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RESEARCH ARTICLE

ESTABLISHING GLIDE PATH- THE INSTRUMENTATION SECRET

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ABSTRACT

The main goal of endodontic therapy is to maintain the original canal anatomy of the root canal system. This can be attained by establishing a proper Glide path. The ease and success of root canal preparation is considerably increased when an effort is made to provide an effective glidepath. Glide path can be achieved using hand files as well as rotary glide path files. If glide path is established properly then there are less chances of endodontic mishaps and risks of undesirable instrument separation is reduced. Hence Glide path is the key to achieve success in endodontic therapy.

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INTRODUCTION

Theconcept of 'endodontic triad' and principles of 3 dimensional cleaning, shaping and filling has been promulgated widely with the development of newer techniques, instruments and materials. However, considering that a major goal of root canal treatment is removal of microorganisms from the complex root canal system, it would therefore appear that 'shaping to facilitate cleaning and filling' might be a more appropriate concept (Chong, 2012). Two-dimensional radiographs fail to reveal the morphological variations of canals in different spatial planes (Schilder, 1974; Cunningham and Senia, 1992; Kartal and Cimilli, 1997). Canal scouting and preflaring are the first phases of canal instrumentation and it has also been noted that during these phases the clinician might more frequently encounter procedural difficulties (Jafarzadeh, 2007).

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Instrumentation of canals with multi-planar curvatures and long, thin curved canals is attended with possible procedural errors due to the stiffness of stainless steel instruments (Goldberg and Araujo, 1997). Due to their relative rigidity andtheir tip that in many cases is aggressive, so that in curved and/or calcified canals they can easily produce ledges or transportation (Walia and Brantley, 1988). The introduction of NiTi hand and rotary instruments revolutionized endodontics as they have a lower modulus of elasticity and exert fewer lateral forces on the dentine walls in curved canals than stainless steel instruments (Walia and Brantley, 1988). *The endodontic Glidepath is defined as a smooth radicular tunnel from canal orifice to physiologic terminus (foraminal constriction)* (West, 2010). A Glidepath has to be successfully prepared to obtain a continuous tapering funnel flowing with the shape of the original canal from the coronal access to the apex[2].Without glidepath, cleaning and shaping become unpredictable or impossible because there is no guide for endodontic mechanics. Its minimal size should be a "super loose No. 10" endondontic file.

The Glidepath must be discovered if already present in the endodontic anatomy or prepared if it is not present. The Glidepath can be short or long, narrow or wide, essentially straight or curved (West, 2010). Glidepath is necessary for smooth and fluent passage in the canal. Hence in this article the significance, instruments, techniques, advantages and disadvantages of glidepath has been elaborated.

Significance of Glide Path

The rationale of endodontics cannot be achieved without the endodontic Glidepath. The rationale states that "any endodontic ally diseased tooth can be predictably saved if the root canal system can be nonsurgically or surgically sealed, the tooth is periodontally sound or can be made so, and the tooth is restorable (West, 2008)."A nonsurgical seal requires first the creation of a radicular path that can be cleaned of viable and nonviable bacteria, vital and nonvital pulp tissue, biofilm, and smear layer; then shaped to a continuously tapering funnel that can be predictably and easily obturated. Second, the Glide path is necessary for quality control and sustainable excellent endodontic[8].Glidepath is mandatory to obtain the rationale of endodontic sand the lack of glide path establishment may result in ledge formation, blockage of root canals, transportation, zip formation, perforation (Dhingra, 2014). A glide path also helps to prevent torque failure and cyclic fatigue. Initially, when rotary files were introduced there was no recommendation for glide path creation. Subsequently, instrument fracture became a significant issue until glide path creation became known as an adjunct to safe rotary use. Hence glidepath became mandatory for efficient and effective use of rotary (Dhingra, 2014). Varioushand/ manual and rotary/ mechanical instruments can be used for preparingglidepath Instruments in Preparation of Glide Path have been elaborated in table 1 (Dhingra, 2014; Cassim and van der Vyver, 2013)

Table 1.

