Study Abstracts

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Comparative study on the shaping ability and cleaning efficiency of rotary M_{two}® instruments

Part 1. Shaping ability in simulated curved canals

Schäfer E, Erter M, Dammaschke T, Int Endod J 2006; 39: 196-202

Aim: To compare the shaping ability of M_{two}® files (VDW, Munich, Germany) with K3 (Sybron Endo, West Collins Orange, USA) and RaCe (FKG, La Chaux-de-Fonds, Switzerland) instruments in simulated curved root canals.

Methodology: Simulated canals with 28° and 35° curves in resin blocks were prepared with M_{two}® files using a single-length technique and with K3 and RaCe instruments using a crown-down preparation technique (n = 20 canals in each case). Pre- and post-instrumentation images were recorded and assessment of canal shape was completed with a computer image analysis program. Material removal was measured at 20 measuring points, beginning 1 mm from the end point of preparation. Incidence of canal aberrations, preparation time, changes of working length and instrument failures were also recorded. The data was analysed statistically using ANOVA and Student-Newman-Keuls-test.

Results: On average, canals prepared with M_{two}® instruments remained better centred compared with those enlarged with K3 or RaCe instruments. Six RaCe instruments and four K files fractured during preparation ($P > 0.05$). No M_{two}® files fractured during preparation. (figure 1) For both canal curvatures, the preparation time was significantly faster ($P < 0.001$) with M_{two}® than with the other systems. It was possible with all types of instruments to control working length well.

Conclusions: M_{two}® instruments prepared curved canals rapidly, respected original canal curvature well and were safe to use.

M_{two}® files remained better centred than K3 or RaCe.
M_{two}® files did not fracture under the conditions of the study.
M_{two}® files prepared the canals faster than K3 or RaCe.

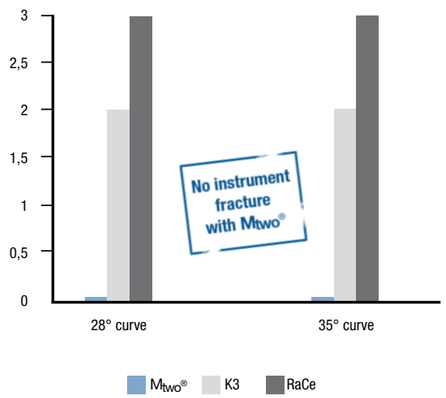


Figure 1
Number of instrument fractures in artificial models

Comparative study on the shaping ability and cleaning efficiency of rotary M_{two}® instruments

Part 2. Cleaning effectiveness and shaping ability in severely curved root canals of extracted teeth

Schäfer E, Erter M, Dammaschke T, Int Endod J 2006; 39: 203-212

Aim: To compare the cleaning effectiveness and shaping ability of M_{two}®, K3 and RaCe nickel-titanium rotary instruments during the preparation of curved root canals in extracted human teeth.

Methodology: A total of 60 root canals of mandibular and maxillary molars with curvatures ranging between 25° and 35° were divided into three groups of 20 canals. Based on radiographs taken prior to instrumentation with the initial instrument inserted into the canal, the groups were balanced with respect to the angle and the radius of canal curvature. Canals were prepared using a low-torque control motor. Using pre- and post-instrumentation radiographs, straightening of the canal curvatures was determined with a computer image analysis program. The amount of debris and smear layer were quantified on the basis of a numerical evaluation scale. The data established for scoring the debris and the smear-layer was separately recorded and analysed statistically using the Kruskal-Wallis-test.

Results: During preparation no instrument separated. Completely clean root canals were never observed. For debris removal M_{two}® instruments achieved significantly better results than K3 and RaCe instruments ($P < 0.001$). The results for remaining smear layer were similar and not significantly different ($P > 0.05$). M_{two}® instruments maintained the original canal curvature significantly better ($P < 0.05$) than the other instruments (figure 2). Instrumentation with M_{two}® files was significantly faster than with K3 or RaCe instruments ($P < 0.05$) (figure 3).

Conclusions: Under the conditions of this study, M_{two}® instruments resulted in good cleaning and maintained the original curvature significantly better than K3 or RaCe files.

