# RECIPROCATING VS ROTARY: WHICH ONE SHOULD I USE?

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## ABSTRACT

**Introduction:** This study compared the canal curvature modi?cation after instrumentation with nickel-titanium (NiTi) rotary ProTaper (Dentsply Maillefer) and WaveOne Primary reciprocating ?les (Dentsply Maillefer, Ballaigues, Switzerland).

**Methods:** Thirty ISO 15, 0.02 taper, Endo Training Blocks (Dentsply Maillefer) were used. In all specimens, the glide path was achieved with PathFile 1, 2, and 3 (Dentsply Maillefer) at the working length (WL). Specimens were then assigned to 1 of 2 groups for shaping: specimens in group 1 were shaped with ProTaper S1-S2-F1-F2 at the WL and specimens in group 2 were shaped with WaveOne Primary reciprocating files at the WL. Pre- and post instrumentation digital images were superimposed and processed with Corel draw Graphic Suite X5 (Corel Corporation, Ottawa, Canada), Adobe Photoshop CS3 (Adobe Systems Inc, San Jose, CA) & Solid works student Edition software (Dassault Systems Solid Works Corp, S.A., Velizy, France) to analyse the angle of curvature representing the canal curvature modification. Data were analyzed using mean, standard deviation, one way ANOVA ($p<0.05$) and t-test.

**Results:** Mean & Standard Deviation were more for wave-one as compared to rotary ProTaper. One way ANOVA shows significant difference between protaper & wave-one at 5% level of significance ($p>0.05$). A positive correlation was observed between Protaper & Wave-one ($p<0.05$) using t-test.

**Conclusions:** The canals prepared with single file reciprocating system preserved the original shape, respected the anatomical shape of the j-shaped canal and produced a continuously tapered funnel shape.


**Keywords:** Canal shaping, nickel-titanium, ProTaper, reciprocating motion, WaveOne

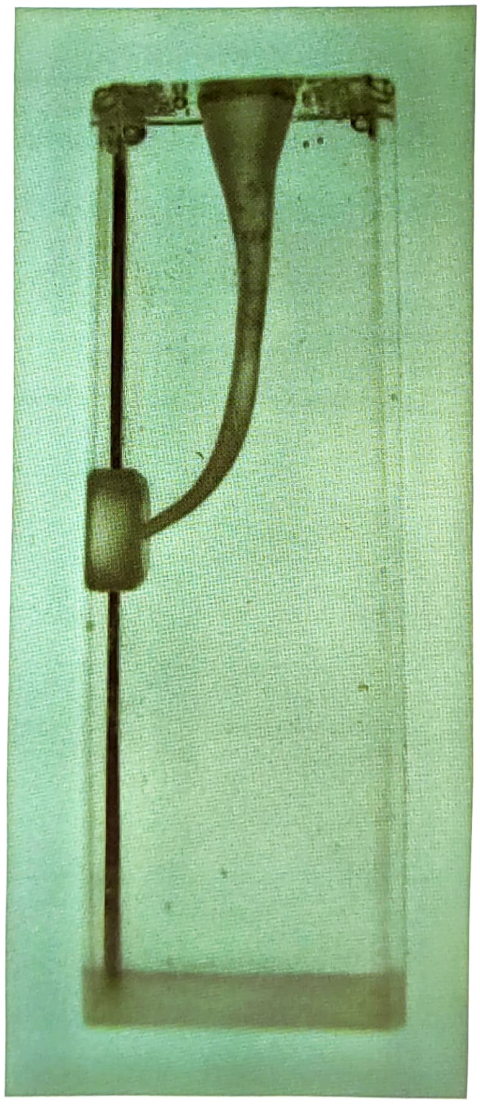

**FIG 2: Canal modification after preparation with WaveOne Primary reciprocating file**

## INTRODUCTION:

Root canal shaping is one of the most important steps in canal treatment. It is essential in determining the efifcacy of all subsequent procedures,including chemical disinfection and root canal obturation.

ProTaper, NiTi instrument, is available both for motor-driven and hand use. It has been reported to cut dentin more effectively and respect the original anatomic shape well. However, in clinical practice, these instruments may be subjected to fracture, mainly because of flexural (fatigue fracture) and torsional (shear failure) stresses. Canal curvature is suspected to be the predominant risk factor for instrument failure because of flexural stresses and cyclic fatigue. The clinician can do very little to prevent or reduce such stresses. The reciprocating motion of the NiTi rotary instrument has been shown to decrease the impact of