Manual	Mechanical/ Rotary
K- Files (Kerr)	PathFiles (Dentsply/Maillefer)
C + files (Dentsply/Maillefer Ballaigues)	G –files (Micro-Mega)
C- Pilot files (VDW)	Safesiders (Essential Dental Systems)
C files(Dentsply /Tulsa Dental Specialities)	V-files (SS White)
Hi-5 Files(Miltex, York)	PreShaper (Specialized Endo)
Pathfinders CS (SybronEndo)	EndoWave (J Morita)
Pathfinders(SybronEndo)	X-PLORER™ Canal Navigation NiTi Files(Clinician'sChoice Dental Products Inc.)
Senseus Profinders(Dentsply/ Maillefer	Scout-RaCe files(FKG Dentaire)
K-Finders(JS Dental, Sendoline)	RaCe ISO 10(FKG Dentaire)
S-Finders (JS Dental, Sendoline)	HyFlex™ GPF (Coltene)
D- Finders (Mani, Tochigi-ken, Japan)	

Techiques for preparation of Glidepath

Different methods for preparing glidepath are

- Hand stainless steel K-files
- Hand files in reciprocating hand piece
- Rotary NiTi files

Hand stainless steel K-files

Various authors have suggested using stainless steel K- files by hand for preparing the glide path (Berutti *et al*., 2004; Walsch, 2004; West, 2006; West, 2010; Mounce, 2005; Ruddle, 2005; Van der Vyve, 2011). The advantages of using stainless steel hand files and K-files compared with rotary NiTi files for creating the glide path are:

- Better tactile sensation (Mounce, 2005)
- Less potential for separation (Mounce, 2005)
- When a small size k-file is taken away from the canal, the file often retains an impression of the canal, and in this way alerts the operator to the curvatures present in the canal (Mounce, 2005; Van der Vyver, 2011);
- The stiffness of stainless steel hand files aids in path-finding and in negotiating blockages and calcifications (Mounce, 2005)
- Lower cost (Cassim, 2013)
- No need for a hand piece (Cassim, 2013)

West in 2006 described the use of stainless steel K-files in a vertical in and out motion to gradually increase the apical area[14]. In cases of narrow, fine and restricted canal a "watch-winding" motion is preferred, to create an "envelope of motion" (West, 2010)."Watch winding" motion was explained by West and Roane as a back and forth oscillation of a file (30 to 60 degrees) clockwise and counter-clockwise as the instrument is pushed downward into the canal. It is a definite inward progression of the instrument in a filing motion. An "envelope of motion" occurs when a precurved file is advanced into the canal short of maximum resistance, then the file is removed while it is simultaneously rotated in a clockwise direction (Schilder, 1974; West, 2006).

Berutti *et al* recommended that the diameter of the canal after glide path preparation should be at least one size larger than the tip of the first rotary file used to prepare the canal (Berutti *et al*., 2004). He also accentuated hat if a glide path larger than size 10 K-file is required then it is advisable to use the "balanced force" motion described by Roane *et al*. 1985. for file sizes 15 and above in order to reduce the risk of ledge formation. This involves turning the handle of the file clockwise, and then turning it counterclockwise using slight apical pressure so that the file does not "unscrew" its way out of the canal. During the clockwise motion, the file blades cut into the dentine and during the apical counter-clockwise motion, the loose dentine is collected into the file's flutes. This motion can be repeated several times as the file is advanced apically. After making a wider glide path the file is turned clockwise and removed (West, 2008). It has also been proposed that Glide path is confirmed when a size 15 K-file slides easily to the working length.

The file is withdrawn 1mm without rotation and should slide to working length. Thereafter, the file is withdrawn 2mm without rotationand should slide to working length. When the file can be withdrawn 3mm to 5mm and slides to working length without theneed for rotation a glide path is confirmed (Van der Vyver, 2011).