M_{two}® files removed debris from the canal walls more effectively than K3 or RaCe.
M_{two}® files maintained canal curvature significantly better than K3 or RaCe.
Preparation was significantly faster with M_{two}® than with K3 or RaCe.

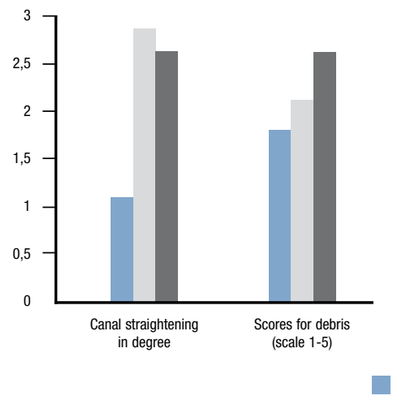


Figure 2
Original canal curvature and debris

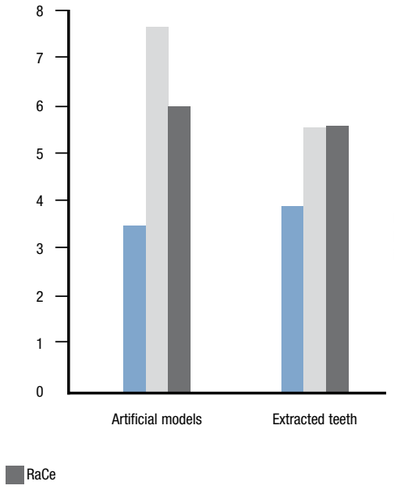


Figure 3
Preparation time in minutes

Root canal preparation with the NiTi systems K3, M_{two}® and ProTaper®

Sonntag D, Ott M, Kook K, Stachniss V, Australian Endo J 2007; 33: 73-81

Aim: The aim of this paper was to examine the result of rotary root canal preparation with the nickel-titanium (NiTi) systems K3, ProTaper® (Dentsply Maillefer, Ballaigues, Switzerland) and M_{two}®.

Materials and Methods: One hundred and fifty curved artificial root canals and 60 mesial canals of human mandibular molars were selected. In the group of curved artificial canals, all canals were prepared to size 35/.04 taper with the three systems. In the group of human mandibular molars, the teeth with mature root canals were radiographed with silver points inserted in bucco-lingual and in mesio-distal positions.

Results: In the artificial root group, one K3 instrument separated. M_{two}® (20 %) showed significantly (P = 0.003) fewer zips than K3 (46.9 %) or ProTaper® (50 %) (figure 4). There were no significant differences in ledge and elbow formation. K3 and M_{two}® had the lowest percentage of canal transportation. There was no significant difference regarding the preparation length or the condition of the apical foramina following the preparation. Canals prepared with K3 (26.5 %) were significantly (P < 0.001) less tapered than ProTaper® (62 %) and M_{two}® (82 %) (figure 5). In the human mandibular molar group, one M_{two}® and one ProTaper® instrument separated. No significant differences were found in the preparation length, transportation or taper.

Conclusions: The three systems tested, K3, M_{two}® and ProTaper®, achieved good preparation results.

M_{two}® showed significantly fewer zips than K3 or ProTaper®.
M_{two}® and K3 had the lowest percentage of canal transportation.
M_{two}® prepared the canals better tapered than ProTaper® or K3.

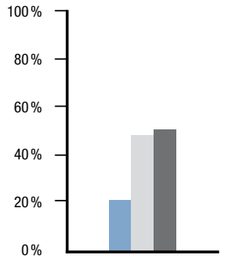


Figure 4
Zips occurred during the preparation of 150 artificial root canals

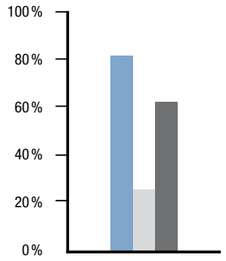


Figure 5
Percentage of 150 conically prepared root canals. A canal was characterised as conical if the diameter increased over the whole gradient from apical to coronal. All three groups showed among one another significant differences.

