The Mtwo NiTi rotary system for root canal preparation

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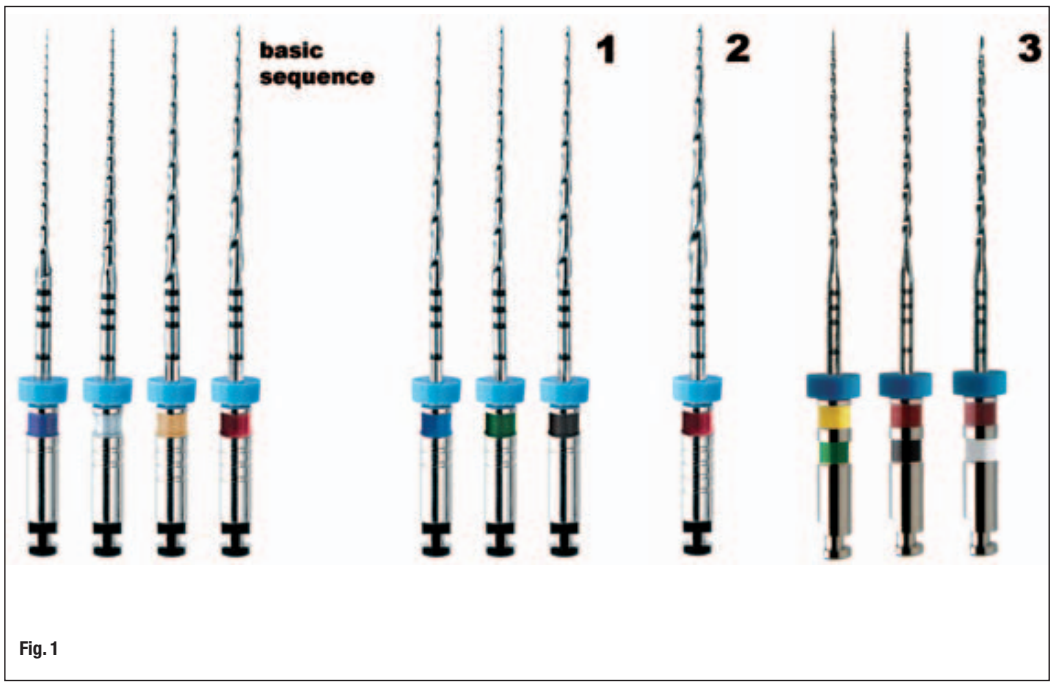


Fig. 1

Fig. 2

_ Introduction

The Mtwo endodontic instruments (VDW, Munich, Germany) are a new generation of NiTi rotary instruments recently introduced in the European market. The standard set for this system includes four 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, that gives the canal a #25/.06 shape, the system is conceived to permit three different approaches to 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 gutta-percha, maintaining a size #25 apical preparation; and the third implies the use of the Mtwo apical files that are further described in the text (Fig. 1).

_ Morphological features

The colored ring on the handle identifies the 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 21 mm, 25 mm, and 31 mm lengths. These instruments are also produced with an extended cutting portion of 21 mm as well as the conventional 16 mm cutting part, allowing the instrument to cut in the coronal portion of the canals, on the cavity access walls, where dentin interferences are often located (Fig. 2).

The cross-section of Mtwo is an "italic S" with two cutting blades (Figs. 3a,b). 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.[1] The RA is one of the most effective measured in NiTi ro-

Fig. 1_ Mtwo instruments, basic sequence and additional instruments to refine the preparation.
Fig. 2_ Mtwo basic sequence with extended working length of 21 mm, useful to eliminate residual interferences in the coronal part of the canal and on the cavity access walls.

