



COMPARATIVE EVALUATION OF CANAL CENTRING ABILITY AND CANAL TRANSPORTATION DURING BIOMECHANICAL PREPARATION USING TWO NITI ROTARY FILES USING CBCT:- AN INVITRO STUDY

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ABSTRACT

Aim: To evaluate and compare canal centering ability, apical transportation and amount of dentin removed after root canal instrumentation with different rotary file systems using CBCT.

Method: Thirty mesial canals of lower molars were selected and divided into two experimental groups (n=15) according to the system used: Neolix/Neoniti and One Shape. Pre- and post-instrumentation CBCT imaging was performed to measure mesial and distal distance of the dentin walls. The canal centering ability and canal transportation was calculated using the formulae given by Gambill *et al.* The volume of removed dentine was measured in mm³ for each root canal by subtracting the uninstrumented canal volume from the instrumented canal volume.

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INTRODUCTION

Maintenance of original anatomy and curvature of the root canal during cleaning and shaping procedure is important as it leads to favourable outcome of the procedure^{1,2}. Moreover narrow and curved canals may lead to increased risk of various iatrogenic procedure errors². To avoid these errors and also to manage the various irregularities of canal anatomy, several nickel titanium (NiTi) root canal systems have been introduced³. NiTi rotary instrumentation has not only been beneficial in reducing the treatment time, clinician and patient's fatigue, but also during recent years due to number of advancements in manufacturing techniques there is improvement in its microstructure leading to optimised cutting and shaping efficiency⁴. Neolix Neoniti (Neolix, châtres-la-Forêt, France) is a third generation of NiTi files manufactured using newly developed wire-cut electrical discharge machining (WEDM) process, which consists of one C₁ file for coronal enlargement and three A₁ files^{4,5} to be used using crown down technique. According to the manufacturers, the heat treatment using during the manufacturing process enhances its flexibility^{4,5}.

The OneShape system (Micro Méga, Besançon, France) is another single file system used in continuous rotation. Specialised characterization of this file is that it consists of non-cutting safety tip and variable tip and 3 variations of cross sections along the active length of the file^{5,6}.

Use of rotary files in severely curved canals increases the likely hood of canal transportation if the file doesn't conform to the curved profile of the canal, therefore evaluation of canal

centering and transportation ability of the NiTi files used is essential.

Various methods have been used to evaluate the efficiency of root canal instrumentation among which CBCT has an added advantage of reduced cost and scanning time, lower dosage of radiation and faster data acquisition compared to micro-CT^{3,6}. This study therefore focuses on evaluation and comparison of canal centering and transportation ability of two NiTi files viz Oneshape files and Neolix NeoNiTi files using CBCT.

METHODOLOGY

Sample selection

30 human permanent mandibular first molars extracted for periodontal and prosthetic reasons with completely formed apices were collected and stored in 0.1% thymol for 24hrs and then in saline.

The teeth were then mounted on wax blocks and radiographed in buccolingual direction to confirm absence calcification, internal resorption and other abnormalities. The curvature angles of the mesiobuccal roots and the roots with curvature angles of 25-30° (according to Schneider's analysis were selected for the study^{8,9}).

Root canal preparation

Access cavity was prepared using Endo-Access bur (Dentsply). The distal roots with the respective part of the crown were sectioned at the furcation level using a low-speed

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diamond bur under water and discarded Mesial roots were then mounted on wax blocks and pre-instrumentation CBCT was done The Mesio Buccal root canals were negotiated using #10 K-file (Dentsply). The working length was determined by inserting #10 K-file to root canal terminus and subtracting 1 mm from this measurement. A glide path was established to the working length using a #15 K-file (Dentsply).

Depending upon the rotary system used for canal preparation the teeth were randomly divided into two experimental groups (n = 15).

- Group 1 : Neolix Neoniti(300- 500 rpm/ 1.5 N/cm)
- Group 2 :OneShape(300- 500 rpm/ 2.5N/cm)

In Group 1:- After establishment of glide path the canals were instrumented using C₁ file in the coronal third then using A₁ (#25/0.06) file in the middle and apical third with in and out motion

In Group 2 After establishment of glide path One Shape file (#25/0.06) was used for instrumentation with copious irrigation and recapitulation was done using #10k file.

Instrumentation was carried out using 15% EDTA gel. Irrigation was done with 2 mL of 5% sodium hypochlorite during instrumentation followed by 1 mL of 17% EDTA for 3 min and a final irrigation with 2 mL of saline solution.

Each instrument was used to prepare three canals, and then discarded.

Pre and Post instrumentation, CBCT scans were taken to check canal transportation and centring ability at three different levels (3,5,7 mm) and statistically analysed.

Canal centering ratio and canal transportation were analyzed using the technique developed by Gambill *et al*, which measures the distance from the edge of the canal to the periphery of the root (mesial and distal) on pre- and post-instrumentation images of the CBCT^{5,10,11}.

The following formula was implemented for canal centering:

$$X' - X / Y' - Y$$

According to this formula, a result of “1” will indicate a perfect centering ability.

Results higher than “1” will indicate more mesial movement and results lesser than “1” will indicate more distal movement.

