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Glide-path: comparison between manual instruments, first generation rotary instruments and M-Wire new generation rotary instruments

Preparazione del glide-path: confronto tra strumenti manuali, strumenti meccanici di prima generazione e strumenti di nuova generazione in lega M-Wire

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Pathfiles;
Proglider;
M-wire;
Canal shaping;
Glide-path.

Abstract
Objectives: The aim of this research is to compare the different glide path instruments in order to assess the work time and the number of use for each instrument.
Materials and methods: There were used 100 endodontic resin blocks with an S curvature for each group of instruments, on each block, first were used the k file # 10 and then the glide path was done using always the Xsmart machine, setting torque 5.2 n/cm^2, speed 250 g/m, all instruments were used until their separation and then the results were studied.

The time was also counted to obtain the complete pre-flaring for each group.

The same test was also repeated on extracted teeth, chosen from mb canal of maxillary molars, and mandibular molars, a total of 50 canals for each group; also in this group the

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pre-flaring was done counting the number of use for each instrument up to their separation and counting the time to obtain it.
Result and conclusions: Pathfiles group tested on resin blocks: pathfile #13 the result was: 100 out of 100 canals, pathfiles#16: 60 out of 100 canals, pathfile #19: 42 out of 100 canals.

Pathfiles group tested on extracted teeth: pathfile #13: 50 out off 50 canals, pathfiles#16: 50 out of 50 canals, pathfile #19: 50 out of 50 canals, no separated instruments.

Proglider group on resin block: single proglider 100 out of 100 blocks.

Proglider group on extracted teeth: single proglider 50 out of 50 canals.

Time to obtain the pre-flaring with pathfile: 10 s.

Time to obtain the pre-flaring with proglider: 8 s.

Both files give good results for an effective canal pre-flaring and glide path, making easier the following canal shaping independently of the chosen shaping technique.

There are no significant differences in the working time, and the strength of the pathfiles is confirmed for the new M-wire file: proglider.

PAROLE CHIAVE
Pre allargamento dei canali;
Variazione anatomia canalare;
Fatica ciclica;
Percorso di scivolamento;
Tempi di lavoro.

Riassunto
Obiettivi: Obiettivo di questo lavoro è mettere a confronto differenti strumenti per il glide-path, strumenti tradizionali in acciaio, strumenti per praflaring in ni-ti e strumenti di nuova generazione per preflaring in lega M-wire. Verrà valutato il numero di utilizzi prima della frattura sia su denti estratti che su simulatori endodontici, e il loro tempo di lavoro.
Materiale e metodi: sono stati utilizzati 100 simulatori endodontici in resina con curva ad s per ogni tipo di strumento analizzato, ed effettuato il preflaring in ogni silmulatore, è sempre stato utilizzato il motore xsmart con torque 5,2 n/cm^2, velocità 250 giri/m tutti gli strumenti sono stati utilizzati fino alla frattura ed analizzato poi statisticamente il risutato, è stato inoltre calcolato il tempo per ottenere il preflaring per ogni gruppo.

Gli stessi strumenti sono stati poi valutati anche su denti estratti, sono stati utilizzati prevalentemente radici vestibolari di molari superiori e mesiali di molari mandibolari, per un totale di 50 canali per ogni gruppo, è stato effettuato il preflering secondo la tecnica prevista dai singoli strumenti, calcolato il numero di utilizzo per ogni singolo strumento fino alla frattura, sono stati inoltre calcolati i tempi di utilizzo per ottenere il preflaring completo in ogni gruppo.
Risultati e conclusioni: Da questo studio si è evidenziato come il preflaring meccanico confrontato con il preflaring tradizionale manuale riesca a conservare meglio l'anatomia del canale evitando spiacevoli incidenti di percorso come false strade o trasporto del canale tipici degli strumenti in acciaio; permette agli irriganti di arrivare all'apice già dalle prime fasi di strumentazione canalare, e si riducono i tempi di lavoro.

con gli strumenti di nuova generazione in lega Ni—Ti M-wire si riesce ad ottenere il preflaring con numero minore di strumenti(si passa da tre ad uno) riducendo di conseguenza ulteriormente i tempi di lavoro.

Introduction

Pre-flaring is the pre-enlargement of canals needed to decrease the fracture risk of Ni—Ti instruments inside the canal.

With pre-flaring the taper lock on the instrument tip is decreased and a glide path is created that facilitates the penetration of the subsequent rotary instruments regardless of the technique used.

Traditionally pre-flaring and glide paths are achieved with manual steel instruments, k-files #10, #15, and #20, used sequentially.