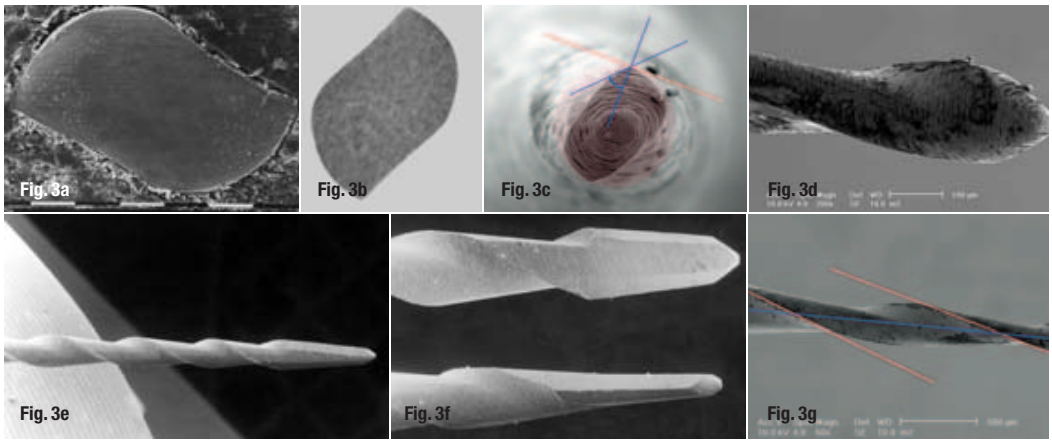


Fig. 3a_ SEM image of Mtwo instrument cross-section, showing the two blade cutting surfaces resulting in an "Italic S" design.
Fig. 3b_ Cross-section obtained by means of µCT scanning and reconstruction of an Mtwo size 25, .06 taper.
Fig. 3c_ SEM image of an Mtwo 25 .06, the axial view shows the two cutting blade surfaces with efficient RA (200x).
Fig. 3d_ SEM image of the non-cutting tip of an Mtwo instrument (200x).
Fig. 3e_ SEM image of an Mtwo size #25 taper .06 in lateral view: the HA increases from apex to crown (50x).
Fig. 3f_ Mtwo A1 lateral view: showing the cutting blade surface and the unique tip design with an exaggerated taper in the last millimeter (50 x).
Fig. 3g_ Mtwo A1 tip: showing the innovative tip of these instruments with two straight blades not spiraled in the last apical millimeter (50 x).
Fig. 4_ Mtwo R tip: showing the cutting surfaces of the tip (200 x).
Fig. 5_ Pre-instrumentation (left) and post-instrumentation (right) root canal cross-section slides of a seoond 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)
Fig. 6_ 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 a 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).
Fig. 7a_ Mesio distal view of pre-instrumentation and post-instrumentation µCT three dimensional reconstruction of a first lower molar prepared with Mtwo system (in collaboration with R. Bedini and R. Pecci - Italian National Institute of Health, Technology and Health Department, Rome, Italy).

tary instruments, enhancing the cutting efficiency of this instrument (Fig. 3c). The tip is non-cutting (Fig. 3d).

The helical angle (HA) or flute angle is defined as the angle formed by the instrument's cutting surface and the dentin wall observed in longitudinal section.[2,3] 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 important parameter to determine not only the instrument's cutting efficiency, but also its mechanical resistance and its dynamic features.

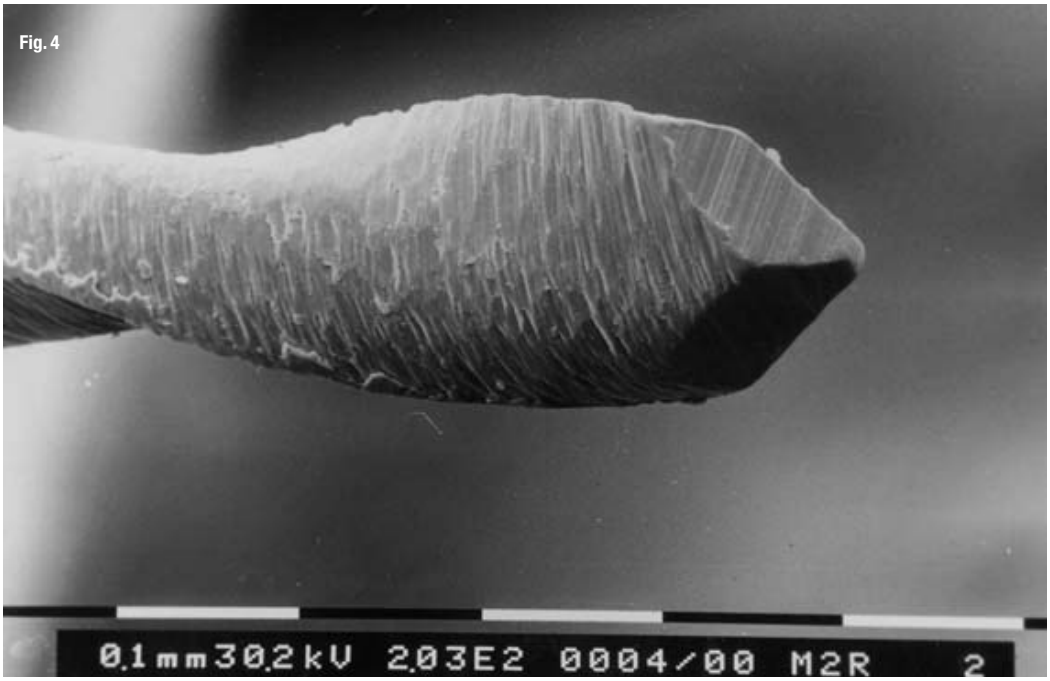
The HA of Mtwo instruments is variable and specific for the different files (Fig. 3e).

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; 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 instrument is necessary to progress in the canal during 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.

