

# Comparison of the Incidence of Postoperative Pain after Using 2 Reciprocating Systems and a Continuous Rotary System: A Prospective Randomized Clinical Trial

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## Abstract

**Introduction:** The objective of the present study was to clinically compare the incidence of postoperative pain and the intake of analgesic medication (frequency and quantity) after endodontic treatment of posterior teeth using 2 reciprocating systems and a continuous rotary system. **Methods:** In a prospective randomized clinical study, 210 patients with vital teeth indicated for conventional endodontic treatment were treated by 5 specialists according to a pre-established protocol. The teeth were randomly assigned to 1 of 3 groups ( $n = 70$ ) according to the instrumentation system used: ProTaper Next (Dentsply Tulsa Dental Specialties, Johnson City, TN), WaveOne (Dentsply Tulsa Dental Specialties), or Reciproc (VDW, Munich, Germany). Treatments were performed in a single visit. After the visit, the patients were given a prescription for ibuprofen 400 mg to be taken every 6 hours if they experienced pain. Participants were asked to rate the intensity of the postoperative pain on a visual analog scale according to 4 classes (no pain, mild pain, moderate pain, and severe pain) after 24 hours, 48 hours, 72 hours, and 7 days. Patients were also asked to record the number of prescribed analgesic medication tablets taken at these time points. **Results:** No statistically significant difference was found among the 3 groups in relation to postoperative pain or analgesic medication intake at the 4 time points assessed ( $P > .05$ , Kruskal-Wallis test). **Conclusions:** The reciprocating systems and the continuous rotary system were found to be equivalent in regard to the incidence of postoperative pain and intake of analgesic medication at the time points assessed. (*J Endod* 2016;42:171–176)

## Key Words

Nickel-titanium instruments, postoperative pain, ProTaper Next, Reciproc, WaveOne

Postoperative pain is defined as the sensation of discomfort after endodontic intervention and is reported by 25%–40% of patients irrespective of pulp and periradicular status (1–3). According to the 2011 systematic review of Pak and White (4), the prevalence of pain in the first 24 hours is 40%, falling to 11% after 7 days. Dentinal debris, pulp tissue, microorganisms, and irrigants can be conveyed to the periradicular tissues during root canal preparation, and such extrusion of debris can lead to postoperative complications, such as flare-ups. Thus, adequate control of the working length (WL) can reduce the extrusion of material through the apical foramen but cannot prevent this completely (5). According to the literature, the incidence of flare-ups during endodontic treatment ranges from 1.4%–16% (6–9). Major advances in rotary instrumentation and metallurgy have led to the introduction of numerous systems with innovative designs in recent years. Nonetheless, all the preparation techniques and instruments available to date are still associated with some degree of extrusion of debris (10–12).

The concept of single-file canal preparation was introduced in endodontics (13) with the launch of Reciproc (VDW, Munich, Germany) and WaveOne (Dentsply Tulsa Dental Specialties, Johnson City, TN) instrumentation systems. These instruments are fabricated with a nickel-titanium alloy called M-Wire using an innovative thermal treatment process (14). The reciprocating motion involves an initial rotation of the instrument in a counterclockwise direction, during which the instrument penetrates and cuts the dentin, and then a rotation in the opposite direction, during which the instrument is released.

The Reciproc system consists of 25.08, 40.06, and 50.05 instruments characterized by an “S”-shaped cross section, spiral flutes with high cutting efficiency, and a gradually decreasing taper after the apical 3 mm. WaveOne system files are available in sizes 21.06, 25.08, and 40.08. The 21.06 (Small) instrument has a constant 6% taper along the entire length of its working part, whereas the 25.08 (Primary) and 40.08 (Large) instruments have an 8% taper from D1 to D3, decreasing progressively from D4 to D16. The WaveOne files have 2 different cross-sectional designs: a modified convex triangular shape from D1 to D8 and a convex triangular shape from D9 to D16.

The ProTaper Next files (Dentsply Tulsa Dental Specialties) operate in continuous rotary motion, and their center of mass or center of rotation is positioned off-center

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relative to the instrument's central axis of rotation. During rotation, the files of this design produce a mechanical wave of motion, which travels along the length of the working part of the instrument, minimizing the contact between the file and dentin. According to the manufacturer, the offset design of this instrument also improves debris removal and flexibility in the working part of the file (15). To our knowledge, the implications of shifting the center of mass and/or rotation of the central axis of the instruments on debris extrusion and incidence of postoperative pain have not been assessed by clinical trials in the literature. Furthermore, reciprocating instruments have not been thoroughly and clinically compared with those of continuous clockwise rotary motion in regard to the incidence of postoperative pain.

The purpose of the present study was to clinically compare the incidence of postoperative pain after the root canal preparation of posterior teeth using 2 reciprocating systems (Reciproc and WaveOne) and a continuous rotary system (ProTaper Next) through a prospective randomized trial. Analgesic medication intake by patients was also studied. The null hypothesis tested was that there is no difference in the incidence of postoperative pain or intake of analgesic medication after using any of the 3 instrumentation systems.