Despite the introduction over the years of rotary instruments specifically designed for pre-flaring, the manual technique continues to offer undeniable advantages: greater tactile control, lower risk of endodontic fracture, the option of pre-curving the instrument in order to pass ledges and false channels; in addition to these benefits, however, it also has disadvantages: long operation times and a higher chance of instrument deformation makes work in very long and sharply curved canals more difficult. It also involves the use of an excessive number of instruments and more complications such as the formation of ledges and apical transportation if used improperly.

These disadvantages and typical complications of steel instruments led to the introduction of the first instruments for mechanical pre-flaring in Ni—Ti: the PathFiles.

The pathfiles are three instruments with tip diameters of #13, #16, and #19 (Fig. 1) characterized by a 0.2 constant taper, elevated flexibility, due both to the slight taper and

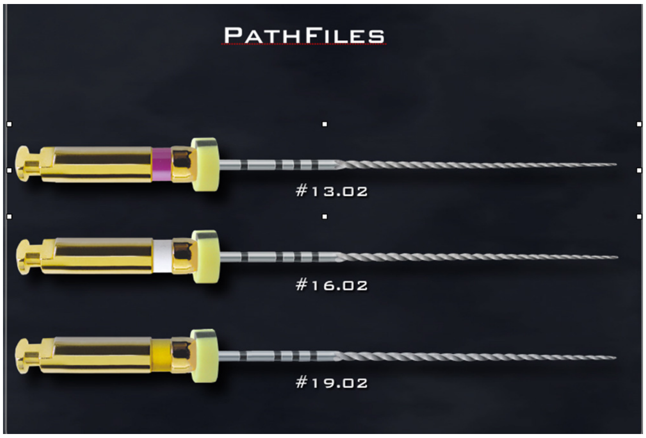

Figure 1 Pathfiles instruments.

the Ni—Ti alloy, and still provide resistance thanks to their square cross section.

Although PathFiles are mechanical instruments in their operation, the use of at least one manual steel file is involved (generally a k-file #10), which serves as an initial exploratory tool.

In 2009[1] several preliminary studies were conducted on pathfiles, which aimed to evaluate the qualitative and quantitative deformations (zips and ledges) at the apical level and the mean percentage of variation in the coronal and apical radius of curvature.

Four groups of operators were used to perform pre-flaring: expert operators who used pathfiles, non-expert operators who used pathfiles, expert operators who used k-files and non-expert operators who used k-files.

The results showed that Path Files better preserved the original anatomy of the canal compared to steel files at both the coronal and apical level.

The steel instruments were responsible for a higher incidence of apical deformations, particularly among the non-expert operators ($p < 0.001$), with apical transportation found to be the most common deformation in the work groups using steel files.

Subsequently, in 2011,[2] several studies were performed using microtac analysis, aimed at evaluating the variation in canal anatomy after creating a glide path both manually and mechanically. 2400 360° views were taken on eight extracted first maxillary molars; only the vestibular roots were considered. These were assigned randomly to the pathfiles pre-flaring or k-file pre-flaring group. All the samples were microscanned 1 mm from the apical foramen and at the point of maximum curvature.

The micro-CT study also confirmed that a mechanical glide path (pathfiles) preserves the original anatomy of the canal with significantly improved results compared to a manual glide path and also causes fewer canal abnormalities.

Despite their excellent quality, Ni—Ti instruments pose a risk of "unexpected" fracture.

Fractures, due primarily to cyclic fatigue, particularly in severely curved canals, thus remain the principal problem, and although the design and methods of manufacturing Ni—Ti rotary instruments have improved, this issue does not appear to be entirely resolved.

Of late different methods have been studied and used for optimizing the Ni—Ti alloy using thermomechanical processes that make it possible to change the bond, making it more flexible and more resistant to cyclic fatigue and torsional stress.[3]

A new generation of Ni—Ti alloys was created: M-wire, R-phase (intermediate phase with rhomboid structure that forms during the transformation from martensite to austenite and vice versa), and Cm-wire (introduced in 2010, extremely flexible but with no elastic memory and thus rarely used).[3]

The improved resistance to cyclic fatigue and torsional stress of the new alloys (with the most widely used being the M-wire alloy), compared to the classic Ni—Ti alloy used for rotary instruments is due precisely to these new thermomechanical processes.

Preliminary studies have shown that a microstructure containing martensite and R-phase is created in addition to the austenite of the traditional Ni—Ti.[4,5]

Various studies have been performed to compare the resistance to cyclic fatigue of the M-wire alloy with other alloys and with traditional Ni—Ti, but since it is impossible to eliminate certain factors such as instrument design and dimensions that are the characteristics of the manufacturer, a comparison study of the alloys has been difficult.

A study by Jhonson [sic: Johnson] et al.[4] reported that instruments in M-wire with a Profile design demonstrated approximately 400% more resistance to cyclic fatigue compared to traditional Ni—Ti with the same design.

