Comparison of the preparation time and deviation caused by Twisted File and Endowave systems in simulated root canals

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ABSTRACT

Introduction: The objective of this work was to compare the time required for preparation of simulated root canals, as well as the deviation in degrees caused by the Twisted File and Endowave rotary systems. **Methods:** This study was conducted on thirty acrylic blocks with simulated root canals with 30° curvature, which were divided into two groups: Group I – Twisted File system; Group 2 – EndoWave system. The preparation was conducted using the X-Smart motor with 1.4 N/cm of torque at a speed of 250 rpm. The blocks with the instruments were radiographed before and after preparation. The radiographs were then digitized for analysis of the angle formed before and after preparation, using the Image Tools software. The preparation time, number of deformed and fractured instruments and deviation were analyzed. **Results:** The results showed that preparation using the Endowave system was significantly faster ($p > 0.05$) and exhibited less fractures when compared to the Twisted File system. As to the apical deviation, both presented significant deviations ($p < 0.05$), especially on the inner wall, without significant difference ($p > 0.05$) between groups. **Conclusions:** It was concluded that preparation of simulated root canals using the Endowave system was faster than the Twisted File, with a lower fracture rate.

Keywords: Endowave system. Twisted File system. Rotary system. Apical deviation. Deformation of instruments.

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Introduction

The concept of cleaning and shaping of root canal is one of the fundamental principles for the success of endodontic treatment.[1] Currently, in addition to manual instruments there are numerous rotary instruments made of nickel-titanium, since its introduction in Endodontics in 1988.[2]

The superelasticity and the cyclic fatigue resistance are two interesting properties of these instruments, which allow them to be successfully used in curved root canals.[3] Studies have shown that the rotary instruments are able to prepare these types of root canal reducing the occurrence of errors, i.e., maintaining the original root canal shape with minimal apical transportation.[4,5,6]

However, besides the existence of a complex anatomy of the root canal, other factors may contribute to accidents and deformities, such as fractures and deviations in the apical region, as the design and cross section of the rotary instrument.[7,8,9]

In this respect, modifications were proposed to improve the performance of rotary instruments and currently can be found two new instruments with different characteristics. Twisted File is an instrument that has its nickel-titanium alloy twisted by thermal treatment, where the twist is obtained with the alloy being in a crystalline structural phase called Rhombohedral (R), which is the intermediate phase between the martensite-austenite phases.[10] This system consists of five instruments, all with the tip size #25, the following tapers: 0.10, 0.08, 0.06, 0.04 and 0.02. Some researchers have compared the cyclic fatigue resistance of this instrument with other rotary systems and found that it showed superior results compared to EndoSequence, similar to Profile and lower than to the Profile GT X series.[11]

The Endowave is another new system on the market, which is commercialized in the United States under the name EndoSequence, and is characterized by presenting in its active part alternate contact points that reduce the torque of the instrument while maintaining centered in the root canal. Another important feature of this instrument is the electro-chemical treatment (electropolishing) received before the finishing, which produces greater smooth surfaces and hardness, favoring greater resistance to deformation and fracture. Some researchers analyzed the fracture resistance of two electropolished instruments (RaCe and Endowave) and a non-electropolished (Profile) and found better results with the electropolished, concluding that this treatment on the surface of the instrument can benefit from better resistance to fracture.[12]

However, the literature is scarce in comparison of these new instruments for safety in the preparation of curved canals.

The aim of this study was to analyze and to compare the Endowave system and the Twisted File on the preparation time, deviation and fracture incidence in the preparation in simulated curved canals.

Material and Methods

This study was conducted with thirty acrylic blocks (Dentsply Maillefer, Ballaigues, Switzerland) with simulated root canals with 30º curvature with length of 17 mm. On the outside of the block two points of the amalgam were made with a ¼ carbide drill (KG Sorensen, São Paulo, Brazil), to provide guidance on the measurement of apical deviation. The blocks were divided into two groups. Group 1 (15 blocks) used Twisted File system (Sybronendo, Orange, CA, USA) according to the following steps:

» 25/0.08 – cervical third (10 mm)
» 25/0.06 – middle third (14 mm)
» 25/0.04 – apical third – (working length 17 mm)

In group 2 (15 blocks) was used Endowave (J Morita Corporation, Osaka, Japan) according to the following sequence:

» 25/0.08 – cervical third (10 mm)
» 25/0.06 – middle third (14 mm)
» 25/0.04 – apical third – (working length 17 mm)

The preparation was conducted using the X-Smart motor (Dentsply Maillefer, Ballaigues, Switzerland), with active auto-reverse drive, with 1.4 N/cm of torque at a speed of 250 rpm. The preparation time required for each block was recorded.

For the analysis of the apical deviation an initial radiographic was made with a #15 K-file inserted into of the simulated root canal of the resin block (Fig 1A). Subsequently, the blocks were instrumented and a new radiograph was performed with a #25 K-file within of the canal (Fig 1B). The radiographs were digitized and apical deviation was measured in Digora for Windows software.

The angulation was determined before and after by the angle formed by the straight line passing over the two points and the straight line of the instrument guide of the most apical point.

The results were analyzed using the Wilcoxon test for comparison of the angulation before and after each group. The Mann-Whitney test was used to analyze the difference in the angle between the two groups and the preparation time. For the number of deformed and fractured instruments was made Fisher's exact test. For all tests, was used the significance level of 5%.

Results

Figure 1 shows the graphical representation of the mean angulation before and after of the groups 1 (Twisted File) and 2 (Endowave). There was significant difference ($p < 0.05$) between the angle before and after for both groups. However, the mean differences between angles before and after of the preparation (in which the deviation occurred towards the inner wall) showed that there was not statistically significant difference ($p > 0.05$) when comparing the two groups.

