

Influence of Operator's Experience on Root Canal Shaping Ability with a Rotary Nickel-Titanium Single-File Reciprocating Motion System

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Abstract

Introduction: The aim of this study was to evaluate the influence of the operator's experience on the shaping of double-curvature simulated root canals with a nickel-titanium single-file reciprocating motion system.

Methods: Sixty double-curvature root canals simulated in methacrylate blocks were prepared by 10 students without any experience in endodontics and by 10 professionals who had studied endodontics at the postgraduate level. The Reciproc-VDW system's R25 file was used in the root canal preparation. The blocks were photographed before and after the instrumentation, and the time of instrumentation was also evaluated. Changes in root canal dimensions were analyzed in 6 positions. **Results:** Significant differences ($P < .05$) were found in the apical transport of the first root canal curvature, with a larger percentage of increase of the root canal occurring in the novice group than in the expert one, as well as in the canal deviation at the beginning of the curvatures, whereas no significant results were obtained in the growth rate of the canal area. There was difference in the time of instrumentation, with 3.76 minutes observed in the novice group, as opposed to 2.05 minutes in the expert group. **Conclusions:** The use of the single-file reciprocating motion system Reciproc is not seen to be influenced by the operator's experience regarding the increase of the canal area. Previous training and the need to acquire experience are important in the use of this system, in spite of its apparent simplicity. (*J Endod* 2014;40:547–550)

Key Words

Dental education, endodontics, reciprocating motion, root canal shaping, simulated root canals

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The preparation of root canals is one of the most important stages in endodontic treatment and is directly related to the simultaneous and ensuing disinfection (1). Its aim is to eliminate pulp tissue, bacteria, and other derived products and also provide a suitable shape for the root canal's filling (2), while respecting the original anatomy (3, 4).

Traditionally, root canal shaping has been done by using stainless steel hand files (5). However, during the 1980s nickel-titanium (NiTi) files were introduced. They have 2 or 3 times more flexibility, thereby facilitating curved root canal instrumentation and providing a larger resistance to twisting-induced fractures than steel files do (6). On the arrival of NiTi alloys, the use of rotating instruments was developed. The Giromatic handpiece (MicroMega, Besancon, France), the precursor to the current rotating instrument, made a reciprocating quarter-turn motion (7). New instruments have recently been introduced that use a reciprocating motion instead of spinning around in a continuous motion (5, 8–10), but in this case, these new instruments show an asymmetric reciprocating movement (10).

With the intention to simplify endodontic techniques, reciprocating single-file NiTi systems have recently appeared to reduce twisting-induced fractures (5, 11), which are the main problem encountered by novice operators when using NiTi files (12).

Few articles have evaluated the influence of operator's experience on the preparation of root canals. Some studies found a larger number of fractures in the learning stage than in the practical period (13) and demonstrated that more deformities and fractures occur when rotary NiTi instruments were used by novice operators (14–16).

Despite this fact, there are studies that demonstrate that one of the advantages of rotary systems is that they can be used by either expert or novice operators (17), because many authors affirm that operators with little experience obtain better results when using rotary NiTi instruments as opposed to the manual type (12, 18–21), although experience and practice are indispensable for proper use and improve results (14, 22).

This study's aim was to evaluate the influence of the operator's experience on the shaping of double-curvature simulated root canals with a NiTi single-file reciprocating motion system. Canal enlargement, canal transportation, and the time required to complete the preparation were evaluated.

Materials and Methods

Sixty double-curvature simulated root canals in methacrylate blocks (Dentsply Maillefer, Ballaigues, Switzerland) were prepared by 10 dental students with no experience in root canal treatments and by 10 dentists with postgraduate training in endodontics in the same university. The Reciproc system (VDW, Munich, Germany) was used. Only theoretical information about this canal preparation system was given to undergraduate students, whereas postgraduate students were already familiar and had practical experience with it. Acrylic blocks were used with simulated root canals with the following characteristics: canal length, 16 mm; first curvature, 5-mm radius and 28° angle; second curvature, 4-mm radius and 29° angle (23).

Canal Instrumentation

Initially, canals were irrigated with water (2 mL), and patency was made with a #10 K-file. They were then instrumented with the Reciproc system's R25 file (VDW), a NiTi

single-file reciprocating motion system. The established working length was 16 mm. The endodontic motor VDW Silver (VDW) was used with 10 reciprocating cycles per second, which is equivalent to approximately 300 rpm. A new file was used in each canal.

Reciprocating files were used in a crown-down manner by making 3 advancing movements, after which the canals were irrigated with water (2 mL each time), and canal patency was confirmed with a #10 K-file. This procedure was repeated until the operator reached the working length with the file used.

Data Collection

Blocks were photographed before and after the instrumentation with a Nikon D3000 camera (Nikon, Amsterdam, the Netherlands) in a fixed position. The pictures obtained were treated with the Adobe Photoshop CS5 program (Adobe Systems Incorporated, San Jose, CA) by using the “find edges” filter. The pictures were superimposed later.

