Forward reciprocation of conventional rotary instruments – Literature review and clinical case reports

Peet J van der Vyver[1], Martin Vorster[2], Farzana Paleker[3] and Natasha Predin Djuric[4]

Introduction

Advances in metallurgy have produced more super-elastic NiTi files that manufacturers claim are strong enough to resist the forces of torsion while maintaining enough flexibility to follow complicated canal anatomy.[1] In addition to improvements in metallurgy, endodontic motors have undergone enhancement with regard to torque control and kinematics that are adjustable in several directions, which offer more effective and safer shaping of root canals.[2] Recently, the Root Pro CL (Medidenta, Las Vegas, USA) (Figure 1) and E-Connects (Eighteenth Medical, Changzou, China) (Figure 2) endodontic motors were launched; they allow clinicians to use conventional rotary instruments in a reciprocating motion.

Reciprocating motion is an evolution of the balanced force technique, offering a good alternative method to prevent procedural errors during root canal shaping.[3] Based on several studies, root canal shaping with reciprocating motion has been postulated to offer superior fracture resistance of the instruments.[2,4-6]

Reciprocating files currently on the market are designed for use in a reverse motion. This motion employs a greater engaging counter-clockwise (CCW) angle (left-cutting) with a non-cutting disengaging clockwise (CW) angle. However, some authors suggest that reciprocating motion (RM) with a CW rotation greater than the CCW motion (forward reciprocation or right-cutting) could expand the use of conventional rotary files typically designed for continuous CW rotation.[7,8]

Apart from reciprocating instruments, all the rotary systems are designed to cut in a CW direction. It is possible that the rotary instrument may neither cut nor infiltrate the canal walls if one tries to use CW cutting instruments in reciprocation motion. Since the reciprocating file systems have been designed to cut in a CCW direction, the CCW angle of motion is greater that the CW angle.[9]

Reciprocating motion with CW rotation greater than the CCW motion could allow the use of a larger number of conventional rotary glide path and file systems, as the flutes of the majority of systems are designed for continuous CW rotation (right-cutting).[10]

The alternating changes in the direction of rotation would, in theory, reduce the number of cycles of the instrument and therefore the cyclic fatigue on the instrument compared with that imposed when instruments are used in a consistent rotating

[1] Prof Peet J van der Vyver (BChD, MSc, PhD), Studio for Endodontics, Restorative Dentistry and Dental Education (www.studio4endo.com); Part-time lecturer at the University of Pretoria, Department of Odontology, School of Dentistry, University of Pretoria, Pretoria, South Africa

[2] Dr Martin Vorster (BChD, MSc), Lecturer/Dentist at the University of Pretoria's School of Dentistry, Pretoria, Gauteng, South Africa. (martin.vorster@up.ac.za) Department of Odontology, School of Dentistry, University of Pretoria, Pretoria, South Africa

[3] Dr Farzana Paleker (BChD, MSc) Extra-ordinary Lecturer, School of Dentistry, University of Pretoria South Africa

[4] Dr Natasha Predin Djuric (BDS), Postgraduate Student, University of Pretoria, School of Dentistry, Pretoria, Gauteng, South Africa and Eastern Cape Department of Health, Department of Health, Cecilia Makiwane Hospital, Department of Dentistry

Figure 1: Root Pro CL (Medidenta) Endodontic Motor

Figure 2: E-Connects (Eighteenth Medical) Endodontic Motor

motion.[5,11] Also, when an instrument is used in reciprocating motion with unequal forward and reverse angles and with limited in-and-out movements, it is less prone to bind to the canal walls.[12]

Yared[13] was the first to propose a canal preparation technique with a F2 ProTaper Universal (PTU) (Dentsply Sirona) NiTi rotary instrument used in forward reciprocation. The file was rotated within the canal in a CW and CCW movement by means of a 16:1 reduction ration contra-angle handpiece and ATR Vision motor (ATR, Pistoia, Italy).

