



## Canal transportation and centering ability of neoendo rotary files in deciduous teeth: An in vitro study using cone beam computed tomography

Palak Janiani<sup>1</sup>, Mahesh Ramakrishnan<sup>2\*</sup>

<sup>1</sup>Department of Pediatric and Preventive Dentistry, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India - 600077

<sup>2</sup>Department of Pediatric and Preventive Dentistry, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India - 600077

\***Corresponding author:** Mahesh Ramakrishnan, Department of Pediatric and Preventive Dentistry, Saveetha Dental College and Hospital, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India – 600077, Email: maheshpedo@gmail.com

Submitted: 16 March 2023; Accepted: 18 April 2023; Published: 04 May 2023

### ABSTRACT

**Background:** The primary goals of cleaning and shaping during pulpectomy procedure is to debride the canals simultaneously to maintain canal morphology and to prevent any transportation or perforations. These are critical iatrogenic faults that can lead to complications.

**Aim:** To utilize cone-beam computed tomography (CBCT) imaging to evaluate how Pedoflex rotary files and Neoendo flex orifice enlarger affect the centering ability and transportation of the canal during a Biomechanical preparations.

**Materials and method:** Forty primary mandibular first molar distal roots were scanned using cone-beam computed tomography (CBCT). The teeth were randomly separated into two equal groups and treated with either Pedoflex rotary files or Neoendo flex orifice enlarger files. After the canals were prepared, they were rescanned using CBCT, and the images were divided into cervical, middle, and apical thirds. The study evaluated and compared the transportation (CT) of the canals and the centering ability of the instruments between the two groups.

**Results:** Both files maintain the canal centering ability better in the middle level than cervical and apical levels. However this was not statistically significant. No difference was observed between the two systems in terms of canal transportation.

**Conclusion:** The study found that there was no significant variation in the canal transportation and centering ability between the two rotary file systems used. Therefore, both systems can be safely utilized with minimal risk of procedural errors during root canal preparation.

**Keywords:** Canal centering, transportation, Pediatric rotary files, Primary teeth, Novel

### INTRODUCTION

A pulpectomy is recommended for primary teeth with advanced caries that affect the pulp. Previously, stainless steel hand files were used during biomechanical preparations in pulpectomies. However, newer NiTi rotary files

have since been introduced, offering improved shaping capabilities and minimizing the risk of technical errors.(1) The goal of canal shaping is to create a tapered preparation that is continuous from the crown to the apex while preserving the path.(2)

J Popul Ther Clin Pharmacol Vol 30(10):e19–e23; 04 May 2023.

This article is distributed under the terms of the Creative Commons Attribution-Non Commercial 4.0 International License. ©2021 Muslim OT et al.

This ability to maintain this path and minimize the size of the foramen is known as the centering ability of an endodontic instrument.

Clinically, orifice enlarging files are commonly used for the cleaning and shaping of primary teeth canals.(3) The Neoendo flex orifice enlarger measures 19mm in length and has a 8% taper. The use of files with appropriate characteristics such as length, taper, and tip size customized to the root canal morphology of primary teeth is crucial for achieving successful endodontic treatment. The same company (Neoendo) has a set of three Pedoflex rotary files which measure 16mm in length and have a 4% taper.

Cone-beam computed tomography technology is commonly used to assess changes in root canal anatomy. CBCT imaging provides high-resolution images that are 15 times smaller than traditional scans. (4) There is literature available assessing the centering ability of hand files compared to other rotary file systems.(5) However, there is no study comparing the centering ability of these two file systems. Hence, the aim of this in vitro study is to assess the canal transportation and centering ability of the Pedoflex rotary files with Neoendo flex orifice enlarger using CBCT imaging. The null hypothesis which is being tested is that there is no significant distinction in terms of centering ability and transportation between the two endodontic instruments.

## MATERIALS AND METHODS

### *Specimen selection*

Forty primary mandibular molars were collected and preserved in formalin solution, each with a minimum root length of 7mm. The crowns of the teeth were cut at the CEJ and the roots were then embedded in a wax block. Conventional access cavities were opened in all teeth using a diamond bur. The working length was established by measuring the length of the file tip that protrudes through the apical foramen and then subtracting 1 mm.

