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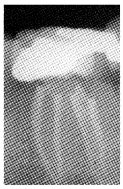

CLINICAL ARTICLE

Canal preparation using only one Ni-Ti rotary instrument: preliminary observations

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Abstract

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Aim To describe a novel canal preparation technique using only one Ni-Ti rotary instrument.

Summary In this novel technique, the canal is negotiated to the working length with a size 08 hand file. Then, the canal preparation is completed with an F2 ProTaper instrument used in a reciprocating movement. In larger canals, the use of additional hand files may be required to complete the apical enlargement.

Key learning points

- A novel canal preparation technique is introduced using only one Ni-Ti rotary instrument in a reciprocating movement.
- The advantages of the technique include a reduced number of instruments, lower cost, a reduced instrument fatigue and the elimination of possible prion cross-contamination associated with the single use of endodontic instruments.

Keywords: Ni-Ti, preparation, ProTaper, reciprocation, rotary, single use.

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Introduction

Effective cleaning and shaping of the root canal system is essential for achieving the biological and mechanical objectives of root canal treatment. The objectives are to remove all the pulp tissue, bacteria and their by-products whilst providing adequate canal shape to fill the canal (Schilder 1974).

Traditionally, the shaping of root canal was achieved by the use of stainless steel hand files. However, nickel-titanium (Ni-Ti) instruments offer many advantages over conventional files. They are flexible (Walia *et al.* 1988), have increased cutting efficiency (Kazemi *et al.* 1996) and have improved time efficiency (Ferraz *et al.* 2001). Furthermore, Ni-Ti

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instruments maintain the original canal shape during preparation and have a reduced tendency to transport the apical foramen (Kuhn *et al.* 1997, Reddy & Hicks 1998, Ferraz *et al.* 2001, Pettiette *et al.* 2001).

With all these apparent advantages, the use of Ni-Ti rotary systems has increased considerably since their introduction. However, their cost and instrument fracture (Alapati *et al.* 2003, 2004, Berutti *et al.* 2004) are notable disadvantages.

The clinician is faced with two major concerns when considering the use of Ni-Ti rotary instruments: (i) possibility of instrument fracture associated with increased instrument fatigue caused by the repeated use and (ii) the possibility of cross-contamination associated with the inability to adequately clean and sterilize endodontic instruments (Spongiform Encephalopathy Advisory Committee 2006). A recent study found prions in human pulp tissue (Schneider *et al.* 2007). Tooth structure and organic debris were observed on the surface of Ni-Ti rotary instruments, and appeared to adhere in the surface cracks despite meticulous ultrasonic cleaning and decontamination (Alapati *et al.* 2003, 2004, Sonntag & Peters 2007). Therefore, the single use of endodontic instruments was recommended to reduce instrument fatigue and possible cross-contamination. However, the single use of endodontic instruments and, mainly the more expensive Ni-Ti rotary instruments, may become an economical burden on the endodontist and the general dentist especially as the available techniques involve the use of at least three to four Ni-Ti rotary instruments. Consequently, the introduction of canal preparation techniques which would reduce the number of instruments required to achieve the mechanical and biological objectives would be beneficial.

The purpose of this article was to describe a novel canal preparation technique using only one Ni-Ti rotary instrument. This novel technique will reduce the number of Ni-Ti rotary instruments required for canal preparation, simplify the armamentarium and would be more cost-effective compared with other Ni-Ti rotary techniques with regards to the single use of Ni-Ti rotary instruments.

Report (technique description)

The technique is simple and straightforward. It involves the use of only one size 08 hand instrument and one F2 ProTaper Ni-Ti rotary instrument (Tulsa Dentsply, Tulsa, OK, USA).

Initial canal negotiation

The canal is negotiated to the working length, as indicated by an apex locator, with a stainless steel size 08 hand file. A trial file radiograph can then be exposed. In severely curved canals, canal negotiation with files sizes 10 or 15 is recommended. This step is accomplished with the continuous intracanal use of a lubricant and/or a 2.5% solution of sodium hypochlorite.

Canal preparation

An F2 ProTaper Ni-Ti rotary instrument is used for the canal preparation in a clockwise (CW) and counterclockwise (CCW) movement. The F2 is used in conjunction with a 16 : 1 reduction ratio contra-angle connected to an ATR Vision (ATR, Pistoia, Italy) motor which allows the reciprocating movement. The CW and the CCW rotations are set on the motor at four-tenth and two-tenth of a circle. The rotational speed is set at 400 rpm.

The F2 instrument is used in the canal with a slow pecking motion and an extremely light apical pressure until resistance is encountered (i.e. until more pressure is needed to make the F2 advance further in the canal). The instrument is then pulled out of the canal,

International Endodontic Journal

cleaned with a gauze to remove the debris filling the flutes, and reinserted and employed in the same manner. This step is repeated until the F2 reaches the working length. No further enlargement would be required for narrow and/or curved canals. For larger canals, hand files can be used after the F2 reaches the working length to complete the apical enlargement.

The canal preparation is accomplished with continuous canal irrigation using a 2.5% solution of sodium hypochlorite and a final rinse with EDTA 17% followed by NaOCl.

Discussion

The technique described involves the use of only one hand instrument and one Ni-Ti rotary instrument.

The F2 ProTaper instrument is able to cut dentine in both directions, CW and CCW. Also, this instrument, with a 0.08 mm mm^{-1} taper at its tip, would provide adequate taper to allow the filling of the root canal system even with the vertical compaction of warm gutta-percha. The F2 ProTaper instrument can be used in some cases at the end of the canal preparation in a continuous CW rotation at 500–600 rpm in a brushing outstroke motion in the coronal and middle thirds of the canal to obtain a greater taper allowing the use of larger heat carriers/pluggers such as the medium or medium large System B plugger (SybronEndo, Orange, CA, USA). One other important aspect of the F2 instrument is the variable taper. This feature would provide an increased flexibility for this larger instrument which can be used in this technique to prepare severely curved canals (Figs 1–3). An instrument with a fixed 0.08 mm mm^{-1} taper would be too rigid to be used in curved canals.