According to Yared, the advantages of this technique are a reduced number of instruments, lower cost, reduced instrument fatigue and the elimination of possible prion cross-contamination associated with the single use of endodontic instruments.[2] A study by Paqué, Zehnder and De Deus showed that in terms of root canal curvature, a single F2 PTU file used in RM is as efficient as the conventional PTU full-sequence technique in CR in root canals of extracted human mandibular molars.[14]

Moreover, reciprocation canal preparation time with only one F2 PTU file (Dentsply Sirona) was shown to be less than the same file system used in full rotation.[5] Similar studies noted that only one file was needed to reach full working length in half the preparation time in comparison to the continuous rotation sequence. Faster canal preparation has the added benefit of reducing operator fatigue.[13,15,16]

Paqué[15] produced comparable results showing that F2 PTU in reciprocating motion is as efficient as the conventional PTU full sequence (Dentsply Sirona) technique in continuous motion. A recent study by Espir[10] showed that the unconventional CW reciprocation motion with Mtwo (VDW) resulted in effective canal preparation. Another advantage of forward reciprocating motion over continuous rotation is that it may reduce root canal aberrations.[8]

Forward reciprocation of conventional rotary instruments – Literature review and clinical case reports

With the introduction of the new motors and ProTaper Gold system, the authors tried to use only the F2 ProTaper Gold file in forward reciprocation, but it was found that the cutting efficiency was very low. However, it was found that the X2 ProTaper Next file performs very well clinically in forward reciprocation.

ProTaper Next (PTN) (Dentsply Sirona) is a rotary root canal-shaping system constructed of M-Wire NiTi, making it almost 400% more resistant to cyclic fatigue than conventional NiTi.[17] PTN features a bilateral symmetrical rectangular cross-section, with an offset from the central axis of rotation (except in the last 3 mm of the instrument (D0–

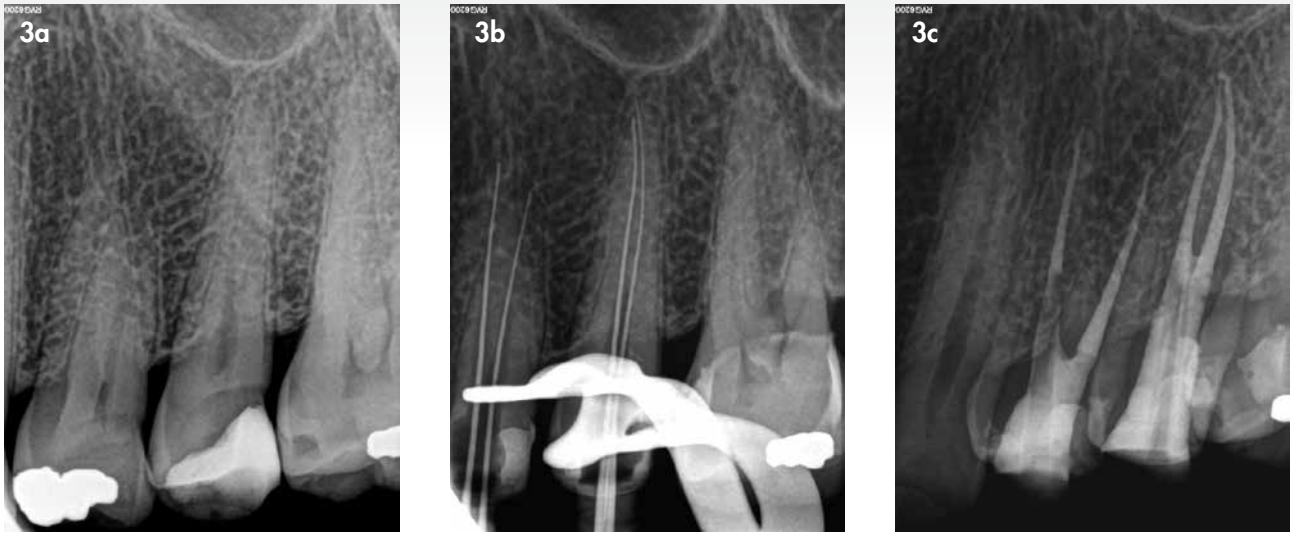

Figure 3(a) Pre-operative periapical radiograph of non-vital maxillary right first and second premolars; (b) Length determination periapical radiograph; (c) Postoperative periapical radiograph showing the result after obturation and core build-up with fibre posts (X.Posts, Dentsply Sirona) and Core.x Flow (Dentsply Sirona)

D3), allowing it to experience a rotational phenomenon known as precession or swagger.