### *Specimen preparation*

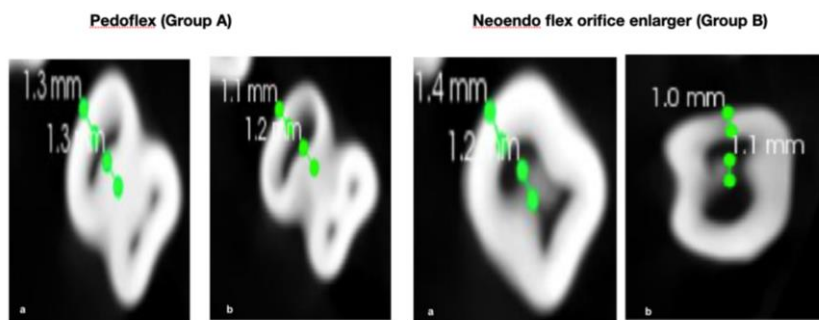
In Group A the Neoendo flex orifice enlarger was used with an endodontic motor (X Smart, Dentsply) at a speed of 300 rpm and torque of 2.3 N cm to prepare the canal. Meanwhile, group B was prepared using the Pedoflex rotary files (Neoendo) with the same motor and speed settings. The recommended sequence from the manufacturer was followed when using the three pedoflex rotary files. During the procedure, a 5.25% NaOCl solution was used for irrigation of the canals using a 27-gauge needle. Lubrication was done using Glyde (Dentsply, Maillefer) during instrumentation, and each file was replaced after the preparation of five canals

### *Scanning and Image Analysis*

CBCT scans were taken of the teeth prior and post the canal cleaning and shaping using a Planmeca ProMax® 3D Mid machine. The slice thickness used was 0.4 mm and the machine was set at 90 kV and 10 mA. The CEJ was used as a reference point for the measurements, which were taken at three different levels from the CEJ: the cervical level (2 mm below), the middle level (4 mm below), and the apical level (6 mm below).

### *Canal Transportation*

The distance and direction of transportation were measured by determining the maximum distance between the edge of the instrumented canal and the corresponding edge of the uninstrumented canal. Gambill et al. (6) developed a formula for transportation calculation  $[(X1 - X2) - (Y1 - Y2)]$ , which was used to assess the extent and direction of transportation. The equation required determining the minimal distance between the outer and inner parts of the root and canal to the edge of the instrumented and uninstrumented canal. A result of 0 obtained from this calculation indicates that there is no transportation, while higher values indicate more transportation. (Figure 1)



**FIGURE 1:** CBCT scanning images (a) pre-preparation (b) post-preparation

### Canal Centering Ability

The mean centering ratio measures how well the instrument stays in the center of the canal. A smaller ratio means the instrument has a better centering ability. To calculate the centering ratio, the formula developed by Gambill et al. (6) was used:  $(X1 - X2) / (Y1 - Y2)$ . A perfect centering result would yield a ratio of one.

### Statistical analysis

The statistical analysis was performed using SPSS version 20.0 (SPSS Inc., Chicago, IL, USA). The mean and standard deviation values were computed for both the canal transportation and centering ability in the study and a t-test was used to obtain the p value (significant at  $p < 0.05$ ).

### RESULTS

The research evaluated the ability of the instruments to center the canal and avoid transportation at three distinct levels: 2mm, 4mm, and 6mm from the CEJ. Based on statistical analysis, there was no notable difference between the two systems in terms of canal transportation. (Table 1)

Compared to the cervical and apical levels, both the Pedoflex rotary file system and the Neoendo flex orifice enlarger exhibited better canal centering ability in the middle level. However, there was no significant statistical difference ( $P < 0.05$ ) noted between them in terms of their ability to maintain canal centering. (Table 2)

**TABLE 1:** Mean  $\pm$  Standard deviation for canal transportation at the three levels

	Group A (Neoendo flex orifice enlarger)	Group B (Pedoflex)
	Mean $\pm$ SD	Mean $\pm$ SD
Cervical level	-0.025 $\pm$ 0.87	-0.007 $\pm$ 0.25
Middle level	-0.015 $\pm$ 0.13	-0.031 $\pm$ 0.08
Apical level	-0.08 $\pm$ 0.97	-0.019 $\pm$ 0.30

**TABLE 2:** Canal centering ability of Neoendo flex orifice enlarger and Pedoflex file system

	Group A (Neoendo flex orifice enlarger)	Group B (Pedoflex)	p-value
	Mean $\pm$ SD	Mean $\pm$ SD	
Cervical level	0.37 $\pm$ 3.82	0.93 $\pm$ 3.23	0.454
Middle level	0.82 $\pm$ 1.10	0.61 $\pm$ 1.72	0.532
Apical level	1.62 $\pm$ 5.41	1.47 $\pm$ 2.46	0.338

## DISCUSSION

The shape of primary teeth, which is ribbon-shaped, presents a significant challenge when using protocols designed for permanent teeth on primary molars. Primary molar roots are frequently curved and this curvature may lead to perforations on the inner surface of the root. (6) In addition, when compared to permanent teeth, primary dentin is softer, and the roots are smaller, slender, and curved. These factors are critical considerations when preparing the canal of primary teeth, which differ from permanent teeth. (7)

The advantage of NiTi rotary files is the efficient and uniform preparation of curved canals with less instrument time compared to hand files. CBCT imaging was used to accurately assess dentin thickness removal, canal curvature, transportation, and centering ratio. (8) This study evaluated the transportation and centering ability of Neoendo flex orifice enlarger and Pedoflex rotary file system using CBCT imaging.

