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# SLOW DOWN EFFECT OF DEBRIS EXTRUSION ON SINGLE-ROOTED TEETH

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## ABSTRACT

Introduction

During the instrumentation phase, despite having a strict control of the working length, one of the main problems that can arise is the extrusion of residues and intracanal irrigants towards the periradicular tissues.

Objective

The aim of this study is to compare the amount of extruded dentin debris during instrumentation using a new endodontic motor in two different functions.

Methods

24 extracted premolars were divided into two groups. The cameral access was performed using a # 4 carbide ball bur, all samples were decoronated to standardize the working length at 17 mm. The samples were instrumented with .06 taper Nickel-Titanium Vortex Blue rotary files (Dentsply Maillefer, Ballaigues, Switzerland) with an E-Connect S. endodontic motor in two of its functions: Slow down and rotary. For the collection of extruded debris, Eppendorf tubes were used, which were weighed individually. After instrumentation, the samples were stored in an incubator at 70 ° C for 5 days to evaporate the distilled water, product of the irrigation, and later the tubes were weighed again by the same scale to obtain the final weight of the tubes with the extruded debris.

Results

  

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When comparing the weight in grams of the amount of debris extruded during instrumentation with two different functions of the E connect S endodontic motor, using Ni Ti rotary files, Vortex Blue, it was observed that the slow down function produces a lower amount of debris, however there were no statistically significant differences between both groups.

Conclusion

Both functions of the E connect S endodontic motor produce dentin debris, however, it was observed that in the slow down function, the amount of apical debris extrusion is slightly lower.

**Keywords:** Dentin debris, Apical debris extrusion, Eppendorf, Slow down

## 1. INTRODUCTION

Correct endodontic treatment is based on a triad of interrelated factors that include biomechanical preparation, disinfection, and root canal filling. During the instrumentation phase, despite having a strict control of the working length, one of the main problems that can arise is the extrusion of residues and intracanal irrigants towards the periradicular tissues, this can cause complications such as postoperative pain, inflammation, or infection, which could slow the healing process. To facilitate root canal preparation, various mechanical devices and techniques have been introduced to further improve the effectiveness of instrumentation (1). Devices can be classified as manual or apparatus-assisted for root canal instrumentation.

Device-assisted instrumentation has the advantage of making root canal treatment easier and faster (2). Instruments subjected to reciprocating motion have been shown to have greater resistance to fatigue and longer life when combined with instruments used in continuous rotational motion. the Vortex Blue rotary system (Dentsply Tulsa Dental, USA) features M-Wire NiTi, a proprietary processing of NiTi wire, which the manufacturer claims offers optimal performance in terms of efficiency, flexibility and resistance to cyclic fatigue, produces a distinctive "blue colored" titanium oxide surface layer. These instruments, produced by complex heating and cooling procedures, show greater resistance to fatigue and greater flexibility with controlled shape memory (3). The apical limit for the biomechanical preparation and obturation of the root canals is extremely important to obtain success in the treatment (4).

Electronic devices for measuring the length of the root canal, known as “electronic apex locators”, have proven to be auxiliary instruments in the treatment to identify both the apical constriction and the apical foramen (5,6).

Endodontic motors with apical locators included, have been created with the purpose of achieving faster and easier root canal treatment.

  

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In addition to controlling torque and speed, these hybrid motors can care for and maintain the apical limit during the mechanical preparation of the root canals[(7)].

They provide control of the position of the instruments inside the root canals up to the interference of movement, torque, speed, and automatic auto reverse parameters. Therefore, the clinician will direct the device to maintain and respect the apical limit during instrumentation, applying all these functions.

However, it should be noted that the high precision values attributed to these electronic locators are partly due to tolerance margins and do not represent exact measurements[(8-10)].

There are certain factors that contribute to the amount of debris extrusion during root canal cleaning and shaping, such as instrument type and design, technique used, number of instruments, apical size, and degree of rotation of the instruments. instruments [(11)].

All endodontic instrumentation systems tested so far cause apical extrusion of debris. Some systems extrude less and others more [(12)].

The accumulation of hard tissue debris during the cleaning and shaping process is a well-accepted phenomenon[(13)].

This three-dimensional smear layer may represent 6% of the total volume of the mesial root of a mandibular molar after instrumentation and only 50% of these particles are removed by strong chelating agents such as EDTA used with NaOCl or techniques. conventional positive apical pressure [(14,15)].

