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Comparison of two Single file systems in Paediatric Endodontics- A cone beam computed tomoghraphic analysis of deciduous teeth

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Abstract

Aim and objective: Primary root canals are considered to be most challenging due to their complex anatomy. With the use of two single file systems namely neolix neoniti and wave one, this study aims to evaluate and compare dentin thickness, canal transportation and instrumentation time of wave one and Neolix Neoniti files in primary root canals using a cone beam computed tomographic (CBCT) analysis.

Material and methodology: A total of 30 extracted human primary teeth were included in the study. Cone beam computed tomographic images were taken before and after the instrumentation for each group. Dentin thickness, canal transportation and instrumentation times were evaluated for each group.

Results: There was no difference in the remaining dentin thickness between wave one and neolix neoniti at any level. A significant difference in the instrumentation time was found. There was a significant difference in the measures of the canal transportation and wave one showed less CT as compared with neolix neoniti.

Conclusion: The new wave one NiTi reciprocating single-file system has proved to be a faster and safer system with less procedural errors as compared with neolix neoniti continuous rotation file.

Keywords: Single File Systems, Wave One, Neolix Neoniti, Remaining Dentin Thickness, CBCT

Introduction

Pulpectomy is considered as the intervention of choice for treating infected pulp tissues in paediatric dental practice[1]. Although this therapy depends on many factors, one of the most important steps is the root canal preparation[2]. However, successful endodontic treatment lies in

understanding the size, morphology and disparity of the root canals of primary teeth.

Rotary instruments were introduced to paediatric endodontics by Barr et al in the year 2000 [1]. Properties of Nickel titanium (NiTi) were discovered by William J. Buehler along with Frederick wang during research at the Naval Ordnance Laboratory in 1959 [9]. The introduction of Nickel titanium rotary instrumentation has not only enabled easier and faster preparation of root canal system but also provided consistent, predictable and reproducible shaping with consistently less iatrogenic damage, this has significant advantage over manual instrumentation techniques as stainless-steel files have shown undesirable results in canals, regardless of the technique or type of files used[2]. The tortuous and irregular canal walls of the primary teeth are effectively cleansed as the flexible as nature of the NiTi instruments allows the files to closely follow the original root canal path[8]. Also, a funnel-shaped canal preparation is obtained, and thus a uniform and more predictable obturation with pastes can be achieved [1]. More importantly, rotary files shorten the preparation time considerably and, therefore, suit the shorter attention spans of children, thus, increasing their cooperation for the endodontic procedure.

In the bygone decade, several rotary NiTi endodontic file systems have been launched to improve the shaping procedure. However, all these systems recommended the use of a series of files to accomplish the final shape. Recently, the concept of single-file systems has been introduced and is currently being debated for its applicability in contemporary endodontics[7]. Two such single-file systems are wave one and neolix neoniti employing reciprocating and rotatory motions respectively. Reciprocating motion is basically any back or forth motion, in clockwise and anticlockwise direction. The main advantage of such a motion is the reduction in the number of endodontic mishaps through instrument separation, which is primarily due to avoidance of continuous dentinal over engagement. The added advantages of these single-file systems include reduction in the working time, prevention of cross-contamination, and improved safety of the shaping procedures[1]. Nowadays, an increasing number of clinicians use one brand or another for preparing the root canals. Many studies have shown that engine-driven rotary NiTi instruments are able to produce better centered canals with lesser amount of transportation than manually operated stainless-steel files.

There are several clinical or laboratory studies using rotary files for root canal preparation, but most of which includes permanent teeth, there are few clinical reports or studies that includes primary teeth. Considering the anatomical, histological and chemical differences between permanent and primary dentitions, such as increased mineralization of permanent teeth and morphological changes owing to the presence of physiological or pathological root resorption, results obtained in permanent teeth cannot be transposed to primary teeth[4]. Application of rotary files may be more appropriate in children with behaviour management problems. Various studies have stated that using rotary files for canal instrumentation in primary teeth significantly reduces the chairside time which plays a prime role in treating children who are less cooperative, thus causing a positive impact on the child's cooperation[8].

