Creating a glide path for rotary NiTi instruments: part one

Peet van der Vyver[1]

Introduction

In the last decade, nickel titanium (NiTi) manual and rotary instrumentation have revolutionized the field of endodontics. Because these instruments are rotated in root canals, they are subjected to structural fatigue that eventually leads to failure (Sotokawa, 1988; Pruett, Clement, Carnes, 1997). Torsion and fatigue through flexure are the main two reasons why rotary NiTi instruments fracture (Serene, Adams, Saxena, 1995).

Torsional fracture occurs when the tip, or any other part of the rotating instrument, binds to the root canal walls while the rest of the file keeps turning. This usually happens when the operator exerts too much apical force on the rotating instrument in the root canal (Kobayashi, Yoshioka, Suda, 1997), there is a wide area of contact between the cutting flutes of the instrument and the canal walls, or if the canal section is smaller than the dimension of the non-cutting or non-active tip of the instrument (Blum et al, 1999; Peters et al, 2003). The end result would be that the elastic limit of the metal is exceeded and fracture of the file is inevitable.

Fracture due to flexural fatigue (bending stress) occurs when an instrument that has already been weakened by metal fatigue is placed under stress. The instrument does not bind to the root canal walls but rotates freely until fracture of the instrument occurs at the point of maximum flexure (Sattapan, Palmara, Messer, 2000; Gabel et al, 1999). The amount of bending stress transformed onto an instrument depends on the anatomy of the root canal, especially in curved root canal (Pruett et al, 1997).

In general, the following factors are associated with fracture of NiTi rotary instruments:

- Instrument design (Bryant et al, 1998)
- Instrumentation technique (Bryant et al, 1998)
- Rotational speed
- Torque on instrument.

According to Roland et al (2002) and Peters et al (2003), the risk of instrument fracture can be reduced by performing coronal enlargement of the root canal. Blum et al (2003) suggested that a glide path should be created with small flexible stainless steel hand files to create or verify that within any portion of the root canal there will be sufficient space for the rotary instrument to follow. In 2004, Berutti et al recommended manual preflaring of the root canal to create a glide path before using NiTi rotary instrumentation. They advocate that the root canal diameter should be at least one size larger as the tip of the first rotary instrument to be used in that root canal. They also reported that a reduction in torsional stress increased the average lifespan of a rotary instrument almost six-fold with a reduced risk of instrument fracture.

Glide path and preparation techniques

According to West (2010) a glide path is defined as a smooth radicular tunnel from the canal orifice of the canal to the physiologic terminus of the root canal. A glide path is achieved when the file forming it can enter from the orifice and follow the smooth canal walls uninterrupted to the terminus (West, 2006). This

Professor Peet van der Vyver, BChD,
Extraordinary Professor, School of Dentistry, University of Pretoria, South Africa.
Private practice, Sandton, South Africa

Figure 1: M4 reciprocating handpiece (Kerr)

confirms that there is a pathway for rotary instruments to passively follow in the canal.

Several authors have recommended using stainless steel K-files by hand for preparing the glide path (Berutti et al, 2004; Gambarini, 2005; Ruddle, 2005; West, 2006; Mounce, 2005). According to Mounce (2005) there are several advantages for using stainless steel K-files to prepare a glide path:

- K-files have excellent tactile sensation
- Low potential for file separation
- When a small size K-file is removed from the canal, the file often has an impression of the canal, thereby guiding the operator to the curvatures present in the canal
- The stiffness of hand steel files aids in negotiating blockages and calcifications.

In 2006, West recommended using a K-file with an initial watch winding motion to remove restricted dentin in very narrow canals, followed by a vertical in and out motion with a 1mm amplitude and gradually increasing the amplitude as the dentin wall wears away and the file advances apically. He recommended that the minimal glide path file size before the use of rotary files should be a loose number 10 K-file.

In 2008, Kinsey and Mounce described a technique using a reciprocating handpiece attached to small size K-file for glide path preparation (Figure 1). The main advantages of using the reciprocating handpiece is to reduce glide path preparation time and hand fatigue with narrow, multiplanar root canals compared to the conventional manual technique. With this technique, a small size K-file is used by hand to negotiate the root canal to length. The M4 reciprocating handpiece (Figure 1) is then attached to the file, and when activated it moves the file alternatively 30 degrees clockwise and 30 degrees counterclockwise.