The M-wire alloy has thus been used not only for shaping rotary instruments but also for mechanical pre-flaring instruments.

The second generation of instruments for mechanical pre-flaring was thus produced: the progliders.

The principal features of the proglider are: M-wire alloy, square cross section with semi-active tip, and a single size of 016.02 with progressive taper; the active component is 18 mm compared to 16 mm in the pathfiles, and three different lengths are available: 21 mm, 25 mm, 31 mm; the 11 mm handle is in gold colored brass and is individually blister packed.

After exploring the canal with a k-file #10, the instrument is used in continuous rotation at 300 rpm/2 Ncm, until it reaches the length of the space (Fig. 2).

Preliminary studies have shown that progliders, like their predecessors, better preserve canal anatomy compared to steel files.

Figure 2 Proglider instrument.

The purpose of this study was to compare the number of uses of pathfiles and progliders prior to fracture on both extracted teeth and on resin endodontic simulators and to calculate the mean time required to achieve complete pre-flaring with both techniques.

Materials and methods

200 endodontic simulators with a 90° curve were used and 100 canals selected between vestibular roots of the first maxillary molars and mesial roots of the first mandibular molars.

These were divided into four groups:

Group (1) Number of uses of pathfiles on resin simulators

100 endodontic simulators with a 90° curve were used, each simulator was explored with a #10 file, and pre-flaring was performed with the pathfiles in each endodontic simulator; an x smart motor at a torque of 5.2 n/cm^2 and a velocity of 250 rpm was used.

The number of uses until fracture was evaluated for each individual instrument and the mean of the simulators used was calculated.

Each individual fractured instrument was replaced with an equivalent new instrument.

Group (2) Number of uses of pathfiles on extracted teeth

35 extracted teeth were tested (vestibular roots of maxillary molars and mesial roots of mandibular molars) for a total of 50 canals.

The pulp chambers were opened, all canals explored with a k-file #10, and mechanical pre-flaring performed with pathfiles™.

The same settings were used for the x smart motor at 250 rpm and with a torque of 5.2 n/cm. Irrigation was performed after each instrument and the number of uses for each individual instrument was calculated.

None of the pathfiles fractured, but pathfile #16 and pathfile #19 showed unwound blades.

Group (3) Number of uses of the proglider on resin simulators

100 resin simulators were used with a 90° curve.

Each simulator was explored with a #10 file and mechanical pre-flaring performed with a proglider in each simulator; an x smart motor with a torque of 4.0 n/cm^2 and a velocity of 300 rpm was used. The number of uses before fracture was evaluated for each individual instrument.

Group (4) Number of uses of the proglider on extracted teeth

35 extracted teeth were tested (vestibular roots of maxillary molars and mesial roots of mandibular molars) for a total of 50 canals. The pulp chambers were opened and all canals explored with a k-file #10, mechanical pre-flaring was performed with a proglider, and the same settings used on the x smart motor: 300 rpm and a torque of 4 n/cm. Irrigation was performed after each instrument and the number of uses for each individual instrument was calculated; none of the progliders fractured.

The mean use times for both the progliders and pathfiles were also calculated.

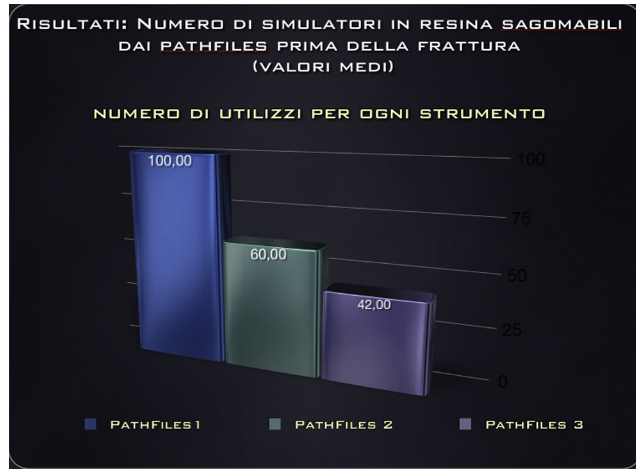

Figure 3 Number of simulators resin can be shaped by pathfiles.

Results

Group (1)

Pathfile #13 never fractured and shaped 100 endodontic simulators, pathfile #16 fractured after 60 uses and was replaced with a new one, pathfile #19 fractured after 42 uses and was replaced with a new one (Fig. 3).

Group (2)

No pathfiles fractured and all three pathfiles operated on 50 canals of extracted teeth; however, pathfiles #16 and pathfiles #19 showed unwound blades (Fig. 4).

Group (3)

The proglider never fractured and shaped 100 endodontic simulators (Fig. 5).

Group (4)

The proglider never fractured and shaped 50 canals of extracted teeth (Fig. 6).