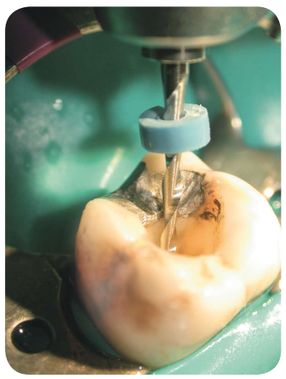


Figure 6
When inserting the file 20/.06 in mb I the profile of the cutting edges and the wide space for dentine removal are clearly visible.

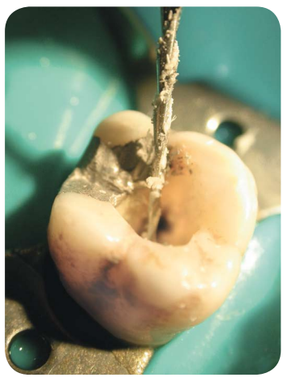


Figure 7
Due to the profile of the cutting edges the dentine chips adhered to the file and are efficiently transported out of the canal to the coronal part.

Cyclic fatigue resistance and three-dimensional analysis of instruments from two nickel-titanium rotary systems

Grande NM, Plotino G, Pecci R, Bedini R, Malagnino VA, Somma F, Int Endod J 2006; 39: 755-763

Aim: To determine how instrument design affects the fatigue life of two nickel-titanium rotary systems (M_{two}® and ProTaper®) under cyclic fatigue stress in simulated root canals.

Methodology: Cyclic fatigue testing of instruments was performed in stainless steel artificial canals with radii of curvature of 2 or 5 mm and an angle of curvature of 60°. A total of 260 instruments were rotated until fracture occurred and the number of cycles to failure were recorded. The morphology of NiTi rotary instruments was investigated by measuring the volume of millimeter slices of each instrument size starting from the tip to the shank by means of µCT analysis. The fracture surface of three representative samples of each size was analysed by scanning electron microscopy (SEM). Data was analysed using one-way ANOVA, Holm t-test, paired t-test and linear regression; the significance was determined at the 95 % confidence level.

Results: Cycles to failure significantly decreased as the instrument volume increased for both radii of curvature tested (P < 0.01). The radius of curvature had a statistically significant influence on the fatigue life of the instruments (P < 0.05). Under cyclic stress larger instruments fractured in less time than smaller ones. SEM evaluation showed typical features of fracture through fatigue failure.

Conclusions: The metal volume in the point of maximum stress during a cyclic fatigue test could affect the fatigue life of NiTi rotary instruments. The larger the metal volume, the lower the fatigue resistance. The M_{two}® files were considerably more resistant to fracture than ProTaper® under the conditions of the study.

M_{two}® files were considerably more resistant to fracture than ProTaper®.

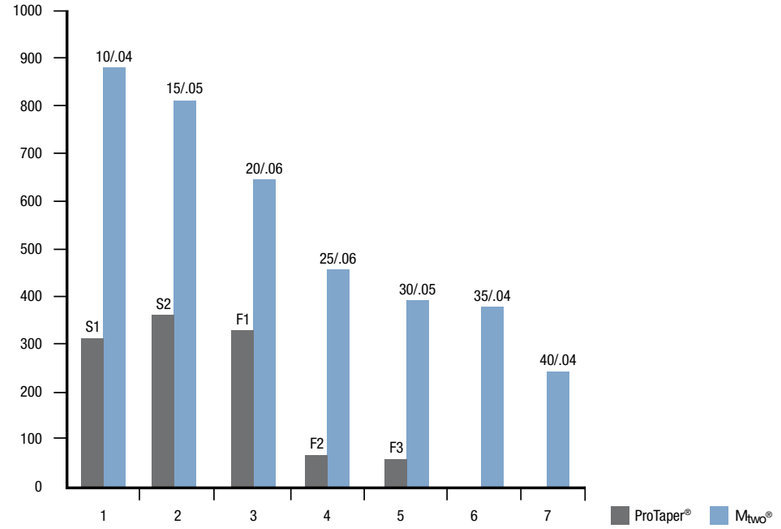


Figure 8
Number of cycles before breakage of instruments Radius of curvature 5 mm Angle of curvature 60°

