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Original Research

Evaluation of Canal Transportation and centering ability of two different single file systems in combination with and without glide path technique using Cone Beam Computer Tomography: In Vitro Study

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***ABSTRACT*:**

Introduction – The primary goal of cleaning and shaping in root canal therapy is the removal of bacteria and dentinal debris while preserving the radicular anatomy. However, this may be difficult, especially in curved canals, because all instrument techniques tend to alter the canal curvature and pathway. The aim of ideal root canal preparation is to prevent iatrogenic aberrations such as transportation. The purpose of this study is to compare and evaluate the canal transportation and centering ability of single rotary file systems (Wave One Gold and OneShape) with or without glide path using cone beam computed tomography imaging. **Methodology:** Forty mesiobuccal canals of mandibular first molars with curvatures of 25°–35° were divided into 4 experimental groups (n = 10) according to the instrumentation technique as follows: group P/WOG (glide path created and canals shape with Wave One Gold system), group N/WOG (glide path perform and canals shape with Wave One Gold system only), group P/OS (glide path created and canals were shaped with OneShape system), N/OS (glide path perform and canals shape with OneShape system only). All root canals will be scanned before and after instrumentation by using CBCT scanner to evaluate root canal transportation and centering ratio at 3, 5 and 7 mm from the apex and volumetric changes. **Results** -The results were statistically analyzed using a one-way ANOVA and Kruskal-Wallis H tests. In this study , in all 3 distances (3,5,7mm), the One Shape system without glide path have the highest transportation ,whereas Wave One Gold with glidepath have lowest, but the difference in transportation amounts in the 4 groups is not statistically significant between group P/WOG and group P/OS . The difference in transportation amount in the 4 groups was not statistically significant $p< 0.001$), No statistically significant difference in the centering ability in 4 groups ($p< 0.001$). **Conclusion-** Creating a glide path before using a single file system in a curved canal may prevent external wall change at the apical third. Within the limitations of present study, WaveOneGold single reciprocation file combined with glide path file respected original canal anatomy better than OneShape file with glide path. Better –centered canals are prepared with WaveOneGold combined with a glide path at all 3 levels.

Keywords- Canal Transportation, Centering Ability, Single File Systems, Glide Path Technique, CBCT.

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INTRODUCTION

The primary goal in cleaning and shaping root canals is the removal of bacterial and dentinal debris while the initial path and shape of the root canal is preserved. In some teeth, gaining this objective seems to be difficult because of the root canal anatomy complexity, degree and radius of the curvature of the canal.[1] During instrumentation; procedural errors such as removal of canal wall structure on the outside curve in the apical half of the canal due to the tendency of files to restore themselves to their original linear shape called as canal transportation, may lead to ledge formation, instrument separation and possible perforation.[2] Also it leaves some parts of root canal system untouched. Bacteria may remain in these areas and cause endodontic failures. One guiding strategy that has emerged as a critical part of endodontic success is creation and maintenance of a glide path. The endodontic glide path is a smooth radicular tunnel from canal orifice to physiologic terminus (foraminal constriction).[3] It is necessary because many available NiTi instruments have non end cutting tips and because of their extreme flexibility, they cannot initially negotiate the root canals. Recent advances for endodontic canal preparation have focused on the concept “less is more" i.e. with use of only one or two files biomechanical preparation of canal can be completed.[4] Thus a single – file system technique has developed for shaping to reducing the ratio of procedural errors mentioned above. Micro-mega now offers One Shape single rotary file system. It is niti with innovative design features. Its non-working (safety) tip ensures an effective apical progression avoiding obstructions which may lead to instrument separation. Its work in continuous rotation.[5] The preparation is rapid 4 times faster than conventional rotary system. Overall duration of treatment is shortened. Simplification of the endodontic instrument sequence is possible.[6] WaveOne GOLD is another single file system has been introduced by Densply, replaces original Wave One series by improving upon its flexibility.it work on reverse ‘balance force’ action using a preprogrammed motor to move reciprocal motion. The files are manufactured using M –wire technology, improving strength and resistance to cyclic fatigue.[7] The manufacturer claims that this single-file system is reliable even in complex root canals. However, complications such as canal transportation related to Reciproc have been an issue of interest and were evaluated with different studies.[8] While a group of studies revealed that the degree of canal transportation related to Reciproc is less than or similar to other rotary and/or reciprocating instruments, the others found greater degree of canal transportation with Reciproc.[9-11] The present study aimed to evaluate and compare canal transportation and centric ability of wave one gold and one shape single file system with and without glide path technique.