The difference in mean use times for pre-flaring was 10 s for pathfiles and 8 s for progliders (Fig. 7).

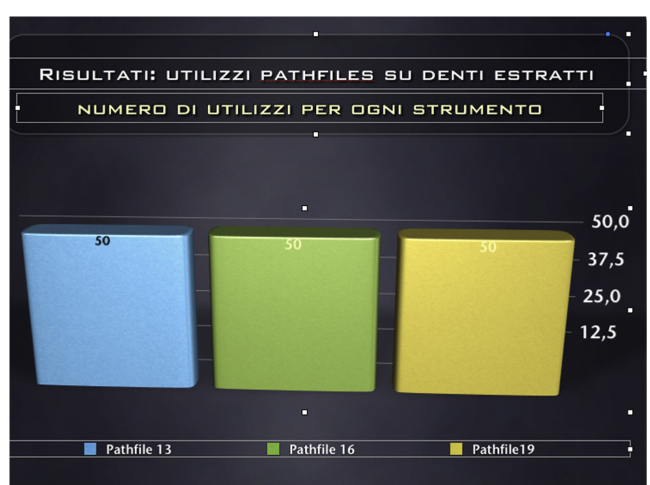

Figure 4 Number of uses pathfile on extracted teeth.

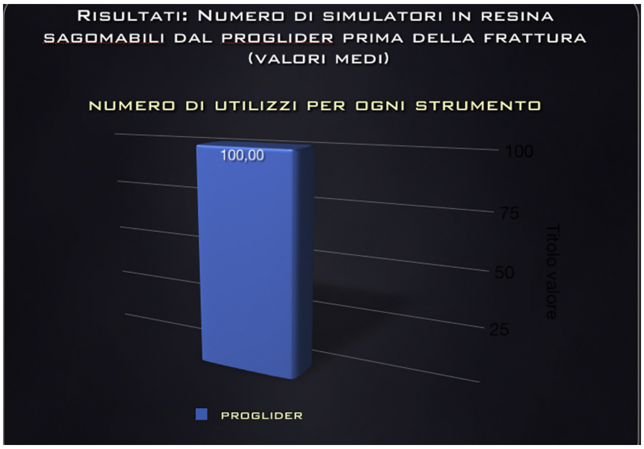

Figure 5 Number of simulators resin sagomabiuli from single proglider.

Figure 6 Number of uses of proglider on extracted teeth.

Discussion

There are undeniable advantages to performing mechanical pre-flaring with both first generation (pathfiles) and second generation (progliders) instruments.

The pathfiles technique involves the use of three instruments with a 0.2 constant taper; they offer elevated resistance to cyclic fatigue, preserve the anatomy of the canal, and create no apical abnormalities.

They are also able to create a glide path in a relatively short time on average.

On the other hand, the proglider is a single instrument with progressive taper and has shown, like its predecessor, to provide elevated resistance to cyclic fatigue; compared to the pathfiles, however, the proglider starts working in the mid and coronal region of the canal, facilitating the use of subsequent instruments by removing coronal obstructions.

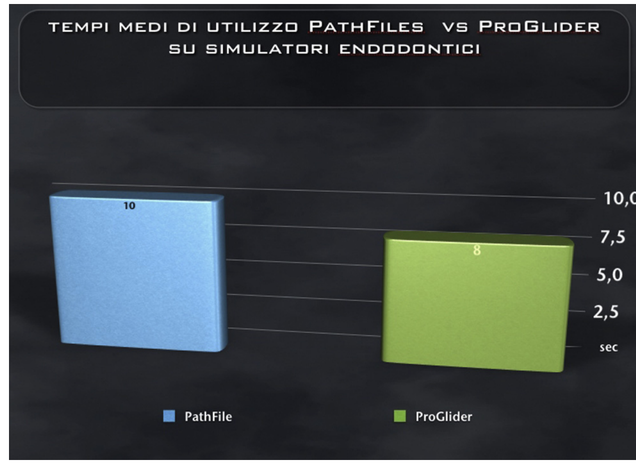

Figure 7 Difference between the average time of use and proglider pathfiles.

The proglider has also been shown to be highly effective in preserving canal anatomy and creating no apical abnormalities.

Conclusions

Both mechanical files have been shown to be effective in pre-flaring and Glide path creation in canals, facilitating the subsequent shaping phases of the canal, regardless of the instrument chosen. Significant differences in operation times were not found since the greater number of the PathFiles was balanced by a slower endodontic advance with the Progliders. The relative resistance to fracture already established for PathFiles was confirmed for ProGliders, despite the larger tip diameter and progressive taper. This can be explained by the greater resistance to cyclic fatigue of the M-Wire alloy used in ProGliders.

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