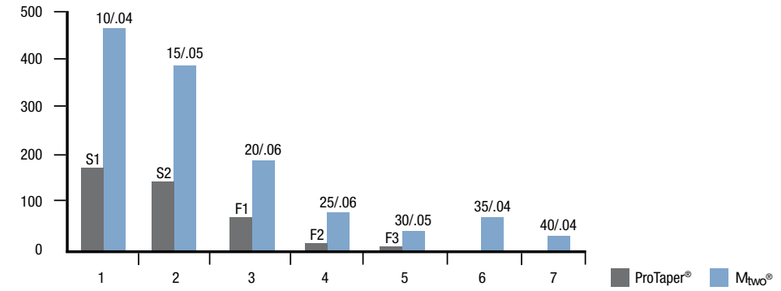


Figure 9
Number of cycles before breakage of instruments Radius of curvature 2 mm Angle of curvature 60°

SEM evaluation of canal wall dentine following use of M_{two}® and ProTaper® NiTi rotary instruments

Foschi F, Nucci C, Montebugnoli L, Marchionni S, Breschi L, Malagnino VA, Prati C, Int Endod J 2004; 37: 832-839

Aim: To compare in-vitro root canal walls after instrumentation with two different rotary NiTi instruments using a scanning electron microscopy (SEM). The hypothesis was that no difference should be observable between the 2 experimental groups in terms of debris on canal walls and surface morphology.

Methodology: Twenty-four single-rooted human teeth were selected. Two types of NiTi instruments were used: M_{two}® and ProTaper®. For both groups irrigation was performed after each instrument change with 5 % NaOCl, 3 % H_2O_2 and 17 % EDTA solutions. Three different areas (coronal, middle and apical thirds) of the root canal were evaluated using SEM. The canal wall of each sample was assessed and compared using a predefined scale of four parameters, namely, smear layer, pulpal debris, inorganic dentine debris and surface profile. Data was analysed statistically using the Kruskal-Wallis-test (ANOVA).

Results: For both groups a statistically significant difference ($P < 0.01$) was found between the apical third and the middle and coronal thirds. No difference was observed between instrumentation groups. In the apical third, canal walls were often contaminated by inorganic debris and by smear-layer. Furthermore, the surface profile was affected by uninstrumented regions, comprising dentine depressions and grooves in which predentine was still visible.

Conclusions: Both instruments produced a clean and debris-free dentine surface in the coronal and middle thirds, but were unable to produce a dentine surface free from smear layer and debris in the apical third. The presence of deep grooves and depressions on the dentine walls in the apical third may well be explained by the lack of complete contact between the instruments and the canal walls.

A comparative study of Endoflare-Hero Shaper and M_{two}® NiTi instruments in the preparation of curved root canals

Veltri M, Mollo A, Mantovani L, Pini P, Balleri P, Grandini S, Int Endod J 2005; 38: 610-616

Aim: To analyse the shaping ability of two new NiTi rotary systems in molar curved canals.

Methodology: Thirty molar root canals with curvatures from 24° to 69° were divided into two groups that were balanced in terms of curvature. The canals in one group were shaped using the M_{two}® and the canals in the other group using the Endoflare-Hero Shaper (Micro-Mega, Besançon, France) in a modified sequence. Pre- and post-instrumentation X-rays were taken using a radiographic platform with a contrast medium being used to enhance canal opacity. The dentine removed at five positions along the canals, the symmetry of canal shaping and the presence of aberrations were analysed through computer-aided measurements. The instrument failures, the working time and the changes in working length were also recorded. The Mann-Whitney U-test was used for statistical analysis.

Results: Both systems produced uniform dentine removal and symmetrical canal shapes; there was no significant difference between the systems ($P > 0.05$). In the apical region, preparations were centred in the canal. A mean loss of working length of 0.55 mm for M_{two}® and 0.58 mm for Endoflare-Hero Shaper was detected, with no significant differences between the instruments ($P > 0.05$). No aberrations were seen and no instruments separated. The mean working time was 124.4 s for the M_{two}® system and 141.3 s for the Endoflare-Hero Shaper but this difference was not statistically significant ($P > 0.05$).

Conclusions: The systems tested in this study were effective in shaping curved canals in extracted teeth.