MATERIAL AND METHODS

Sample Selection

The present study consisted of 40 mesiobuccal root canals selected for this study. (Figure 1 & 2) The selection criteria for this study were a complete apex, 25 to 35 degree canal curvature (according to Schneider method in which teeth were radiographed using radiovisiography in buccolingual direction . A line was drawn parallel to the long axis of the canal. The second line was drawn from the apical foramen to intersect with the first at the point where the canal began to leave the long axis of the tooth, thus the acute angle formed was measured and the angle of curvature was determined.) a minimum length of 18 mm, uncalcified canals and type iv Vertucci canals. The teeth were kept in normal saline until the examination. (Figure 3)

Sample Preparation

The access cavity was prepared using a endo Z bur and working length determined using a # 10 k file , then teeth were hemisected with distal halves being removed and mesial halves mounted on a modeling wax 5 *5 cm block. the crown was not removed in order to all identification of buccal side for further procedures. All the teeth were then scanned with the CBCT device. Because most teeth are curved in their apical third 3, 5 and 7mm distance from the apex were examined in this study. A number from 1 to 40 was assigned to each tooth and teeth were allocated to 4 groups using random numbers production. (Figure 4)

Root Canal Preparation

The following rotary files were used in this study:

Preparation of the sample with Group P/WOG: Group of 10 samples prepare with Wave One Gold primary with an 8%taper and 0.25mm tip size at 400rpm, 5Nm with proglider with 2% taper ,0.16mm tip size at 300rpm , 5Nm. (Figure 5)

Preparation of the sample with Group N/WOG: Group of 10 samples prepared with Wave One Gold primary with an 8%taper and 0.25mm tip size at 400rpm,5Nm torque without glide path. (Figure 6)

Preparation of the sample with Group P/OS: Group of 10 samples prepared with One shape with an 6%taper and 0.25mm tip size at 400 rpm 5 Ncm torque with One-G with 3% taper ,0.14mm tip size at 300rpm, 5 Ncm torque. (Figure 7)

Preparation of the sample with Group N/OS: Group of 10 samples prepared with One- G primary with an 6%taper and 0.25mm tip size at 300rpm, 5 Nm torque without glide path. (Figure 8)

Each file in each system was used for 5 teeth and then discarded. in all group the instruments were placed in a

1:1 handpiece with a silver reciproc electric motor monitor .after 3 inward – outward motions, the instrument was retrieve from root canal , canal was irrigated with 2 ml 2.5 % normal saline, and fil flutes were cleaned from debris. The instrument was again inserted into the root canal, and this was repeated until the file reached the working length.

Evaluation of Canal Transportation and Centering Ability

After preparation of root canals, CBCT images were repeated for all teeth with the same exposure as preoperative scan. Mesiodistal and buccolingual diameters were recorded at 3, 5 and 7 mm from the apex in both the preoperative and postoperative CBCT images. Canal transportation was determined using the following formulas: (a1- a2)- (b1-b2). In this formula **a1** is the least distance between mesial borders of the root and the canal before instrumentation, a2 is the least distance between mesial borders of the root and the canal after instrumentation, b1 is the least distance between distal borders of the root and canal before instrumentation and b2 is the least distance between distal border of root and canal after instrumentation. (c1- c2) – (d1-d2). In this formula, c1 is the least distance between the buccal border of root and the canal before instrumentation, c2 is the least distance between the buccal borders of the root and canal after instrumentation, d1 is the least distance between lingual borders of the root and the canal before instrumentation, d2 is the least distance between the lingual borders of root and the canal after instrumentation. According to these formulas, 0 means no canal transportation, whereas positive and negative values show mesial and buccal and distal or lingual transportation, respectively. Centering ability was determined by a1- a2 /b1- b2 or b1- b2 /a1- a2 formulas. In these formulas, the fraction with the lesser value was selected for statistical analysis. According to these formulas, 1 represents complete centering, whereas other values show changes in the canal pathway. Statistical analysis is performed using one-way ANOVA and Kruskal-Wallis H tests.

RESULTS-

In this study , in all 3 distances (3,5,7mm), the One Shape system without glide path have the highest transportation , whereas Wave One Gold with glide path have lowest., but the difference in transportation amounts in the 4 groups is not statistically significant between group P/WOG and group P/OS . The difference in transportation amount in the 4 groups was not statistically significant $p< 0.001$).The difference in the centering ability in 4 groups was not statistically significant $p< 0.001$). (Table 1)

TABLE 1: RESULTS OF STUDY PRESENTED IN MASTER CHART.