Distal roots of the primary mandibular molars were chosen for this study due to their shorter length, rounder shape, and tapering towards the apex. (9) A perfect centering ability of the instrument can significantly lower the risk of apical transportation and other procedural errors during root canal instrumentation. This is because deviation from the original canal curvature can result in excessive dentin removal on one side, the formation of a ledge in the dentinal wall, and cross-sectional appearance of the canal as an hourglass shape. (10)

The results of this study show that at the middle level, both rotary file systems exhibit better canal centering ability. These findings are consistent with those of Selvakumar et al (11) Other studies comparing the K3 NiTi rotary instrument with a taper of 0.02% demonstrated a lower amount of canal transportation and a higher canal centering ratio compared to K3 with a taper of 0.04% and stainless steel K files. (11) (12)

As it is already established that NiTi files cause less transportation than stainless steel hand instruments, our study focused on comparing pediatric rotary files with the existing NiTi instruments of the same manufacturer. However,

one limitation of our study was that, despite our efforts to standardize the samples, it is not fully possible to standardize the shape and size of canals in extracted teeth.

## CONCLUSION

Based on the limitations of this study, there were no discernible differences in the extent of canal transportation and centering ability between the rotary files utilized. Consequently, either Pedoflex rotary files or Neoendo flex orifice enlarger can be utilized with less chance of procedural errors during root canal preparation.

## REFERENCES

1. Prabhakar AR, Yavagal C, Dixit K, et al. Reciprocating vs rotary instrumentation in pediatric endodontics: cone beam computed tomographic analysis of deciduous root canals using two single-file systems. *Int J Clin Pediatr Dent* 2016;9(1):45–49. DOI: 10.5005/jp-journals-10005-1332
2. Tambe VH, Nagmode PS, Abraham S, et al. Comparison of canal transportation and centering ability of rotary protaper, one shape system and wave one system using cone beam computed tomography: An in vitro study. *J Conserv Dent* 2014;17(6):561–565. DOI: 10.4103/0972-0707.144605.
3. Jeevanandan G., Govindaraju L. Clinical comparison of Kedo-S paediatric rotary files vs manual instrumentation for root canal preparation in primary molars: a double blinded randomised clinical trial. *European Archives of Paediatric Dentistry*. 2018;19 (4) : 273-278.
4. Todd R. Cone beam computed tomography updated technology for endodontic diagnosis. *Dent Clin North Am* 2014;58(3):523–543. DOI: 10.1016/j.cden.2014.03.003
5. Haridoss S, Rakkesh KM, Swaminathan K. Transportation and Centering Ability of Kedo-S Pediatric and Mtwo Instruments in Primary Teeth: A Cone-beam Computed Tomography Study. *Int J Clin Pediatr Dent* 2022;15(S-1):S30–S34.
6. Juliet S., Jeevanandan G., Govindaraju L., Ravindran V., Subramanian E. Comparison between Three Rotary Files on Quality of Obturation and Instrumentation Time in Primary Teeth-A Double Blinded Randomized Controlled Trial. *Journal of Orofacial Sciences*. 2020;12(1) :30-34.

7. Gambill M, Alder M, Del Rio E. Comparison of nickel titanium and stainless-steel handfile instrumentation using computed tomography. *J Endod* 1996;22:369–375. DOI: 10.1016/S0099-2399(96)80221-4
8. Kuo C, wang y, Chang H, Huang G, Lin C, Li U, et al. Application of Ni-Ti rotary files for pulpectomy in primary molars. *J Dent Sci* 2006;1:10-5.
9. Govindaraju L., Subramanian E.M.G., Jeevanandan G. Comparing the Influence of Conventional and Rotary Instrumentation Techniques on the Behavior of the Children: A Randomized Clinical Trial. *International Journal of Clinical Pediatric Dentistry*. 2021;14(S2): S179-S185.
10. Ash MM, Nelson SJ. *Wheeler’s dental anatomy, physiology and occlusion*. 9th ed. Philadelphia, PA: W.B. Saunders; 2009. p. 63.
11. Asif A., Jeevanandan G., Govindaraju L., Vignesh R., Subramanian E.M.G. Comparative evaluation of extrusion of apical debris in primary anterior teeth using two different rotary systems and hand files: An in Vitro study. *Contemporary Clinical Dentistry*. 2019;10 (3): 512-516.
12. Selvakumar H, Anandhan V, Thomas E, et al. Evaluation of canal transportation and centering ability of K 3 (0.02%) and K 3 (0.04%) with hand K files in primary teeth using spiral computed tomography. *J Indian Soc Pedod Prev Dent* 2014;32(4):286–291. DOI: 10.4103/0970-4388.140943
13. Sruthi S., Jeevanandan G., Govindaraju L., Subramanian E. Assessing quality of obturation and instrumentation time using Kedo-SG blue, Kedo-SH, and reciprocating hand K-files in primary mandibular molars: A double-blinded randomized controlled trial. *Dental Research Journal*. 2021;18: 76.