The disadvantages of preparing a glide path with hand instruments are

- Fatigue of operator
- Time required in the preparation of the glide path (Berutti *et al*., 2009).
- Risk of the introduction of canal aberrations with larger file sizes (West, 2010; Berutti *et al*., 2009).
- Greater change to original canal anatomy (Pasqualini *et al*., 2012).
- Increased apical extrusion of debris (Greco *et al*., 2011).

Hand files in reciprocating hand piece

This technique involves using small size K-files braced in a reciprocating and piece for glide path preparation (Mounce, 2008; Kinsey and Mounce, 2008). The canal length is first negotiated with the help of small stainless steel K-file and then attached to reciprocating hand piece. The hand piece is then moved vertically up and down, with an amplitude of 1mm to 3mm and bursts of reciprocation for approximately 15 to 30 seconds in each root canal. Sequentially larger size K-files (06 to 10) are inserted to just beyond the apical constriction to reduce the risk of blockage. Due to the relative stiffness of the file, Van der Vyver recommends placing a size 20 K-file one mm short of the apex during this method of glide path preparation to avoid apical transportation (Van der Vyver, 2011). TheM4 reciprocating hand piece (Sybron Endo) and Endo-Express reciprocating hand piece (Essential Dental Systems, NJ, USA) have a 30 degree equi-angle arc of reciprocation (five minutes on a clock face). The NSK Ti-Max Ti35L 10:1 reciprocating hand piece (NSK, Nakanishi, Japan) has a 90 degree angle of reciprocation or 15 minutes on a clock face.

The advantages of using a stainless steel K-file in a reciprocating and piece for glide path preparation are:

- Preparation time is reduced
- Reduced operator fatigue
- Reduced hand fatigue, especially in canals with multi-planar curves
- Reduced risk of instrument separation compared with rotary NiTi methods (Kinsey and Mounce, 2008)

The disadvantages are

- The need for a dedicated hand piece
- Risk of apical transportation with files larger than a 15 K-file (Van der Vyver, 2011; Kinsey and Mounce, 2008)
- Risk of apical extrusion of debris if hand piece is inserted apically with force (Van der Vyver, 2011)
- Decreased tactile sensation.

Rotary NiTi files

These files were introduced to facilitate glide path establishment. Establish an initial glide path with the no. 10 K-fileby using a “watch-wind” or “in-and-out movements” by hand is recommended before using rotary glidepath files. There are different systems of rotary glidepath files available in the market in different tip sizes and tapers-

PathFile NiTi rotary files (Dentsply Maillefer)

The system consists of three rotary instruments which are available in 21mm, 25mm, and 31mm lengths that can be used in standard endodontic motors and hand pieces (Van der Vyver, 2011). PathFile no.1 (0.13 mm) is then introduced into theroot canal at a rotation speed of 300 rpm in a delicatein and out movement until working length is reached (3-5 seconds). The instrument is then removed fromthe canal. Irrigation is recommended after use of each Path file to remove dislodged debris from the root canal. Path File no.2 (0.16 mm) is then introduced followed by Path File no 3 (0.19 mm) following the same protocol as described above. Once the glide path is established start preparing the root canal with NiTi rotary instruments of choice (Van der Vyver, 2011).

G-files

These glide path preparation instruments were introduced by Micro Mega Company in2011 and the system consists of two files which are available in different lengths of 21mm, 25mm and 29mm. The tip sizes are ISO 12 and ISO 17 and the non-cutting tip is asymmetrical which helps in the progression of the file into the canal. These files are flexible due to their small instrument diameters and their slight 3% taper. They have non-working (safety) tip and electro-polished to optimize their efficiency in apical progression while aiding in upward debris removal (http://micro-mega.com/en/g-files/).