_ Mtwo A and Mtwo R

The Mtwo system has been completed with three rotary files specifically designed for apical preparation,



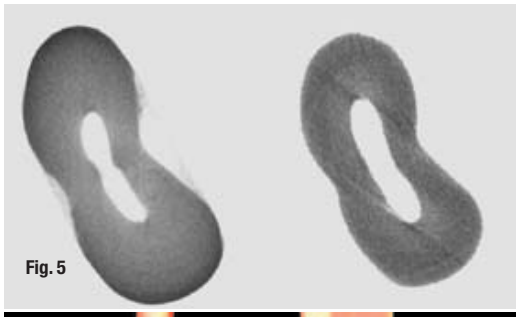


Fig. 5

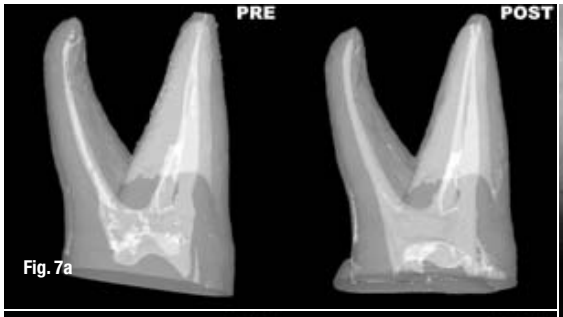


Fig. 7a


Fig. 6

Fig. 7b


Fig. 8a

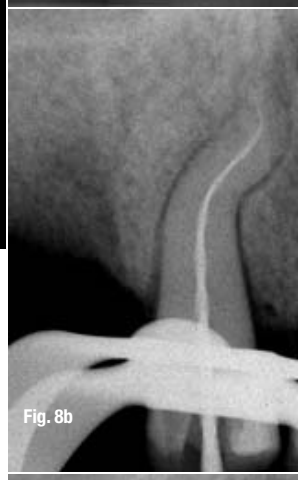


Fig. 8b


Fig. 8c


Fig. 8d

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 millimetre while the rest of the coronal portion is a 2% ISO taper (Fig. 3f). The A1 instrument has a tip size (D0) of 0.20 mm and 15% taper in the first millimeter, thus measuring 0.35 mm in D1. A2 instruments have a tip size of 0.25 mm and 15% taper in the first millimeter, thus measuring 0.40 mm in D1. A3 instrument presents a tip size of 0.25 mm and 20% taper in the first millimeter, thus measuring 0.45 mm 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 (Fig. 3g). 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.[4-6] 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.[7]

The Mtwo R instruments are specifically designed for the retreatment of obturation materials. The retreatment files are Mtwo R 15/.05 and Mtwo R 25/.05, presenting an active tip that allows clinicians to easily penetrate obturation material (Fig. 4).

_ Operative sequence

The Mtwo NiTi rotary instruments are used at 300 rpm. Mtwo instruments are used in a simultaneous technique without any early coronal enlargement.[8] 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 1 mm to 2 mm so that it can work passively in a brushing action to selectively remove the interferences and to advance towards the apex. The instruments are used with a lateral pressing movement in order to obtain a circumferential cut, and only allowed to rotate at length for few seconds (Figs. 5,6).

The operative sequence suggested for these instruments is a crown-down technique, whereby the apex is reached by every NiTi instrument at each step. 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 1 mm to 2 mm so that it can work passively to create the space necessary to go to the apex (Figs. 7a,b). Using the instruments with a lateral pressing movement (brushing, milling) the tendency to progress automatically in the canal (a sensation of being "sucked down") increases its efficiency. The high flexibility and fatigue resistance9 of the Mtwo instruments permits the use of this approach in severly curved root canals with an efficient and safely action (Figs. 8,9).

_ Conclusion

An important consideration regarding the proposal for a simultaneous approach using NiTi rotary instru-


Fig. 9a

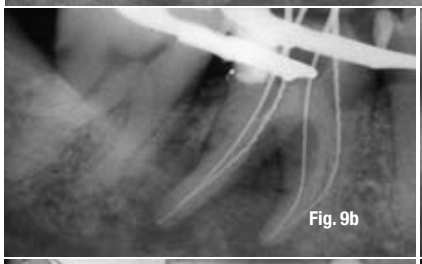


Fig. 9b


Fig. 9c


Fig. 9d


Fig. 9e

Fig. 7b_ Bucco lingual view of pre-instrumentation and post-instrumentation µCT three dimensional reconstruction of a first lower molar prepared with Mtwo system (in collaboration with R. Bedini and R. Pecci – Italian National Institute of Health, Technology and Health Department, Rome, Italy).
Fig. 8_ **a)** Right second upper premolar with acute pulp inflammation **b)** Mtwo #20 taper.06 to the working length, **c)** Obturation of the root canal system in two projections
Fig. 9_ **a)** Right first lower molar with chronic apical periodontitis **b)** Working length film to confirm the "electronic length" **c,d)** Obturation of the root canal system in two projections, after the cleaning and shaping phases performed with the Mtwo system **e)** 1 year control

ments concerns differing points of view about the crown-down concept. In the simultaneous technique, the coronal portion is prepared before the apical one, using smaller instruments first. In the NiTi era, the crown-down concept is instead associated with the use of bigger instruments (eg, tip diameter, taper) for the shaping of the coronal portion, followed by smaller instruments to advance toward the apex15. 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. This new concept 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 0.20 mm. _

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