Concerning the profile of the canal, 6 sections were traced perpendicular to its shaft. The first was at the beginning of the canal, the second was at the middle of the beginning of the canal (before the first curvature), the third was in the first curvature, the fourth was between the first and second curvatures, the fifth was in the second curvature, and the sixth was at the end of the canal (Fig. 1A). Size differences between the original canal and the canal after instrumentation were measured in each segment with the Image J software (National Institutes of Health, Bethesda, MD), and likewise the distance from the instrumented canal outline (on both sides) to the original canal outline (Fig. 1A, magnified area). Differences between the areas of the original canal and the instrumented canal were also measured.

Operators were timed beginning at canal irrigation and ending when they reached the working length with the reciprocating file.

Statistical Analysis

After checking that data were normally distributed, the analysis of variance test was applied to compare the mean values obtained by the 2 groups of operators (novice and expert). Differences were considered statistically significant if $P < .05$.

Results

Twenty-four methacrylate blocks were analyzed in the novice group and 27 in the expert group because those canals where any instrument was separated were not evaluated (6 instruments were separated in the canal in the novice group and 3 in the expert group).

Increase of the Canal Area after Instrumentation

No significant differences ($P = .32$) were obtained relative to the increase of the canal area between expert and novice operators, $118.62 \pm 29.17 \text{ mm}^2$ in the novice group and $111.48 \pm 22.27 \text{ mm}^2$ in the expert group (Fig. 1B and C, respectively).

Canal Enlargement

Significant differences ($P = .006$) were obtained in the third segment of the canal transport in the first curvature, where the average increase was 177.17% in the novice group and 135.52% in the expert group. No significant differences were found in any other segment (Table 1).

Canal Transport

Significant differences were obtained between expert and novice operators relative to canal deviation in segments 2 and 4 ($P = .046$ and $P = .006$, respectively), which are the segments before the first and second curvatures. When the third and the fifth segments, which are the first and second curvatures, were analyzed, a greater wear on the internal face was seen (Fig. 1B and C).

Time of Instrumentation

Expert operators took significantly less time ($P = .00$) to instrument canals, with a mean of 1.62 ± 0.55 minutes as opposed to 3.80 ± 1.68 minutes for the novice group.

Discussion

This study's aim was to evaluate operator's experience on canal preparation in simulated root canals by using a single-file NiTi reciprocating motion system.

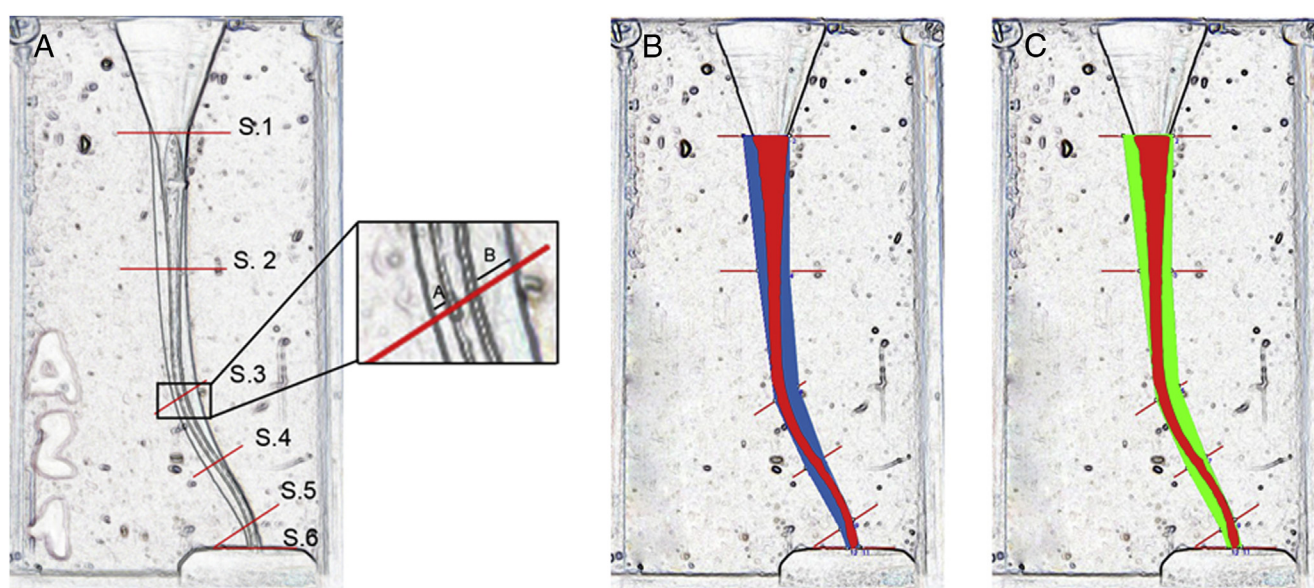


Figure 1. Combination of preoperative and postoperative images with the studied sections. (A) The third area has been magnified, showing the measured deviations (A and B); (B and C) simulated canals from the average results (red, preoperative situation; green, after expert shaping; blue, after novice shaping).

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