

## Impact of Experience on handling of rotary instruments: a comparison between undergraduate students and specialists

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### Abstract

**Aim:** To assess the cyclic fatigue fracture resistance of engine-driven Revo-S instruments used by dental students, residents and endodontists.

**Methodology:** A total of 90 Revo-S instruments size 25, 0.08 taper used by students (n=30), residents (n=30) and endodontists (n=30) were tested. Each group was divided into 3 subgroups (n=10) to be tested in simulated canals with 60°, 45° and 90° angles of curvature and a 3 mm radius at a continuous speed of 350 rpm and 0.8 nm torque until they were fractured. The time of fracture for each instrument was recorded. The data was associated using one-way analysis of variance followed by Tukey's Honestly Significant Difference test.

**Results:** The instruments used by undergraduate students resulted in a significantly longer cyclic fatigue life ( $P < 0.0001$ ) when compared with the ones used by residents or endodontists. No difference of cyclic fatigue was found between residents and endodontists

**Conclusions:** Many usage of number 25, 0.08 taper Revo-S files should be avoided in graduate or specialist clinics rather than undergraduate clinic.

**Keywords:** Undergraduate, Dental student, Cyclic fatigue, Revo-S, Experience, Fracture.

### Introduction

Ni-Ti files were manufactured in the late 1988's<sup>1</sup> and offer greater legibility and provide advantages such as improvement of the shaping effectiveness and reduction of transportation<sup>2</sup> compared to stainless steel instruments. However, the torsional load during shaping causes cyclic fatigue which may result in instrument fracture.<sup>3</sup> This is a distressful occurrence as it may compromise the success of the root canal treatment.

The curvatures with short radii have been a focus for Ni-Ti instrument manufacturing and designing<sup>4</sup> as instrument separation seems to be more common for such roots.<sup>3</sup>

The Revo-S files produced by Micromega<sup>5</sup> is an engine driven Ni-Ti file works in a 360° continuous rotation. These files are characterized by an asymmetrical crosssection with three sharp cutting edges<sup>6</sup> resembling the cross sectional design of One-Shape instruments<sup>5</sup> and keeps changing throughout the cutting part from the tip to shaft region. This design results in a so-called 'snake like' movement and claimed to facilitate negotiation of curvatures as well as progression towards the apical third.<sup>7</sup> On the other hand, the design is claimed to decrease the screwing effect and the stress on the instrument.

The utilization of a specific rotary instrument may display differences with respect to the previous experience of the practitioner. Experience was shown to have no effect in terms of root canal dimensions when the files were used in reciprocating motion<sup>8</sup>

However, cyclic fatigue resistance of 360° rotary instruments used by practitioners with varying degrees of experience is not a topic that has been evaluated previously

despite of the fact that they are more widely used over the world. The purpose of this study was to evaluate the cyclic fatigue fracture resistance of engine-driven Revo-S instruments used by dental students, residents and endodontists.

### Materials and Methods

Ninety number 25, 0.08 taper Revo-S files used by students (n=30), residents (n=30) and endodontists (n=30) were tested. A rectangular block produced from stainless steel series stainless steel at <32 RC (CNC machined and containing 3 curvatures of 60, 45 and 90 degrees was used. Each group was divided into 3 subgroups (n=10) to be tested in simulated canals with the indicated angles of curvature. The files were then exposed to cyclic fatigue test using a stainless steel device produced for and already used in previous studies.<sup>9,10</sup> The specialized tool enabled the files to rotate freely within a stainless steel artificial canal with 3 mm radius at a constant speed (350 rpm) and torque (0.8 nm). The plastic top face cover over the apparatus allowed the visibility of the files rotating inside the canal and the removal of broken files during instrumentation. To reduce friction as the metal instrument contacted the metal canal walls, synthetic oil (Wd no:40; USA) was used. The instruments were rotated with MM control unit (Micromega, France) which has a particular activity to control the angles of rotation in clockwise movement.