## Materials and Methods

This study was approved by the local research ethics committee (069127/2014). Five endodontists experienced in the techniques, materials, and technologies analyzed took part in the study. All specialists followed a pre-established protocol for the ProTaper Next, WaveOne, and Reciproc instrument systems.

## Patient Selection

A total of 210 patients (133 women and 77 men) aged 19–73 years were included in this study. Sample size calculation was performed using Cochran's method (1986). Based on a type I error of 0.05 and a power of 80%, a minimum sample size of 43 would be required to detect differences between the 3 study groups. Therefore, the 70 teeth assigned to each group were enough to ensure a representative sample. All participants had maxillary or mandibular molar or premolar teeth indicated for conventional endodontic treatment for prosthetic purposes diagnosed with vital pulps. Patients with non-vital teeth and cases of apical periodontitis, endodontic retreatment or symptomatic/asymptomatic irreversible pulpitis, root resorption, immature/open apex, or a root canal in which patency of the apical foramen could not be established were all excluded from the study. Patients refusing to participate in the study, those whose teeth had issues precluding single-visit treatment, those using some type of medication preoperatively such as analgesics or nonsteroidal or steroid anti-inflammatory drugs, and patients with any uncontrolled systemic disease were also excluded.

Patients were referred for treatment at 1 of the private dental clinics of the participating endodontists over a 6-month period spanning from June to December 2014. The diagnosis of vital pulp was confirmed by collecting dental history and performing periapical digital radiography, periodontal evaluation, percussion, and cold test (Endo Ice; Coltene/Whaledent Inc, Cuyahoga Falls, OH). The diagnostic findings were checked by comparing the tooth's response against that of an adjacent tooth with a vital pulp. The treatment protocol was explained to patients, and all selected patients signed an informed consent form. Although patients had a general notion of the type of instruments to be used, they were not told which specific system would be used in their particular case.

## Random Selection of Instrumentation System

Of the total sample of 210 teeth, 70 were designated to each of the 3 instrumentation systems. Because the study design included 5 specialists, each professional prepared 42 teeth, 14 per system. The following method was used to ensure random selection: at the outset of the investigation, each endodontist had a dark box at their dental practice containing 14 red, 14 blue, and 14 green tokens; each color represented 1 of the 3 systems investigated in the study. At the beginning of the treatment visit, the clinical assistant randomly determined the instrumentation system to be used for the patient by blindly drawing a colored token from the dark box, without returning it until all the patients had been assigned to 1 of the 3 systems. The groups were allocated as follows: group PTN (red token), preparation using ProTaper Next; group WO (blue token), preparation using WaveOne; and group R (green token), preparation using Reciproc.

## Treatment Protocol

Local anesthesia was administered and consisted of 2% lidocaine with epinephrine 1:100,000 (Xylocaine; Dentsply Pharmaceutical, York, PA).

After gaining access, the canals were explored with #06, #08, #10, and #15 K-type hand files (Dentsply Maillefer, Ballaigues, Switzerland) according to the initial diameter of the foramen, its degree of flattening, and its canal curvature using a watch-winding motion. The entire procedure was performed under a dental operating microscope (OPMI PICO; Carl Zeiss, Göttingen, Germany).

The WL was established by introducing a #10 K-file up to the apical foramen as determined by a Root ZX II apex locator (J Morita Corp, Kyoto, Japan), and then by withdrawing the file and subtracting 0.5 mm from the length, which was measured with the aid of an endodontic ruler. The WL was confirmed radiographically. All instruments were driven by an electric micromotor with limited torque (VDW Silver Reciproc Motor, VDW). Torque limits and rotation speed were set individually for each file system used. WaveOne and Reciproc instruments were used in reciprocating mode (WaveOne All and Reciproc All).

Debris was removed from the instrument using alcohol-soaked gauze, either immediately after each instrument change (ProTaper Next system) or after 3 in-and-out (pecking) motions (WaveOne and Reciproc systems) according to the manufacturer's recommendations. Irrigation with 2 mL 2.5% sodium hypochlorite (NaOCl) was performed using a 24-G needle (Max-I-Probe; Dentsply Tulsa Dental, York, PA) during access and a 31-G NaviTip needle (Ultradent Products Inc, South Jordan, UT) when reaching the WL after each file insertion.

The instrumentation sequence used during the treatments in each group followed the procedure recommended by the respective manufacturer.

**Group PTN.** For the PTN group, Sx files (originals from the ProTaper Universal system; Dentsply Maillefer, Ballaigues, Switzerland) were used for preflaring of the first two thirds using X1 and X2 (25.06) for preparation of narrow and curved canals and X3 and X4 (40.06) for preparation of large canals up to the WL. The files were worked using a continuous rotary brushing motion at a speed of 300 rpm and a torque of 2 Ncm.

**Group WO.** For the WO group, the Primary file (25.08) was used to prepare narrow and curved canals, and the Large file (40.08) was used for large canals. Three in-and-out motions were applied with stroke lengths not exceeding 3 mm in the cervical, middle, and apical thirds until attaining the established WL.

**Group R.** For the Reciproc group, R25 files (25.08) were used in narrow and curved canals, and R40 files (40.06) were used in large canals. Three in-and-out motions were applied with stroke lengths not

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