GROUP	Distance from apex	Mesiodistal transportation (mm), mean (SD)	Buccolingual transport ation (mm), mean (SD)	Centering ratio, mean (SD)
P/WOG	3mm	0.09 (0.021)	0.08 (0.020)	0.52 (0.058)
	5mm	0.08 (0.028)	0.06 (0.017)	0.54 (0.081)
	7mm	0.06 (0.018)	0.05 (0.018)	0.59 (0.071)
N/WOG	3mm	0.05 (0.016)	0.05 (0.022)	0.61 (0.052)
	5mm	0.04 (0.018)	0.04 (0.018)	0.64 (0.078)
	7mm	0.04 (0.014)	0.04 (0.021)	0.70 (0.071)
P/OS	3mm	0.03 (0.012)	0.02 (0.013)	0.91 (0.051)
	5mm	0.03 (0.012)	0.02 (0.010)	0.93 (0.056)
	7mm	0.02 (0.010)	0.01 (0.010)	0.93 (0.062)
N/OS	3mm	0.04(0.018)	0.02(0.018)	0.70 (0.071)
	5mm	0.05(0.016)	0.04(0.013)	0.61 (0.052)
	7mm	0.02(0.010)	0.01(0.010)	0.64 (0.078)

FIGURE 1: ARMAMENTARIUM USED IN THE RESEARCH

FIGURE 2: PICTURE OF SAMPLES

FIGURE 3: MOUNTING OF SAMPLES ACCORDING TO GROUPS

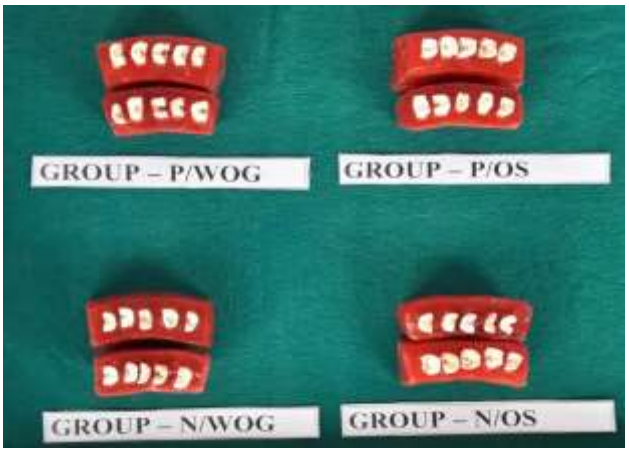

FIGURE 4: PREPARATION OF SAMPLES

FIGURE 5: GROUP-P/WOG

FIGURE 6: GROUP-N/WOG

FIGURE 7: GROUP-P/OS

FIGURE 8: GROUP-N/OS

DISCUSSION -

The objective of mechanical preparation of root canals is the cleaning of all canal walls while maintaining the original anatomy. This leads to preparation of root canal – enabling irrigation, intracanal medicament and 3 dimensional oburation.[12] Curved canals provide a challenge for endodontic preparation because it is proven that all instruments and preparation techniques tend to alter the pathway of the root canal. Canals are curved in the apical third. Transportation is the iatrogenic changes in the physiologic pathway of the root canal, mainly in the external surface of the curve. Different types of transportation can occur from type I (mild form) to type III (severe form). Only type I transportation can be managed by non-surgical endodontics. Transportation of the root canal may lead to several problems and errors.[13] It can cause inadequate debridement of the apical region and excessive removal of dentin in the coronal region of the concave surface of the root curvature. Moreover, continuing the incorrect pathway may lead to zipping of the apical foramen or perforation.[14] When using extracted natural teeth for the preparation of root canals, imaging techniques (CBCT imaging being the most available and accurate for endodontic purposes) may provide more reliable results in the evolution of root canal transportation for application in the clinical area.[15] Endodontic glide path is a smooth tunnel shape from the canal orifice to physiologic terminus. Many studies shows that coronal pre-flaring and making a glide path either manually or mechanically are essential for safer use of NiTi rotary instrumentation ,because it keeps rotary instruments from excessive torsion stresses that lead to file facture.[16] Enlargement of the coronal and middle portions by the Proglider files and OneG files may have reduce the torsional stress for the root canal preparation so that the WaveOne file and OneShape file could more easily achieve a working length.[17] For glide path creation we uses two rotary NiTi instruments, in P/WOG group glide path creates with Proglider files and in P/OS group uses OneG files, both are single files.[18] After further canal preparation with the WaveOneGold file with Proglider file (P/WOG) group shows less overall canal transportation then P/OG group and other groups.[17] The two systems which is single file design for glide path creation create different apical sizes of the canal – for the WaveOneGold group (P/WOG) it closer to the size of the shaping files use when compared with the OneShape group (P/OS) This situation can explain to some extent the results from our study.[19] A glide path is the unimpeded path from the canal orifice to the canal terminus, which the rotary shaping instruments will follow. Rotary glide path preparation allows better initial removal of pulp tissue and debris from the canal, allowing the operator to maintain the working length and patency of root canals.[20] According to most of the studies occurrence of canal modifications and aberrations seems to be significantly reduced when previous glide path is performed. However, some other studies controvert it.[21]

CONCLUSION-

Creating glide path before using single file system in curved canal may prevent external wall change at the apical third. Within the limitations of present study, WaveOneGold single reciprocation file combine with glide path file respected original canal anatomy better than OneShape file with glide path. Better –centered canals is prepare with WaveOneGold combining with glide path at all 3 levels.

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