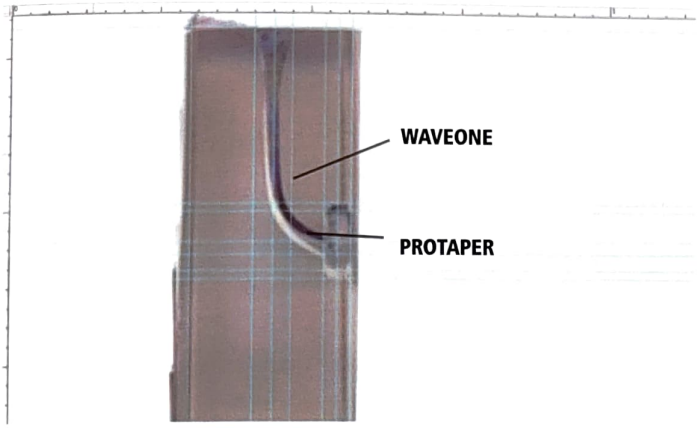


**FIG 3: Superimposition of protaper with waveone**

cyclic fatigue compared with rotational motion. Therefore, it has been recently proposed that the single-file shaping technique may simplify instrumentation protocols and avoid the risk of cross contamination.Moreover, the use of only one NiTi instrument is more cost-effective, and the learning curve is considerably reduced.

The new WaveOne NiTi single-?le system has been recently introduced by Dentsply Maillefer (Ballaigues, Switzerland). The system is designed to be used with a dedicated reciprocating motion motor. The files are manufactured with M-Wire (Dentsply Tulsa Dental Specialties, Tulsa, OK) NiTi alloy. The WaveOne Primary ?le has the same tip size and taper features as the ProTaper F2 but a variable section and reverse cutting blades. The purpose of this study was to compare the canal curvature modification of the WaveOne Primary ?le with the ProTaper system upto F2 rotary file.

Materials and Methods: Thirty ISO 15, 0.02 taper, Endo Training Blocks (Dentsply Maillefer) were used. Each simulated canal was colored with ink injected with a syringe . Each specimen was mounted on a stable support consisting of a rectangular slot the size of the specimen (30 X 10 mm) and a support for a digital camera (Nikon D70; Nikon, Tokyo, Japan) positioned centrally and at 90 degrees to the specimen. Digital images of all specimens before instrumentation were obtained and saved as JPEG ?les. Specimens were then randomly assigned to 2 different groups (n = 15 each).In group 1, the glide path was created with PathFile 1, 2, and 3 (DentsplyMaillefer) at the full working length (WL) using Glyde (Dentsply Maillefer) as the lubricating agent. Each canal was shaped using ProTaper S1-S2, and then the WL was checked and shaping was accomplished with F1-F2 at the WL with the X-Smart Plus motor (Dentsply Maillefer) set to 300 rpm and a 5-Ncm torque with a 16:1 contraangle. Canal patency was checked with a #10 K-?le (DentsplyMaillefer) before the glide path , after the glidepath, before using ProTaper S1, and after ProTaper S2 before using the F1-F2 Fnishing files.

In group 2,the glidepath was created with PathFile 1, 2, and 3 at the full WL by using Glyde as the lubricating agent. Canals were shaped with WaveOne Primary reciprocating ?les using a pecking motion **(Fig. 2)**. The WL was checked when the instrument had reached the limit between the middle and apical third, and then shaping was accomplished at that the definitive WL.

The dedicated reciprocating motor X-Smart Plus (Dentsply Maillefer) of the WaveOne file was used with the manufacturer configuration setup. Canal patency was checked with a #10 K file (Dentsply Maillefer) before the glidepath, after the glidepath, and before using WaveOne Primary, and when WaveOne Primary had reached the limit between the middle and the apical third before completing shaping at the full WL.

New instruments were used in each specimen. After instrumentation, all specimens in each group were repositioned in the slot and photographed as described previously. By using digital imaging software (Corel draw Graphic Suite X5 (Corel Corporation, Ottawa, Canada), Adobe Photoshop CS3 (Adobe Systems Inc, San Jose, CA) & Solid works student Edition software (Dassault Systems Solid Works Corp, S.A., Velizy, France) the pre & postinstrumentation images were processed and superimposed.

The processing of the images was done in the following steps:

**Step 1-** Alignment & auto colour: Alignment of the axis of blocks done with reference to the scales in the toolbox of CorelDRAW Graphic Suite X5 (Corel Corporation, Ottawa, Canada). Then, auto color is an image correction tool which provides better visibility and maintains the color gamut difference per pixel.

**Step 2-** Inversion of Protaper: One image is set to inversion mode to differentiate the properties of both images from each other while overlapping using Adobe Photoshop CS3 (Adobe Systems Inc, San Jose, CA).

**Step 3-** Superimposition **(Fig 3)**: Superimposition is the placement of an image on top of an already- existing image (inversion mode) to add to the overall image effect. Thus the differences were calculated based on optimization.