An effective way to prepare curved canals when using hand files in a CW and CCW movement has been described (Roane *et al.* 1985). Ni-Ti rotary instruments used in a continuous CW rotation also allow the preparation of curved canals. However, several instruments were required to completely shape a canal. Hand files may also be required for increased apical enlargement. In the present technique only one rotary ProTaper Ni-Ti instrument was used regardless of the canal width and the desired degree of apical enlargement. Although in the present technique the instrument would frequently engage dentine at its tip, the CCW rotation would immediately disengage the instrument. Theoretically, the CW and CCW movement would reduce the incidence of torsional fracture by taper-lock. However, this issue needs to be investigated.

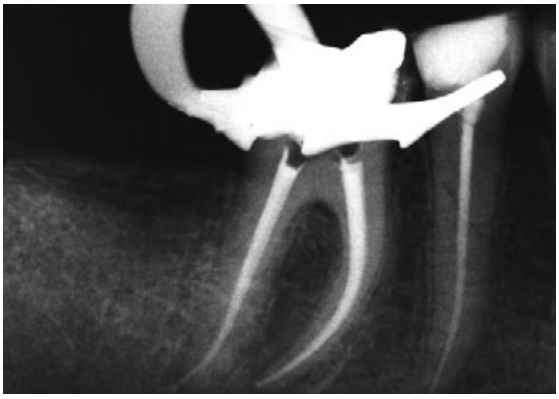

Figure 1 Root canal treatment on tooth 46; the canals were prepared with an F2 instrument.

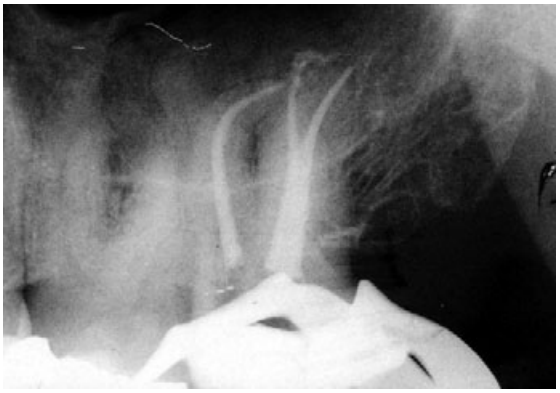

Figure 2 Root canal treatment on tooth 27; the canals were prepared with an F2 instrument.

Figure 3 Root canal treatment on tooth 46; the canals were prepared with an F2 instrument.

The degrees of CW and CCW rotations were determined from the torsional fatigue profile of the F2 ProTaper instrument (unpublished results; Thompson 2006). These values were less than the degree of rotation at which the F2 instrument would fracture if bound in dentine (Thompson 2006).

The CW rotation was greater than the CCW rotation. When the instrument is rotated CW, it will screw in the canal. When rotated CCW, the instrument will unscrew out of the canal. As the CW rotation is greater than the CCW rotation, the end result is a screwing in effect and an advancement of the instrument in the canal. Consequently, only very light apical pressure should be applied on the instrument as its advancement would be almost automatic.

At the present time, the ATR Vision motor (ATR, Pistoia, Italy) was the only one available in North America to allow the setting of the specific values of the CW and CCW rotations.

In the standard Ni-Ti techniques using continuous rotation, it is crucial to enlarge the canal to at least a size 15 file prior to the use of rotary instruments (Peters *et al.* 2003, Berutti *et al.* 2004, Patino *et al.* 2005). If not, although the instrument would still advance in the canal, it would bind in dentine; instrument fracture may then occur due to taper-lock. In the present technique, the size 08 hand file ensures the presence of a patent glide path. The impression was that further enlargement with hand files may not be necessary even for the preparation of severely curved canals and canals with a double curvature (Fig. 4) as long as a minimal glide path was established.

International Endodontic Journal

Figure 4 S-curved MB canal prepared with an F2 instrument.

Several authors (Stabholz *et al.* 1995, Ibarrola *et al.* 1999) recommended preflaring of the canal prior to its negotiation with hand files to the working length to minimize the incidence of procedural errors. In the present technique, the canal can be negotiated passively to resistance with a hand file size 8, and then the F2 is used to enlarge the canal to the length reached by the hand file. This step would be repeated until the hand file and the F2 reach the working length.

In the present technique, only one Ni-Ti rotary instrument was used during canal preparation. In multi-rooted teeth, regardless of the canal width, also one Ni-Ti rotary instrument would be used for the different canals compared with three to four Ni-Ti rotary instruments with the standard techniques.

Similar to the standard Ni-Ti rotary instrumentation techniques, one limitation for the application of the present technique is the presence of a sharp (non-gradual) canal curvature. In such a case, the instrumentation with the F2 would be carried to a level coronal to the curvature; the preparation of the apical part would then be completed with hand files.

Conclusion

A novel canal preparation technique with only one Ni-Ti rotary instrument used in a clockwise and counterclockwise movement is described. This technique would offer two major advantages: (i) the single use of endodontic instruments would become more cost-effective and (ii) the elimination of possible prion cross-contamination and a reduced instrument fatigue associated with the single use of endodontic hand and rotary reamers and files.

The preliminary experience with this technique and the first impression were encouraging. However, the need of proper laboratory and clinical evaluation of several parameters (apical extrusion of debris, incidence of instrument fracture, canal transportation, need of preflaring, etc.) would be essential.

Disclaimer

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