## 2. MATERIALS AND METHODS

Twenty-four lower premolars extracted for periodontal or orthodontic reasons were used, a periapical radiograph was taken to verify that they were single canals. Chamber access was made using a #4 carbide ball bur and decoronated to standardize the working length at 17mm. using a flat end diamond pan bur. Canal patency was checked with a #15 K-file (Dentsply Maillefer, Ballaigues, Switzerland). The working length was established by running a #15 K-file down the root canal until it became visible through the apical foramen and subtracting 1 mm. of the initial length.

They were instrumented with .06 taper Nickel-Titanium Vortex Blue rotary files (Dentsply Maillefer, Ballaigues, Switzerland) using an E-Connect S endodontic motor and were divided into two groups of 12 teeth each (n=12).

  

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Group I: 12 canals instrumented with Vortex Blue up to a caliber 40/.06 at the apical with the help of the E-connect S endodontic motor in its slow down function.

Group II: 12 canals instrumented with Vortex Blue up to a caliber 40/.06 at the apical with the help of the E-connect S endodontic motor in its oscillatory function.

Each canal was irrigated with 6 ml. of distilled water using 1 ml. for each file.

Debris collection

The model described by Myers and Montgomery (16) was used, the Eppendorf tubes were weighed on an electronic scale. Three consecutive measurements were taken for each tube and the mean measurement for each tube was its weight.

An opening was made in the lid of the container with a hot instrument and the Eppendorf tube was pressed in. The space between the tube and the opening was sealed with modeling wax using a heated instrument. This last step was repeated by inserting the tooth into the Eppendorf tube and sealing around it with modeling wax to prevent leakage of the irrigating solution through the space between the tube and the tooth.

A hypodermic needle was placed along the eppendorf tube to balance external and internal air pressure. Aluminum was used to cover the plastic container, avoiding operator bias during the instrumentation procedure.

Once the instrumentation was finished, the lid of the tube was removed together with the tooth and the needle, the debris adhering to the external surface of the tooth root was collected by washing the apical third of the root with 1 ml. of distilled water in the tube. The samples were stored in an incubator at 70°C for 5 days to evaporate the distilled water and then the tubes were weighed again on the same scale to obtain the final weight of the tubes with the extruded debris.

The amount of apically extruded debris was calculated by subtracting the initial weight of the tube from the final weight.

## 3. RESULTS

It began with statistics of centrality and variation with respect to the dependent variable for each of the groups and study times. Subsequently, when checking the assumptions of homogeneity of variances and normality (levene test and Kolmogorov-Smirnov test). It was decided to use Student's t tests for independent and paired samples.

  

All tests were carried out with a significance level of 0.05 in the statistical package IBM SPSS Statistics 23.

Tables 1 and 2 show the punctual values obtained for each group with respect to the weight of grams of debris.

**Table 1: Oscillatory group. Relationship between the initial and final weight of the samples.**

| GROUP 1 | OSCILLATORY | Column1 |
|---|---|---|
| # Sample | Initial weight | Final weight |
| 14 | 0.624 | 0.625 |
| 16 | 0.63 | 0.633 |
| 10 | 0.618 | 0.621 |
| 18 | 0.617 | 0.623 |
| 31 | 0.618 | 0.623 |
| 24 | 0.617 | 0.621 |
| 33 | 0.627 | 0.632 |
| 11 | 0.632 | 0.633 |
| 6 | 0.615 | 0.618 |
| 3 | 0.62 | 0.625 |
| 7 | 0.617 | 0.623 |
| 20 | 0.613 | 0.619 |

**Table 2: Slow down group. Relationship between the initial and final weight of the samples.**

| GROUP 2 | SLOW DOWN | Column1 |
|---|---|---|
| # Sample | Initial weight | Final weight |
| 2 | 0.616 | 0.617 |
| 28 | 0.637 | 0.641 |
| 27 | 0.619 | 0.622 |
| 30 | 0.637 | 0.641 |
| 34 | 0.616 | 0.619 |
| 13 | 0.629 | 0.633 |
| 1 | 0.637 | 0.641 |
| 4 | 0.626 | 0.631 |
| 8 | 0.608 | 0.614 |
| 17 | 0.626 | 0.629 |
| 21 | 0.633 | 0.635 |
| 23 | 0.67 | 0.673 |

  

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The analysis began by obtaining descriptive statistics of centrality and variation with respect to the dependent variable weight in grams of debris for each of the groups and study times. The initial weight of the oscillatory group reported a mean of .621 ± .006 gr and a final weight of .625 ± .005 gr. Likewise, the slow down group presented an average value of .630 ± .016 gr and a final weight of .633 ± .016 gr. (Table 3)