There are limited literatures or studies exists to evaluate efficacy of single files systems in pediatric endodontics, hence the present study was conducted with the aim to evaluate and compare dentin thickness, canal transportation and instrumentation time of wave one and Neolix Neoniti files in the primary root canals

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Materials and Methods

For this study thirty natural deciduous (14 single rooted and 16 multirooted) were collected from department of pedodontics, ACPM Dental college dhule**.** Before conducting the study approval of research ethics committee of the institute was obtained. Inclusion criteria includes, deciduous teeth with at least 10 ± 1.0mm of working length, absence of any pathological internal or external root resorption, absence of internal or external resorption in furcation area and moderate root angulations[4]. The samples were randomly divided into two groups

Group A: wave one single file system

Group B: Neolix neoniti single file system

Sample preparation: samples selected for the study were cleaned and immersed in 2.0% chlorhexidine for 24 h. the specimens covered with a layer of wax sheet and embedded in dental stone by using a plastic mold to ensure stabilization of the specimens for biomechanical preparation.

Root canal preparation:

Conservative access cavity preparation was made for all the teeth. Each canal was negotiated with 10 & 15 no. stainless steel K file to check patency and to determine working length. ethylenediaminetetraacetic acid (RC Help, Prime dental products Pvt Ltd.) was used for lubrication. The preparation was performed with single-file systems, wave one (primary) (Dentsply maillefer, Switzerland) and Neolix neoniti (NEOLIX, Châtres-la-Forêt, France) in the respective groups using endodontic motor. 1% sodium hypochloride was used as an irrigant during the entire procedure[1].

Figure 1: canals were first scouted with a #10 K-file glide path established

Figure 2: The canal preparation was performed with single file systems, wave one and Neolix neoniti in respective groups

Teeth were scanned before and after mechanical preparation with Cone Beam Computed Tomography (CBCT) scanner. Sections were taken at coronal, middle and apical levels. M1 was the measurement of the quantity of voxels from the external surface of the mesial portion of the root to the mesial wall of the non-instrumented canal. M2 was the measurement of the quantity of voxels from the external root surface of the mesial portion of the root to the wall of the canal after instrumentation. D1 was the measurement of the quantity of voxels of the external surface of the distal portion of the root to the distal wall of the non-instrumented canal. D2 was the measurement of the quantity of voxels from the external surface of the distal portion of the root to the distal surface of the canal after instrumentation[1].

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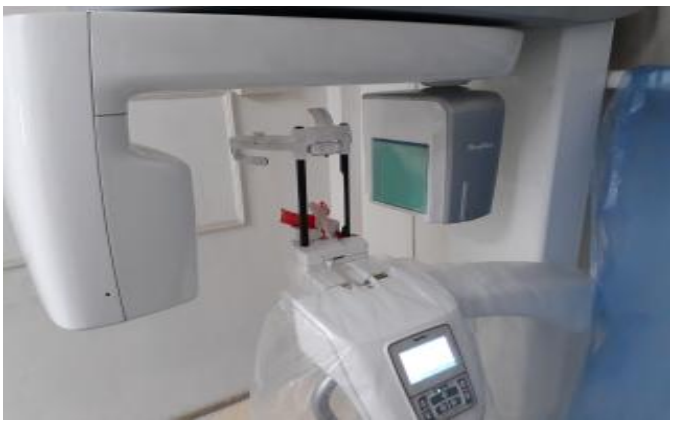

Figure 5: Teeth were scanned before and after mechanical preparation with Cone Beam Computed Tomography (CBCT) scanner.