Glide path preparation using a reciprocating handpiece

- Establish working length and patency of root canals with 08 or 10 K-file. In this clinical case, number 08 K-files were used. (Figure 2)

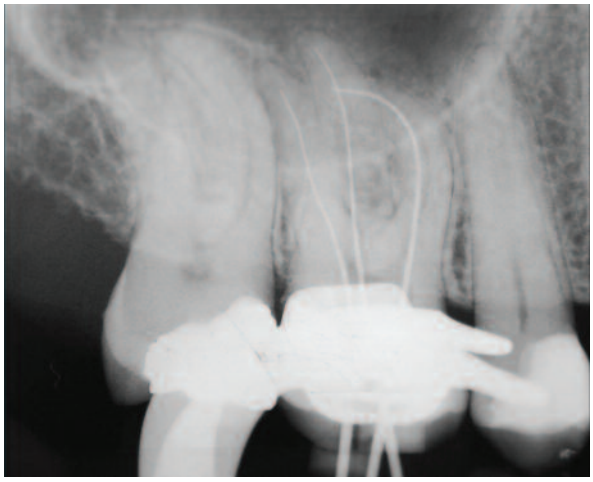
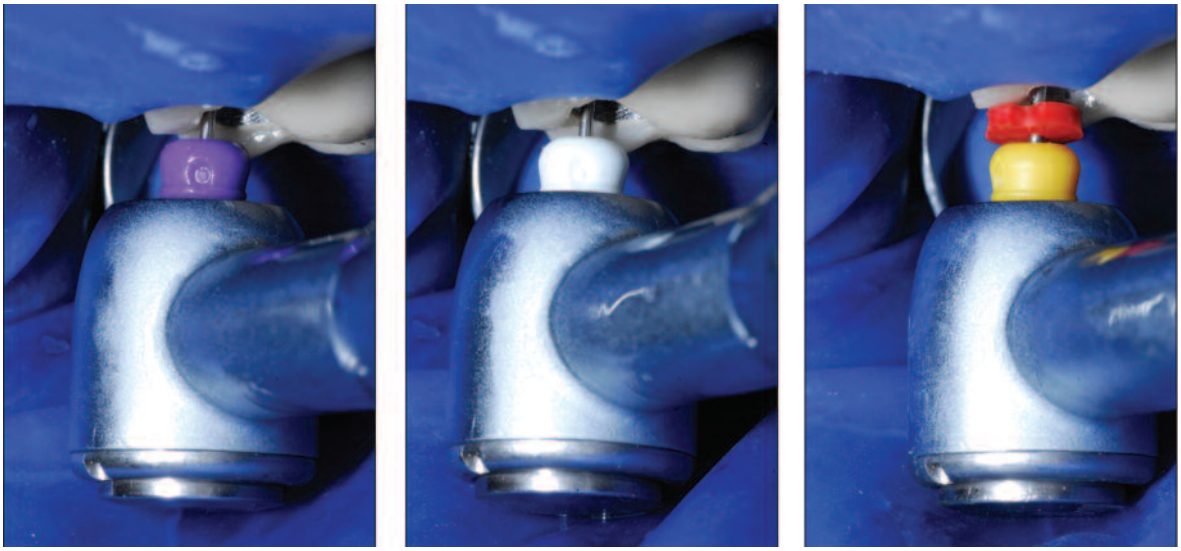


Figure 2

Figure 3

- Select the smallest size K-file that fits tightly into the root canal (in this case 08 K-file). Pre-curve the tip of the file and work the file down the canal using a 'watch-wind' motion until the file has reached working length. Attach the M4 reciprocating handpiece to the handle of the file. While keeping the file at working length activate the handpiece. (Figure 3) Let the handpiece 'watch-wind' the K-file for 5-10 seconds until you feel that the file becomes loose in the root canal. Keeping the handpiece activated, withdraw the file approximately 0.5mm from canal and move it back to length. Withdraw 1mm and move it passively back to length. If the file cannot be



Figures 4a-4c:

moved back to length, the handpiece must be removed and the file manually taken to length before proceeding. This process can be repeated until the file can be withdrawn and moved back to length over a distance of 3-3.5mm. This will confirm glide path preparation with a number 08 K-file.