Endodontic preparation of oval root canals: comparison between three techniques

Preparazione endodontica dei canali ovalari: confronto fra tre tecniche.
Malagnino VA, Passariello P, Sorci E, Giornale Italiano di Endodonzia 2004; 18/3: 142-148

Introduction: It is difficult to prepare root canals with oval cross-sections since their irregular shape make steady contact of the instruments with the canal walls a challenge. The literature shows that the filing movement of stainless steel instruments does not shape the canal walls completely in this situation. Circumferential filing movements allow improved contact with the canal wall, although this method does not always guarantee the preparation of the entire root canal. The filing movement of stainless steel instruments may straighten the canal curvature and therefore influence the morphology or even transport the apex.

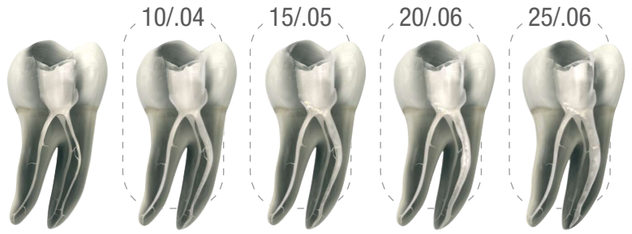
Aim: The aim of our study was to compare the performance of three different new generation NiTi instruments while preparing oval root canals: M_{two}® files which cut laterally and file with a circumferential movement, rotary engine-driven K3 instruments and stainless steel instruments, such as K-Flex and Rispi, which are used with a circumferential movement.

Materials and methods: 27 extracted teeth with oval root canals were selected and divided into three groups. Each tooth was prepared, cut into three sections – the apical, the middle and the coronal third – and examined under a stereo microscope. Further specimens were analysed based on the number of instrumented walls. The canal perimeter was divided into four sections: the mesial, distal, buccal and lingual sections. The treatment results were compared and evaluated on a scale of 0 to 4.

Results: The results of our study confirm that it is not possible to optimally clean and shape oval root canals with mere mechanical rotation of NiTi instruments and that a filing movement allows for a more complete instrumentation of root canals of such anatomical shape.

Conclusion: Our study proved that M_{two}® instruments which combine passive and circumferential filing ensured better instrumentation of oval root canals than NiTi instruments with a mere filing movement. Furthermore, M_{two}® instruments allowed for a more even preparation and smoother canal walls than stainless steel instruments. Circumferential filing neither causes modifications of the root canal morphology nor a transportation of the apex. All root canal walls appeared to be entirely and evenly cleaned.

M_{two}® ensured better instrumentation of oval root canals than K3 instruments.
M_{two}® allowed for a more even preparation and smoother canal walls than stainless steel instruments.
M_{two}® used with circumferential filing retained canal morphology and did not transport the apex.



M_{two}® instruments: working steps in the canal

M_{two}® basic sequence

The effectiveness of manual and mechanical instrumentation for the retreatment of three different root canal filling materials

Somma F, Cammarota G, Plotino G, Grande NM, Pameijer CH, JOE 2008; 34: 466-469

Aim: The purpose of this study was to compare ex-vivo the efficacy of two new engine driven NiTi rotary systems: the M_{two}® R and the ProTaper® retreatment files with a manual technique in the removal of 3 root filling materials (Guttapercha, Resilon and EndoRez).

Material & Methods: Ninety intact straight single-rooted permanent extracted premolars with a round canal, a curvature < 5° and with completely developed apices were selected for this study on the basis of similar root lengths, approximately 16 mm. Endodontic treatment was performed using M_{two}® NiTi rotary instruments. Canals were enlarged to a size 40, .04 taper at the working length. All roots were filled using lateral condensation. Retreatment was deemed complete when the last file reached the working length, there was no filling material covering the instrument, and the canal walls were smooth and free of visible debris. Extrusion of debris of root canal filling material through the apical foramen was observed visually using loupes with 3x magnification. Canal wall cleanliness was evaluated through optical stereo microscopy (OSM) and scanning electron microscopy (SEM) analysis. A linear regression analysis was performed to assess the influence of different covariates on the time required for material removal, whereas three different logistic regression analyses were performed to investigate the influences of filling materials, instruments used, and level of observation, considered as potential prognostic factors on the prevalence of apical extrusion of material.