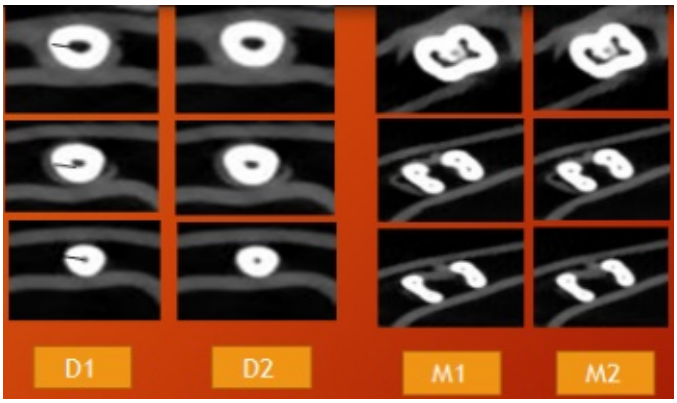

Figure 6: Dentin thickness for wave one (C: Cervical level,M: Middle level, A: Apical level).

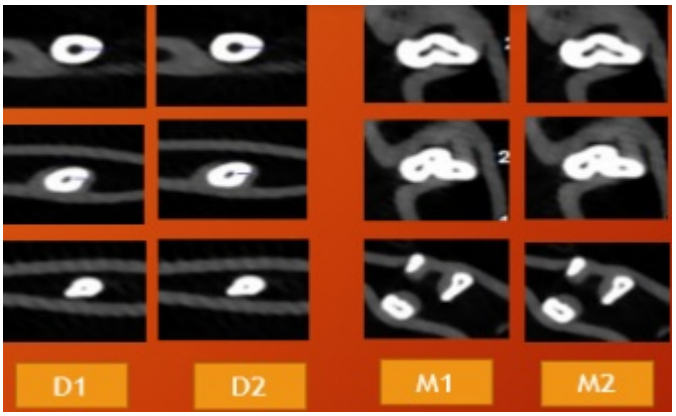

Figure 7: Dentin thickness for Neolix neoniti (C: Cervical level, M: Middle level, A: Apical level)

Canal transportation was calculated from the following equation: Canal transportation = (M1 − M2) − (D1 − D2).

CT equal to 0 (zero) meant lack of transportation, a negative value represented transportation to the distal direction, and a positive value represented transportation toward the mesial direction. Dentin thickness was measured on the axial cuts from the periphery of the pulp space to the outer surface of the tooth at three levels (cervical, middle, and apical). Instrumentation time (instrumentation plus irrigation) was measured using a digital stopwatch.

Statistical analysis

Intergroup comparison for Canal transportation, and dentin thickness was done by Kruskal-Wallis test. Mann-Whitney U-test was used for pairwise comparisons if Kruskal-Wallis was significant. Student's t-test was used for instrumentation time comparison between the two groups. Microsoft Word and Excel were used to generate graphs and tables.

Results

- Statistical analysis showed no difference in the remaining dentin thickness between wave one and neolix neoniti at any level.
- A significant difference in the instrumentation time was found. The mean instrumentation time of wave one was 1.94 minutes compared with that of neolix neoniti which was 2.98 minutes

Statistical analysis showed a significant difference in the measures of the canal transportation and wave one showed less CT as compared with neolix neoniti.

Table 1

		Mean dentin thickness (in mm)
Middle M1	Waveone	1.452667
	Neolix neoniti	1.487333
Middle M2	Waveone	1.361333
	Neolix neoniti	1.388
Middle D1	Waveone	1.28
	Neolix neoniti	1.380667
Middle D2	Waveone	1.206667
	Neolix neoniti	1.254667

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Table 2

		Mean dentin thickness (in mm)
Middle M1	Waveone	1.452667
	Neolix neoniti	1.487333
Middle M2	Waveone	1.361333
	Neolix neoniti	1.388
Middle D1	Waveone	1.28
	Neolix neoniti	1.380667
Middle D2	Waveone	1.206667
	Neolix neoniti	1.254667