Regarding the paired and independent comparisons, it is observed that for both the oscillatory group and the slow down group, a statistically significant difference was observed between their initial weight and the final weight ($p < 0.001$). As for the independent comparisons between both groups, no significant differences were observed ($p > 0.05$). However, it is important to emphasize that despite the differences in means seen in the independent contrasts applying the Student's t-test, no significant differences were observed as in the paired contrasts due to its mathematical methodology that composes it. (Table 3 and Figure 1)

**Table 3: Descriptive and centrality statistics regarding the weight in grams of debris for each of the groups and study times.**

| | | Peso_Inicial | Peso_Final | *valor p* |
|---|---|---|---|---|
| Oscilatorio | Media | .621 | .625 | <0.001 |
| | D.E. | .006 | .005 | |
| | Mínimo | .613 | .618 | |
| | Máximo | .632 | .633 | |
| Slow Down | Media | .630 | .633 | <0.001 |
| | D.E. | .016 | .016 | |
| | Mínimo | .608 | .614 | |
| | Máximo | .670 | .673 | |
| *valor p* | | .086 | .097 | |

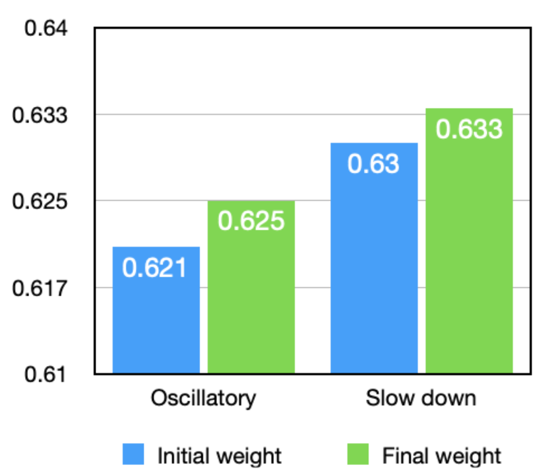


**Figure 1: Comparative graph of the weight of debris between the groups and study times**

  

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## 4. DISCUSSION

Despite having a strict control of the working length, one of the main problems that can arise during the cleaning and shaping procedures of the root canal is the extrusion of intracanal residues and irrigants towards the periradicular tissues [16-17].

Currently, the new motorized devices make the instrumentation a simpler procedure and seek with their new configurations to achieve greater cleaning, always maintaining a stable working length, which makes the treatment more efficient and practical for the operator.

With this research work we seek to test the effectiveness of these new devices and their different configurations, in this case the E-Connect S endodontic motor in its slow down function that aims to reduce the number of extruded debris by reducing revolutions per minute when approaching the previously established working length and try to reduce post-operative complications with this.

However, there are currently no research studies that compare the amount of extrusion of debris towards the apical foramen of this new endodontic motor.

The results of this study showed that regardless of not rejecting the null hypothesis, and not finding statistically significant differences between the slow down and oscillatory groups, a decrease in the extrusion of dentin debris was observed during the instrumentation of the root canals in the samples. of the slow down group, unlike the oscillatory group.

There are certain factors that contribute to the amount of debris extrusion during root canal cleaning and shaping, such as instrument type and design, technique used, number of instruments, apical size, and degree of rotation of the instruments [11].

Several studies have currently evaluated the number of debris extruded during the preparation of root canals [18]. In this study, lower premolars with complete root formation, with a single root canal and with a degree of curvature between 0 and 10º according to the Schneider technique were used. The generally accepted methodology described by Myers and Montgomery [16] was used to collect the apically extruded debris.

To eliminate the erroneous results derived from the crystallization of sodium hypochlorite, distilled water was used as irrigant. In addition, as the size of the final instrument can affect the number of debris extruded apically [19], NiTi Vortex Blue rotary files ending with a 40.04 caliber were used.

  

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The instrumentation technique and the type of instrument used during root canal preparation can affect the number of extruded debris [(20)]. Recent studies have evaluated debris extrusion using Vortex Blue files.

H.S. Topcuoglu et al. [(21)] compared the apical extrusion of debris associated with Vortex blue, K3XF and protaper next, and reported that in all the systems used they generated extrusion of dentin debris, however, VB and PTN resulted in less extrusion of debris compared to the others. systems.

## 5. CONCLUSION

Under the limitations and conditions of the study, the following conclusions are established:

● Both the slow down function and the oscillatory extrusion of debris were observed during the instrumentation of the ducts.

● The slow down function showed a greater reduction of dentin debris during root canal instrumentation.

● The use of the slow down function can be a good option to carry out root canal instrumentation.

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