According to manufacturer’s protocol for use

The working length with a small diameter precurved stainless-steel instrument (10 K files) is first determined. The rotating G1 instrument is then introduced into the canal, progressing with a slow movement without any apical pressure until the working length has been reached. They have speed of rotation: 400 rpm and torque: 1.2 Ncm. After irrigation, the G2 instrument is used in the same way; then the last hand file is used again to check canal patency and confirm the working length (http://micro-mega.com/en/g-files/).

ScoutRace (FKG Dentaire)

These glidepath instruments are used for the mechanized scouting of high curvature or S-shaped canals. Scout Race is a sequence of three Race instruments with a taper of .02 and ISO diameters 10, 15 and 20. At first passage instruments, they are used after the working length (WL) has been determined using hand K-Files or an apex locator. Three instruments with: ISO 10/.02,15/.02 and 20/.02 and length 21, 25 and 31mm are available with recommended speed of 800 rpm (min. speed: 600 rpm) and torque: 1 Ncm (http://www.fkg.ch/products/glide-path/scoutrace)

RaCe ISO 10

It is another system from FKG and consists of three files that progressively increase in taper of 2%, 4% and 6%and all have

the same apical diameter of 0.1mm. They are intended for reaching the WL when hand ISO 6 or 8 K-Files can no-longer advance in calcified or very narrow canals. The main indications for these instruments are constricted and obliterated canals, as well as abrupt coronal curvatures. These files will scout the canal and also create coronal preflaring because of the increasing taper of the instruments. Lengths of 21, 25, 31 mm are available with recommended speed of 800 rpm (min. speed: 600 rpm) and torque: 1 Ncm (http://www.fkg.ch/ products/ glide-path/race-iso-10)

HyFlex™ GPF

The HyFlex GPF ensure optimal shaping of the glide path due to the controlled memory. They are characterized by good durability and resistance to fracture. Despite the extreme flexibility that allows the files to follow unusual anatomies, the HyFlex Glide Path Files are very easy to use and ensure safe treatment. They are available in 21, 25 and 31mm lengths. File Assortment contains (www. hyflexcm.com/ DevDownloads/ HyFlexFamily_bro.pdf):

- GPF Navigator NT 15/01 10mm flute
- GPF CM K File 15/02 16mm flute
- GPF CM K File 20/02 16mm flute

Capar *et al.* compared the cyclic fatigue resistance of 5 different rotary path finding instruments made of conventional nickel-titanium wire, m-wire, and controlled memory wire and concluded that the cyclic fatigue resistance of the HyFlex GPF instrument was the highest, and the curvature radius had a significant effect on the fatigue resistance (Capar *et al*., 2015).

Advantages

The advantages of using NiTi rotary instruments for glide path preparation are:

- Reduced operating time (http://www.fkg.ch/ products/glide-path/scoutrace)
- Reduced canal aberrations (ledges, zips and apical transportation) (http://www.fkg.ch/products/glide-path/ scoutrace)
- Better maintenance of original anatomy (http://www. fkg.ch/products/glide-path/scoutrace)
- Less operator fatigue
- Less hand fatigue
- Reduced apical extrusion of debris (http://www.fkg.ch/ products/ glide-path/race-iso-10)
- Reduced post-operative pain
- An easy-to-learn technique (http://www.fkg.ch/ products/glide-path/scoutrace)

The disadvantages of using NiTi rotary instruments for glide path preparation are:

- Additional cost
- Increased risk of file fracture
- Decreased tactile sensation.

Conclusion

In conclusion the endodontic Glide path is the secret to radicular rotary safety. If used properly, will increase life of rotary instruments; produce a safe rotary result and an endodontic experience that you truly control. The preparation of a glide path not only helps to reduce the risk of instrument separation but also conveys to the clinician an intimate knowledge of the tortuous anatomy of the canal from the orifice to the terminus. While novel mechanical methods of glide path preparation serve to increase the efficiency of this essential prerequisite of canal shaping, the role of hand instruments should not be overlooked.

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