Table 3

		Mean dentin thickness (in mm)
Apical M1	Waveone	1.324
	Neolix neoniti	1.389333
Apical M2	Waveone	1.258
	Neolix neoniti	1.274667
Apical D1	Waveone	1.176
	Neolix neoniti	1.286667
Apical D2	Waveone	1.008667
	Neolix neoniti	1.14

Table 4

	Groups	N	Mean	Std. Deviation	Mean Difference	t value	p value
M1 – M2	Waveone	15	.075333	.0309069	-0.049	-3.365	0.003*
	Neolix	15	.124667	.0476395			
D1 – D2	Waveone	15	.075333	.0438938	-0.073	-2.855	0.010*
	Neolix	15	.148000	.0882529			
(M1-M2)-(D1-D2)	Waveone	15	.000000	.0566947	0.031	1.055	0.303
	Neolix	15	-.031333	.1000619			

Table 5

	Groups	N	Mean	Std. Deviation	Mean Difference	t value	p value
M1 – M2	Waveone	15	.089333	.0810173	-0.01	-0.421	0.677
	Neolix	15	.099333	.0435015			
D1 – D2	Waveone	15	.073333	.0255417	-0.042	-2.462	0.024*
	Neolix	15	.115333	.0609293			
(M1-M2)-(D1-D2)	Waveone	15	.016000	.0861726	0.032	1.066	0.295
	Neolix	15	-.016000	.0779927			

Table 6

	Groups	N	Mean	Std. Deviation	Mean Difference	t value	p value
M1 – M2	Waveone	15	.066000	.0386079	-0.049	-2.169	0.039*
	Neolix	15	.114667	.0779071			
D1 – D2	Waveone	15	.167333	.2037669	0.021	0.358	0.723
	Neolix	15	.146667	.0920145			
(M1-M2)-(D1-D2)	Waveone	15	-.101333	.1931271	-0.029	-0.369	0.715
	Neolix	15	-.072000	.2396486			

Table 7

Groups	Mean Instrumentation Time (in mins)
Waveone	1.943333
Neolix neoniti	2.98

Discussion

Primary teeth are considered to be more complex & challenging anatomically when compared with permanent ones[1]. Application of rotary files may be more appropriate in children with behavior management problems. Various studies have stated that using rotary files for canal instrumentation in primary teeth significantly reduces the chairside time which plays a prime role in treating children who are less cooperative, thus causing a positive impact on the child's cooperation[8]. The principles of rotary motion have been in clinical usage for up to 25 years now. However, the physics behind reciprocating motion is based on the "law of action and reaction," which results in a balanced force during canal instrumentation. The reciprocating movement minimizes torsional and flexural stresses, increases the canal centering ability, and reduces the taper lock of the instrument within the canal. Recent studies have shown that an alternating reciprocating movement is a valid option to optimize endodontic instrumentation by reducing the risk of instrument fracture and root canal deformity. The use of such a reciprocating motion in place of continuous rotation could thus prove to be advantageous in terms of reducing the stress as well as the time required for the preparation of curved root canals[1].

The Wave One system is a new concept in the preparation of the root canal. Only one single-shaping file is required to instrument the canal to an adequate size and taper. The main characteristics of this system are single use, a

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reciprocating action, and M-wire alloy manufacturing technology which improves strength and resistance to cyclic fatigue. Even more recently, Neolix files have been introduced in which complete canal shaping is possible with only one single file, which is used in continuous rotation[7]. The less instrumentation time in wave one single-file system could be explained by the fact that reciprocating motion does not over engage the dentin, thus reaching the working length faster when compared with rotational motion[1].

Conclusion

Within the limitations of the study, it was concluded that the new wave one NiTi reciprocating single-file system has proved to be a faster and safer system when compared with neolix neoniti continuous rotation file. According to the present study, it can be revealed that the effect of the single-file system is improved when using reciprocating motion, increasing its cutting efficiency, durability with less procedural errors. Further ex vivo and clinical studies should be performed to ascertain such differences

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