Results: For all groups, none of the NiTi rotary instruments or hand files showed intracanal failure or visible signs of plastic deformation. Furthermore, no perforations, blockages or ledgings were recorded. The multivariate linear regression showed that retreatment time was fastest when using M_{two}® instruments followed by ProTaper®. Resilon root filling material required more time for removal compared with gutta-percha and Endorez. Cleaner canals were observed when the sizes of the retreatment files were matched to the original size of the preparation. More apical extrusion was observed with the rotary instruments than with the Hedstrom files.

Conclusions: The results showed that NiTi rotary instruments and hand instruments left remnants and debris on the root canal walls, mostly in the middle and apical third of the canal, irrespective of the root filling material that was used. The results suggest that a combined use of rotary and hand instruments may achieve the desired optimal results. NiTi retreatment rotary files remove filling material quickly yet should be followed by hand instrumentation to refine and complete the removal process. This ensures better canal wall cleanliness especially in the apical third. In addition the size of apical preparation can be increased. Furthermore, to minimize apical extrusion of debris, NiTi rotary instruments should be used 1 to 2 mm short of the working length.

M_{two}® retreatment files
with cutting tip

A comparison of cyclic fatigue between used and new M_{two}® NiTi rotary instruments

Plotino G, Grande NM, Sorci E, Malagnino VA, Somma F, Int Endod J 2006; 39: 716-723

Aim: To evaluate the cyclic fatigue of M_{two}® NiTi rotary instruments after controlled clinical use in molar teeth.

Methodology: Twenty M_{two}® instruments of each size were selected and divided into two groups; group A consisted of 10 new instruments (control group); group B consisted of 10 used instruments. Each instrument in group B was used to clean and shape 10 root canals of molar teeth in patients. Cyclic fatigue testing of instruments was performed in tapered artificial canals with a 5 mm radius of curvature and a 60° angle of curvature. In all, 140 instruments were rotated until fracture and the number of cycles to failure was recorded. Data was analysed using one-way ANOVA, Tukey´s HSD test and independent sample t-test to determine any statistical difference; the significance was determined at the 95 % confidence level.

Results: A reduction of cycles to failure between new (group A) and used (group B) instruments was apparent. A statistically significant difference ($P < 0.05$) was noted between instruments of groups A and B in all sizes with the exception of size 40, .04 taper.

Conclusions: Clinical use significantly reduced cyclic fatigue resistance of M_{two}® rotary instruments when compared with an unused control group. However, all the instruments had minimal instrument fatigue when discarded after controlled clinical use.

Effect of prion decontamination protocols on nickel-titanium rotary surfaces

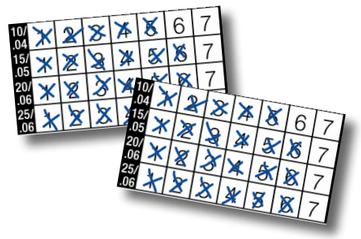
Sonntag D, Peters OA, JOE 2007; 33: 442-446

Aim: The aim of this study was to determine whether currently recommended prion decontamination protocols are adequate to clean NiTi rotaries without damaging the instrument surface.

Methodology: The effect of prion removal protocols on 7 brands of nickel-titanium files was investigated. Baseline debris scores were determined under magnification after staining with van Gieson's solution. After shaping root canals in vitro, rotary instruments were mechanically and ultrasonically cleaned followed by immersion for 24 hours in 2 M sodium hydroxide (NaOH), 6 M CH_5N_3, or 3 % sodium hypo-chlorite (NaOCl); control files were stored dry. After sterilization, files were again stained and evaluated.

Results: Two of seven file brands demonstrated significantly higher baseline debris scores (K3: 96,3 % and RaCe) compared to final scores. M_{two}® and ProTaper® achieved the best baseline values (10 %). Uniformly, debris could not be completely removed on any instrument system; there were no significant differences among the prion decontamination protocols. After immersion in NaOCl, 27.8 % of instruments showed corrosion; however, no deterioration after immersion in the other solutions was found in the other groups. Regarding corrosion, no significant difference was found between brands.

Conclusions: Based on these findings, single use of nickel-titanium rotary instruments appears beneficial.



M_{two}® Control Stickers

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