Figure 2 shows in seconds the mean of time required for preparation by the groups, presenting significant difference ($p < 0.05$).

Table 1 shows the number of fractured and not fractured instruments in both techniques. There was no significant difference.

Table 1. Number of fractured instruments during instrumentation with the systems.

	Non-fractured	Fractured	Total
Twisted File	5	2	7
Endowave	5	1	6

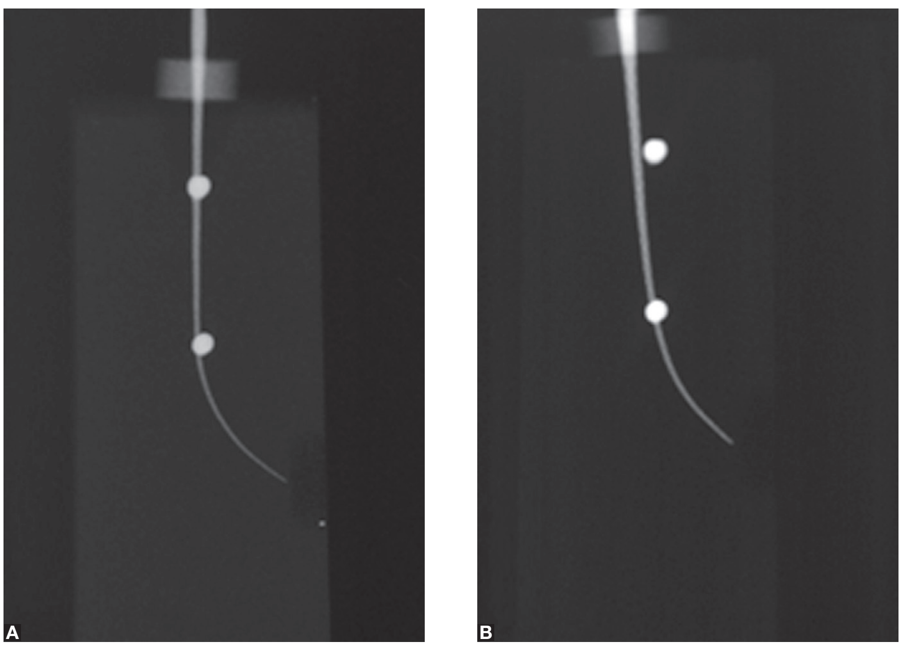
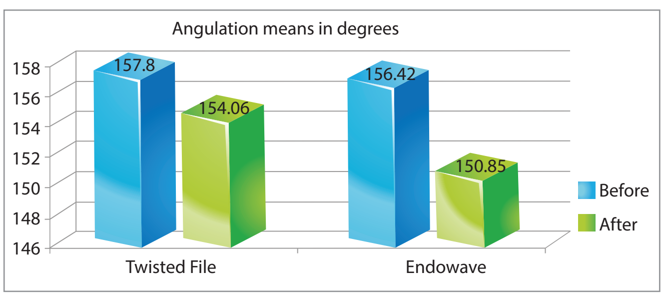
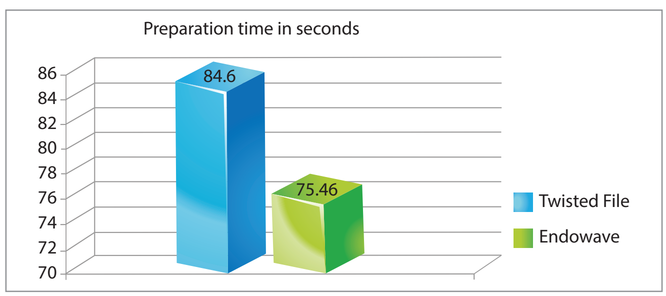


Figure 1. Radiographic images before (**A**) and after (**B**) a instrumentation.



Graph 1. Mean of the angulation before and after in the instrumentation of the groups.



Graph 2. Mean of the preparation time in seconds in both groups.

Discussion

In the employment of a rotary system to be a mechanical method, there are some factors involved such as torque and speed.[13] In this study, both systems employed 1.4 N/cm of torque and a speed of 250 rpm because the speed and angle at which the instruments were used (30°) represent a lower chance of fractures than in greater speeds and angles.[14]

Therefore, in relation to deformation and fracture there was no significant difference between the two systems, although the deformation has occurred faster in the Twisted File instruments. The deformation probably may be related to the characteristic of the manufacturing, while in the Endowave employ the machining and the metal is austenite phase, the Twisted File instruments are manufactured by twist and the metal is in an intermediate phase, i.e. between austenite and martensite phases called Rhombohedral phase. However, in a study the Twisted File instruments presented striations/grooves and cutting blades by twist, unlike other rotary instruments that use machining process, a procedure that creates microfractures in its active part may lead to fracture.[15]

Another factor to be considered in this result is that in the case of Endowave it is performed electropolishing, a factor that has given greater torsional fatigue resistance and cyclic.[12]

In relation to the preparation time, Endowave system was spent significantly less time to prepare than the Twisted File. In spite of both have triangular cross-section and filleted blade, the differences may be related to surface hardness of the steel, which in the case of Endowave can favored a greater cutting ability.[16]

For the apical deviation the angle in both instruments after preparation was significantly lower than that before preparation demonstrating that these instruments worked more effectively against the inner wall of the canal. In comparing the systems, although the deviation to the inner wall was higher in the Twisted File, there was no significant difference between the two systems. One factor observed was that although both systems have the canal instrumented until the instrument 25/04, at the moment of insertion of gutta-percha point 25/02 none penetrated the instrumented extension, showing that such dilatation is not effective.

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