- Negotiate (by hand) the next ISO sized pre-curved K-file in the canal – up to working length (in this case, size 10 K-file). Repeat procedure. Follow the same procedure with size 15 K-file. If a size 20 K-file is used the author recommends to place this file 1mm short of the working length due to the higher risk of transportation in apical part of the root canal due to the stiffness of the larger size instruments (Figure 4a).

To check if a glide path was established the clinician must be able to place size 15 or 20 K-file in root canal up to

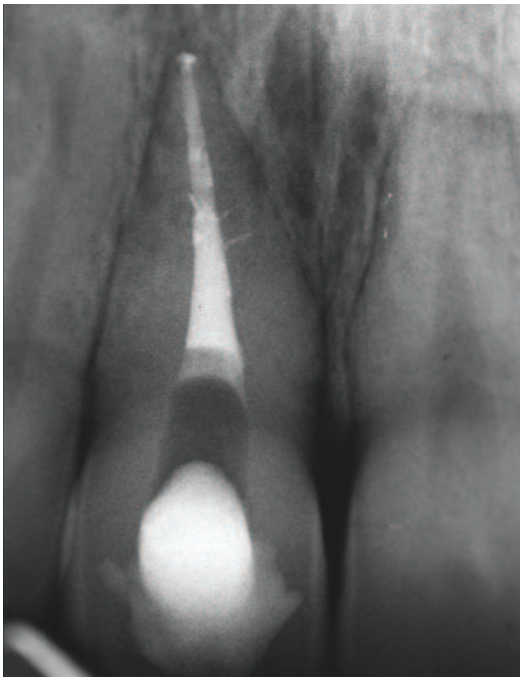


Figure 5. Upper right central incisor that was prepared with Twisted Files (Sybron Endo) and obturated with RealSeal (Sybron Endo).

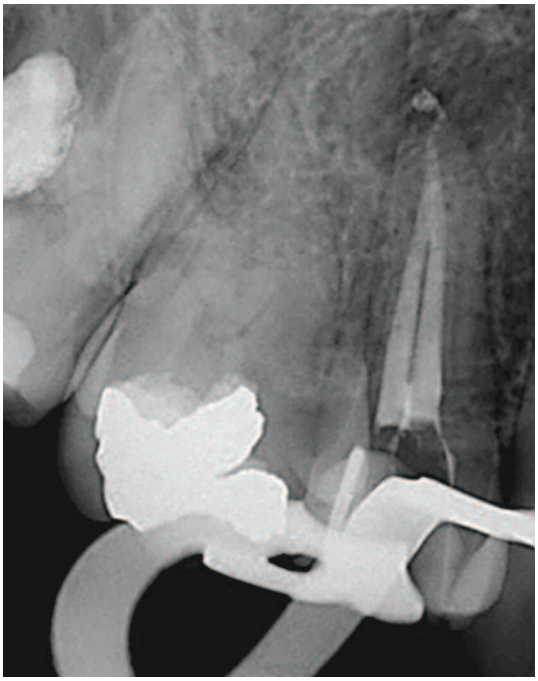


Figure 6. Upper right second premolar that was prepared with Twisted Files (Sybron Endo) and obturated with System B Elements (Sybron Endo).

working length, withdraw the file 1.5mm from canal and push it back to working length without any difficulty (by hand). (Figure 4b)

Repeat the above but withdraw the file 3mm and then 5mm from working length. When the file can travel 5mm in the root canal without any obstruction, a successful glide path preparation is confirmed. Proceed with rotary NiTi files of your choice to complete canal preparation. (Figure 4c). Figures 5 and 6 depict clinical cases where the M4 hand piece and stainless steel K-Files were used to create a glide path before root canal preparation with rotary nickel titanium files.

Recently, PathFile NiTi rotary files (Dentsply Maillefer) were introduced to the market for glide path enlargement. The system consists of three rotary instruments that can be used for glide path enlargement after initial negotiation and establishment of a glidepath with a number 10 K-file. PathFile number 1 (purple) has an ISO 13 tip size, PathFile number 2 (white) has an ISO 16 tip size and PathFile number 3 (yellow) has an ISO 19 tip size.

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