In a recent study by the authors, the canal-shaping abilities of WaveOne Gold Glider in combination with the Primary WaveOne Gold file, a reverse reciprocating Gold-Wire file system, and ProGlider in combination with only the X2 PTN file, a conventional rotary NiTi M-Wire file used in a forward reciprocation, were analysed using micro-CT imaging. ProGlider in combination with only the X2 PTN file in forward reciprocation yielded significantly better results for both transportation and centring ability at the apical level of the root canal systems. The results of this study suggest that the ProGlider/X2 PTN file combination may be used in a forward reciprocating motion.

The following clinical case reports illustrate the clinical results obtained by using a ProGlider and only the X2 PTN instrument in forward reciprocation in either the Root Pro CL (Medidenta) or E-Connects (Eighteenth Medical) endodontic motors.

Case Report 1

The patient, a 58-year-old man, presented with bite sensitivity on his non-vital maxillary right first and second premolars (Figure 3a). Access cavities were prepared and two root canal systems were located in each premolar. Length determination was determined using an electronic apex locator and confirmed radiographically (Figure 3b). After canal negotiation and creation of a reproducible micro-glide path, the glide path was expanded by using a ProGlider (Dentsply Sirona) in reciprocation motion in the Root Pro CL endodontic motor (Medidenta, Las Vegas, USA). Root canal preparation was done using only a X2 PTN instrument, also operating in reciprocation using the endodontic motor. After irrigation, the root canal systems were obturated using PTN X2 Gutta Percha Points (Dentsply Sirona) and Pulp Canal Sealer (Kerr). Figure 3c shows the final result after obturation and core build up with fibre posts (X.Posts, Dentsply Sirona) and Core.x Flow (Dentsply Sirona).

Case Report 2

A 47-year-old man presented with irreversible pulpitis on his maxillary right first molar (Figure 4a). Three root canal systems were detected under magnification after access cavity preparation. The canals were negotiated, working length determined and a reproducible micro-glide path was prepared using a size 10 K-File. The glide path was expanded using a ProGlider (Dentsply Sirona) and root canal preparation done with a X2 PTN instrument, both in reciprocation motion in the E-Connects (Eighteenth Medical) endodontic motor. After irrigation, the root canal systems were obturated using PTN X2 Gutta Percha Points (Dentsply Sirona) and Pulp Canal Sealer (Kerr). Figure 4b depicts the final result after obturation. Note the sharp apical curvature

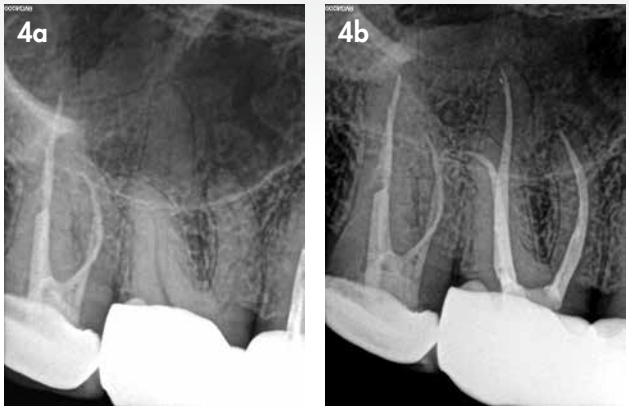

Figure 4(a) Pre-operative periapical radiograph of maxillary right first molar that presented with irreversible pulpitis; (b) Postoperative periapical radiograph showing the result after obturation depicts the final result after obturation. Note the sharp apical curvature in the distal root canal system that was maintained.

in the distal root canal system that was maintained using the X2 PTN file in reciprocation motion.

