instrument must first be used as far as possible; then substituting a smaller one, the curve of the canal can be reached for a greater distance. The smaller one can be inclined to a greater angle and carried farther than the larger instrument'.

This approach can be considered as the first attempt to describe a crown-down technique, but it was linked to the technical limitations of the manual rigid stainless steel file available at that time (Figure 17). With the development of highly flexible and highly efficient last generation NiTi files it is possible to achieve a crown-down approach in different ways, using bigger instrument first or starting from smaller and more flexible files. In the simultaneous technique, in fact, the coronal portion is prepared before the apical one, using smaller instruments first. The use of the smaller instrument first is not in contrast to the crown-down approach, because it is also a crown-down technique in which the canal is prepared starting from the coronal towards the apical portion, even if all instruments reach the apex. In other techniques, such as ProTaper (Maillefer, Baillagues, Switzerland), the files are manufactured with variable tapers in the same file. The first files to be used at full working length, Shaping 1 and 2, have bigger taper in the coronal portion and a small tip with less taper in the apical portion. This is aimed to produce an early coronal enlargement, maintaining the path to the working length. This leads to the fact that the quantity of dentin removed is high, with a strong engagement of the files in the coronal portion and the need to use apical pressure to progress. With the simultaneous approach the smaller file is not engaged so much during the cutting action and the coronal space is created only with lateral movements with a better sensation of the tip binding because this

action does not need apical pressure. So while the other technique files are designed to give their diameter to the root canal preparation, with a segmentation of the action of each instrument, in the simultaneous approach with M*two* files the diameter of the instrument is lower than the diameter of preparation given to the root canal.

In a recent experimental observation it has been noted that after the use of just the first two instruments in the M*two* sequence the diameter of root canals in the coronal portion was bigger than when it was prepared with orifice shapers files, high tapered files specifically designed for this (Figure 18). This approach facilitates root canal shaping particularly in the most difficult cases, reducing the incidence of procedural errors that could occur in the first phase of the treatment in which the canal has to be negotiated with rigid stainless steel files to at least 0.20mm. Furthermore, it should be noted that, in contrast with early coronal enlargement that achieves an orifice and middle third preparation indiscriminately, the 'simultaneous technique' is based on a selective coronal enlargement, in which the dentin removal in the coronal portion is only the one necessary to reach the apex with the files of the sequence and not more (Plotino et al, 2007b). Reducing the enlargement in the coronal and middle portion of root canals can improve the mechanical resistance of the endodontically treated tooth (Rundquist BD and Versluis A, 2006).

Conclusion

The full use of NiTi alloy features has led to the development of new instrument design that could represent a step forward in the approach to root canal treatment especially in complex cases. The use of flexible and highly efficiency NiTi instruments together with their use directly to the working length seems to be as the future trend in improving cleaning and shaping procedures in root canal therapy (Clinical Cases 5-8).

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Q1

In the Mtwo system which of the following are incorrect when assessing instrument taper?

a) Two rings mean .04 taper
b) Three rings mean .06 taper
c) Four rings mean .08 taper
d) Five rings mean .10 taper
e) All of the above
f) None of the above

Q2

Helical angle is an important design feature of Mtwo. Which of the following is correct in this regard?

a) The helical angle is constant across the range
b) The helical angle is more closed in the larger sizes
c) The helical angle is more closed for the smaller sizes
d) The helical varies and is file specific

Q3

Mtwo instruments are used in which of the following sequences?

a) Basic sequence, 10.04, 14.05, 20/.06, 25/.06
b) Apical enlargement follows with either 30/.05, 35/.04,40/.04
c) Both of the above at 250-300rpm
d) None of the above

Q4

Which of the following comments regarding Mtwo use are incorrect?

a) The instruments are used with a classic pecking action
b) The instruments are used in a brushing action
c) The technique uses the 'simultaneous' approach
d) The diameter of Mtwo files is less than the diameter of the preparation given to the canal