The following formula was used for canal transportation:

$$(X' - X) - (Y' - Y)$$

Results higher or lesser than 0 indicates canal transportation

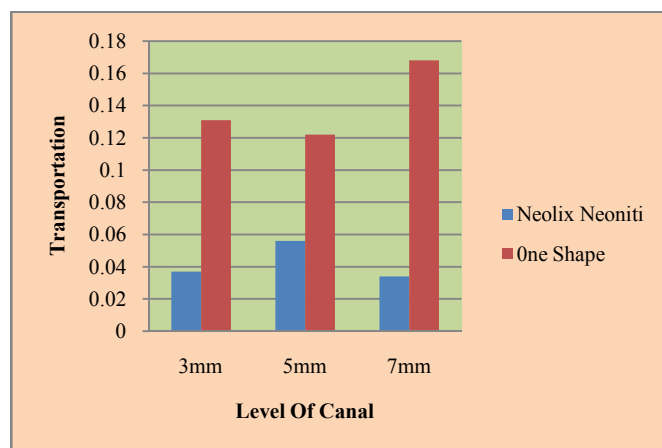
RESULTS

A statistical analysis (SPSS 15.0; SPSS Inc., Chicago, IL, USA) of the data was performed using independent *t*-test. The statistical significance level was set at *P* < 0.05.

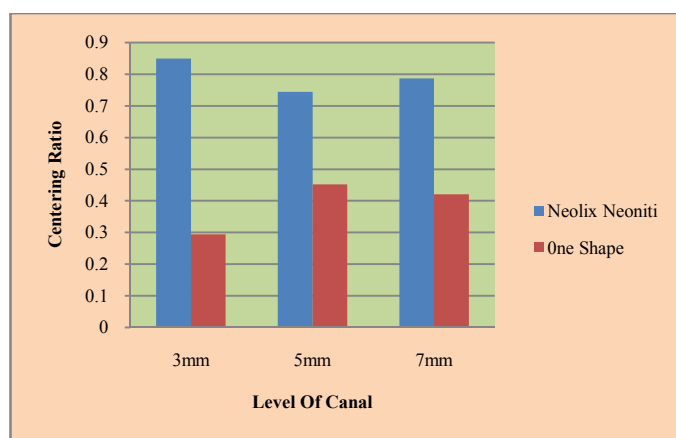
Statistical analysis between the two groups showed that Neolix neoniti caused significantly less canal transportation and had better canal centring ability than one shape files

Table 1 The mean and standard deviation values of the canal transportation and centering ratio at the three studied levels (3,5 and 7 mm) for each tested group .

Level (mm)	Assessment	Neolix Neoniti	One Shape
3	Transportation	.037333±.0088372	.131333±.0106010
	Centering Ratio	.849400±.0639696	.294933±.0726031
5	Transportation	.056000±.0124212	.122000±.0086189
	Centering Ratio	.744733±.0937157	.452733±.0778180
7	Transportation	.034667±.0051640	.168667±.0341983
	Centering Ratio	.787867±.1055414	.421000±.0395529



Graph 1 Degree of Canal Transportation Mesiodistally For Tested Groups



Graph 2 Centering Ratio for Tested Groups

DISCUSSION

Canal anatomy, file systems used, instrumentation technique implemented are some of the factors that affect the outcome and prognosis of biomechanical preparation, as various

iatrogenic errors like transportation, ledge formation, ineffective or excessive preparation are affected by it.^{2,12} Thus knowing canal centring and canal transportation ability of file system is important.

In this study canal centring and transportation ability of two NiTi files was evaluated using mesiobuccal canals of lower mandibular molars as these roots generally exhibit moderate to severe curvature and varied complex anatomy.^{2,12,17} CBCT was used for evaluation as CBCT is an important endodontic diagnostic aid and has proven to provide good results for evaluation of change in canal shape and transportation ability of the different instrumentation files,^{5,6,10} also it has an added advantage of reduced cost and scanning time, lower dosage of radiation and faster data acquisition compared to micro-CT.^{3,6}

In this study the null hypothesis was rejected as Neolix NeoNiti which consists of one C₁ file for coronal enlargement and three A₁ files (tip sizes of #20/0.06, #25/0.06, #40/0.04).^{4,5} showed significantly higher centring ratio and lesser transportation as compared to One Shape file. In a study by Forghani *et al* in 2017 Neolix Neo NiTi when compared to Protaper universal files produced less canal deviation and transportation and also required less time for preparation.⁴ Also another study in 2016 compared canal transportation of Neolix Neo NiTi files with Reciproc files using similar methodology and concluded that NeoNiti caused significantly less canal transportation in both mesiodistal and buccolingual direction.

The results of this study are consistent with all the previous studies, that have concluded that Neolix NeoNiti files have better shaping properties and cause less canal deviation from its original anatomy.^{4,5,14,15} This may be due to its non-homothermic rectangular cross section at its gothic tip, also it has progressive flexibility which the manufacturers claim to be due to use of developed wire-cut electrical discharge machining (WEDM) and appropriate heat treatments.^{4,5,14,15}

In previous studies published few studies One shaped files had higher canal transporting ability than Wave One gold, Protaper universal files etc.^{6,7,16} Therefore the results of this study are consistent with the conclusions of the past studies where One Shaper files produced higher canal transportation than other NiTi files.^{5,6,7,16} One Shape files though produces increased cutting and require less preparation time but these are less flexible due to their unique cross-section (triangular or modified triangular cross section and three sharp cutting edges in the middle and apical thirds and an S-shaped cross section with two cutting edges near the shaft).^{5,6}

CONCLUSION

Within the limitations of this study, it was concluded that Neolix Neoniti had a significantly higher centering ratio and less transportation than One Shape at all the three levels tested i.e. 3mm, 5mm and 7mm from the apex.

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