Case Report 3

The patient, a 58-year-old woman, presented with a non-vital mandibular left first molar (Figure 5a). An access cavity was prepared and two root canal systems were located in each premolar. Length was determined using an electronic apex locator and confirmed radiographically (Figure 5b). After canal negotiation and creation of a reproducible micro-glide path, the glide path was expanded by using a ProGlider (Dentsply Sirona) in reciprocation motion in the Root Pro CL endodontic motor (Medidenta, Las Vegas, USA). Root canal preparation was done using only an X2 PTN instrument, also operating in reciprocation using the endodontic motor. The canals were irrigated with heated 3.5% sodium hypochlorite using the EndoVac system (Sybron Endo) and the canals dried with paper points. The root canal systems were obturated using PTN X2 Gutta Percha Points (Dentsply Sirona) and Pulp Canal Sealer (Kerr). Figure 5c shows the final result after obturation.

Conclusion

In this series of cases, the authors illustrate the use of a ProGlider in combination with only the X2 PTN instrument, used in forward reciprocation instead of rotation. Clinically successful outcomes, with the added benefits of forward reciprocation and favourable research results when evaluating centring ability and transportation, could validate this combination as a preferred treatment modality in the future.

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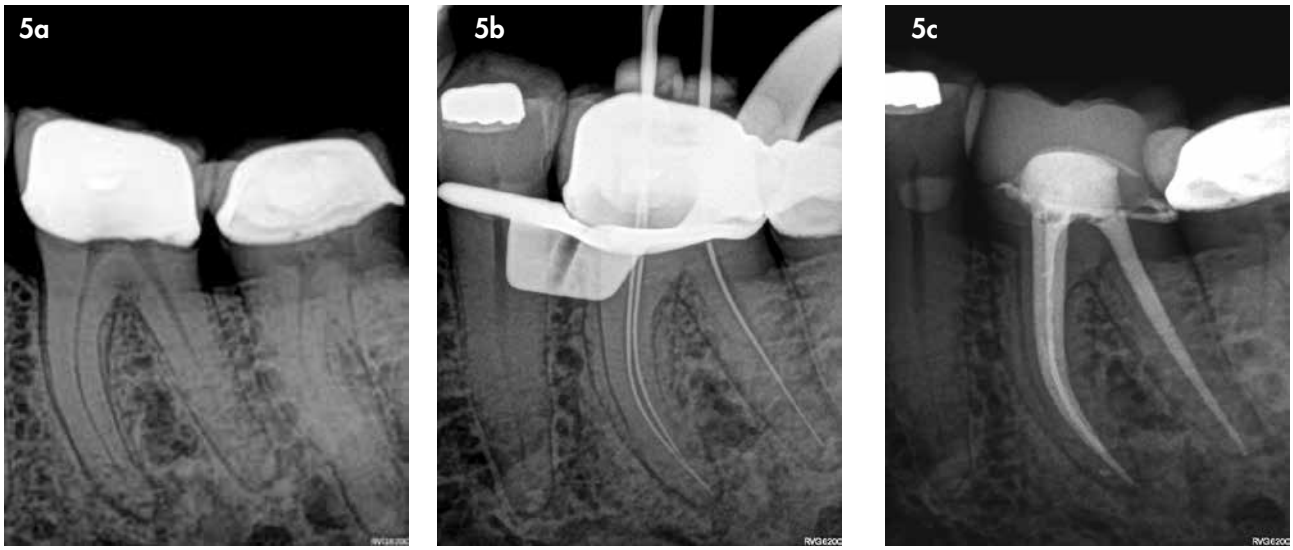

Figure 5(a) Pre-operative periapical radiograph of non-vital mandibular left first molar; (b) Length determination periapical radiograph; (c) Postoperative periapical radiograph showing the result after obturation

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