**Step 4-** Degree of Angle of Curvature-Protaper: Two reference points were assumed to precisely calculate the angle of curvature. Two intersection points were defined for the protaper and the angles for the same were calucated via Solid Works student Edition software

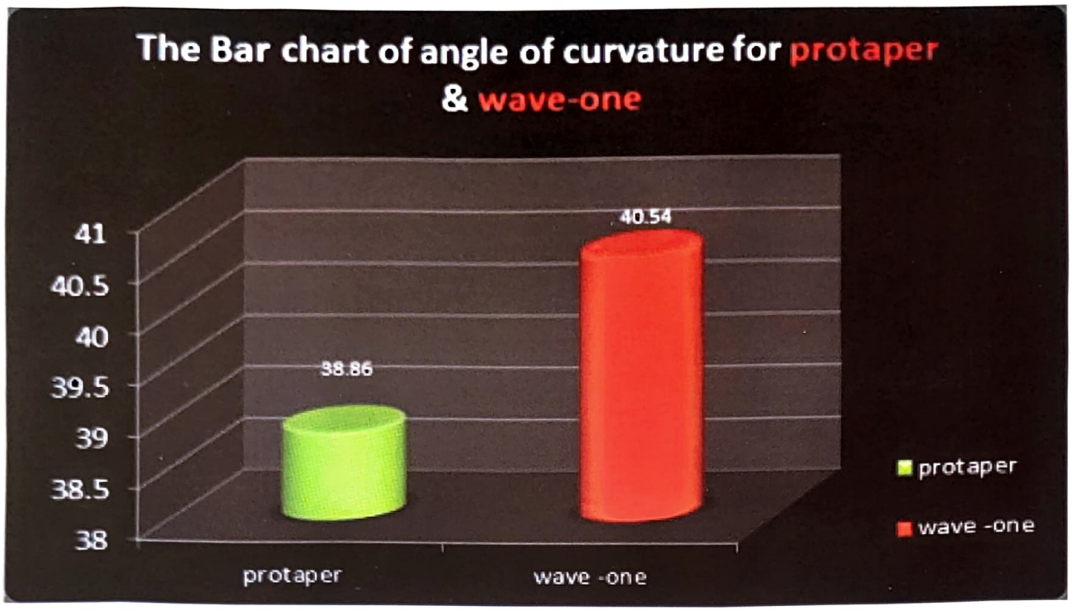


**FIG 4: BAR CHART OF ANGLE OF CURVATURE FOR PROTAPER AND WAVEONE**

(Dassault Systems Solid Works Corp, S.A., Velizy, France). The Angular calculation was based on the principle of geometry. Also, the angles were confirmed using the trigonometric formulas for each block.

**Step 5**-Degree of Angle of Curvature-WaveOne: this is calculated in a similar manner as step 4.

**Results:** Mean & Standard Deviation for angle of curvature were more for wave-one as compared to rotary ProTaper. Mean value for WaveOne was 40.54 as compared to 38.87 for rotary protaper and standard deviation for waveone was 2.67 and for rotary protaper 2.30 respectively **(Fig 4)**.

One way ANOVA shows significant difference between protaper & wave-one at 5% level of significance ($p = 0.457$).

A positive correlation (0.9856) was observed between Protaper & Wave-one ($p<0.05$) using t-test.

**Discussion:** The purpose of this study was to compare the ability of 2 NiTi instruments, the WaveOne Primary and the ProTaper system used upto F2 rotary ?le, in canal curvature modification after instrumention . In the present study, simulated canals were chosen to standardize the conditions. In this study, geometric variations of canal curvature in the middle plane of standardized resin blocks were analyzed through a 2-dimensional (2D) photographic method. Several studies showed that the use of NiTi rotary instruments enabled more predictable and eficient canal preparation with less procedural errors, particularly in narrow and severe curved canals, compared with hand instrumentation. The advantages of the reciprocating motion are based on the physics law of action and reaction applied to root canal instrumentation, which results in a balanced force,as theorized by Roane et al. This concept, despite incomplete elucidation, has shown its clinical relevance in severely curved canals.The reciprocating movement minimizes torsional and ?exural stresses, increases the canal centering ability, and reduces the taper lock within the number of instrument cycles within the root canal. The use of the reciprocating motion instead of the continuous rotation method could be advantageous in terms of stresses and the time required for the preparation of curved root canals with a single use of an NiTi ?le. In our study, the single-?le technique used with the reciprocating motion enhanced the canal centering ability, leading to less invasive root canal preparation. This outcome may be particularly significant where dentine thickness is lower.

In conclusion, within the limits of this study, the new WaveOne NiTi Primary reciprocating single-file better maintained the original canal anatomy, with less modi?cation of the canal curvature compared with the ProTaper system up to F2. Further investigations are needed to understand whether the better performance of the instrument may be attributed to the reciprocating motion, the variable section design, the Wire alloy or the reverse cutting blades, or a combination of these variables.

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