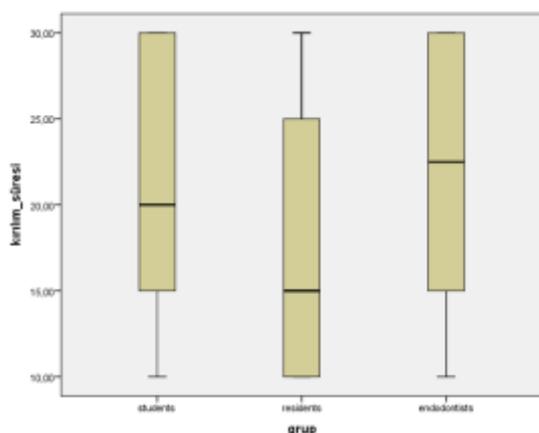
The time of fracture for each file was calculated. The data was compared using one-way analysis of variance followed by Tukey's Honestly Significant Different test.

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## Results



**Fig.1:** The graph showing the fracture time between the groups.

The comparison of the time for fracture between groups is presented in Figure 1. The instruments used by undergraduate students resulted in a significantly longer cyclic fatigue life ( $P < 0.0001$ ) when compared the ones used by residents or endodontists. No difference of cyclic fatigue was found between residents and endodontists ( $p > 0.05$ ).

## Discussion

The aim of this study was to assess and compare the usage of Revo-S Ni-Ti files in different experience levels. The developing new phase of alloys Ni-Ti and producing processes has led to a new era of Ni-Ti instruments. More flexible<sup>11</sup> and more resistance to cyclic fatigue cause files to be more durable.

File fracture is a complication that can occur during canal instrumentation resulting from a variety of factors. Among these, cyclic fatigue<sup>12</sup> of the instrument plays a significant role. In fact, the force applied by the operator can vary between individuals. However; it can be speculated that as a practitioner acquires more experience, less caution might be exercised during the utilization of rotary files relying on previously gained manual skills. Consequently, as observed from the results of the present study, specialists may have a tendency to force the instruments to their limits whereas the novice undergraduate students are more cautious to avoid any accidental errors such as instrument fracture.

That scientific research compared cyclic fatigue resistance of Revo-S instruments used in continuous rotation on a static metal block. The majority of previous studies have used cylindrical metal tubes of at least 1 mm in diameter with differing radii and angles of curvature,<sup>3,13,15</sup> while others have used a sloped metal block to pretend different angles.

A previously described metal apparatus with simulated root canals was preferred in the present study a better standardization in terms of canal curvature and improved

reproducibility

Rotary instruments are widely used in the field of endodontics and offer the practitioner multiple advantages, such as reduction of time spent for shaping, the generation of a homogeneous final root canal shape and a tapered preparation respecting the original canal anatomy. On the other hand, acquisition of knowledge and skills on the usage of these systems is a time-dependent process. Many repetitions in simulated canals or blocks are necessary until the practitioner is deemed to be competent in utilizing rotary instruments during clinical practice. Educators thus bear an important responsibility in the instillation of adequate knowledge and skills regarding this feasible and practical technology. It is in fact a favorable finding that undergraduate students exercise caution during the usage of rotary systems which might be an indication of their sense of responsibility. On the other hand, considering that completion of endodontic treatment within a shorter period compared to hand instruments is the major goal of engine-driven rotary instruments, students must have the competency to instill this advantage in their routine endodontic practice.

Extreme hesitation and over-caution may result in delayed or incomplete root canal preparations.

Instrument fracture is a complication during endodontic treatment that can be very troublesome both for the practitioner and the patient during endodontic treatment. Despite many attempts to produce resistant systems by manufacturers, fractures are still likely even in the most experienced hands. However; the practitioner should acquire a thorough knowledge on the instrumentation systems he/she intends to use as well as be able to have full command during patient care. The balance between feasible usage and caution should be maintained so that the best outcome is achieved in terms of root canal shaping, one of the fundamental steps of endodontic treatment.

On the other hand emphasis should be placed on the successful instillation of tactile skills during preclinical period so that rotating instruments can be used with their full capacity without causing any other complications i.e. ledge formation.

## Conclusion

The dental students caused less rotary instrument fracture than residents and endodontists. This result favors utilization of rotary instrumentation by undergraduates.

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## Conflict of Interest

None.

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