RESEARCH ARTICLE

Computed Tomographic Assessment of Remaining Dentin and Risk of Perforation after Kedo-S and Mtwo Rotary Instrumentation in Root Canals of Primary Teeth: An *In Vitro* Study

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Abstract

Background: Root canal cleaning is a key step in the endodontic treatment of the primary molars. An innovative generation of endodontic instruments has been devised with the aim of emerging better procedures. The objective of the study is to assess the preparation of time, the risk of lateral perforation, and the removal of dentin from Kedo-S and Mtwo rotary instruments on primary teeth.

Study design: This is an *in vitro* experimental study comparing the two groups.

Materials and methods: A total of 50 extracted mandibular primary first molars are collected, divided randomly into two groups of 25 teeth each. Group I: Kedo-S Pediatric rotary file, Group II: Mtwo rotary file. Distal canal is standardized for evaluation and teeth are sectioned at the CEJ. The teeth were instrumented according to manufacturer's guideline. Both the groups are scanned before and after instrumentation of the canal using cone-beam computed tomography (CBCT) and values are evaluated.

Results: Compared with Mtwo files, Kedo-S files need less instrumentation time and limited lateral perforation. No statistical differences were reported between the instrumentation of Kedo-S and Mtwo with regard to the amount of dentin removed.

Conclusion: In pediatric endodontics, Kedo-S pediatric rotary file can be considered an effective alternative to traditional rotary files because it requires less instrumentation time and preserves dentin thickness.

Keywords: Instrumentation time, Kedo-S, Pediatric rotary endodontics, Perforation, Primary molars, Remaining dentin thickness.

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Introduction

The primary aim of filing in pulpectomy procedures in primary teeth is the elimination of organic debris.[1] With manual or rotary nickel–titanium (Ni–Ti) instruments, this objective can be achieved.[2] Several difficulties such as ledging, apical perforation, and mid root strip perforation may weaken the quality of the treatment as it fails to remove infection from the root canal system and thereby making it challenging to obturate.[3] It is necessary to select an instrument that sustains the original shape of the canal without creating deviations and provide a uniform removal of dentin from the walls of the canal in primary molars as it have root canal systems have ribbon shaped morphology, shorter, curved, and thin dentinal walls.[4] In an attempt to minimize these challenges, a new generation of instruments has been introduced with varying tapers, noncutting safety tips, and varying length of cutting blades have been implemented to obtain optimal canal preparations.

The Kedo-S pediatric rotary file was an exclusive rotary file system for primary teeth. It is a single file system consists of D1, E1, and U1. The overall length of the file is 16 mm and the working area is 12 mm in length (cutting flutes). The presence of variable taper (4–8%) with different tip diameters of D1–0.25, E1–0.30, and U1–0.40 contributing to its use in primary teeth is the uniqueness of these files.[5] Mtwo files have been developed in 2003 and include four instruments with variable tip sizes ranging from 10 to 25 and flutes ranging from 0.04 to 0.06 to 0.07. According to the manufacturer, the minimally invasive Mtwo Ni–Ti instruments can be used without initial coronal enlargement in single-length techniques.[6,7]

Schafer reported that the original curvature of the canal is maintained due to the high flexibility and fatigue resistance of the Mtwo instruments, and that the procedure is successful, safe, and timely.[8,9] Hence, this study was conducted using Kedo-S and Mtwo rotary files through cone-beam computed tomography (CBCT) to compare and evaluate the amount of dentin removal, lateral perforation, and instrumentation time.

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Materials and Methods

The present study was conducted in the Department of Pediatric and Preventive Dentistry, Faculty of Dental Sciences, Sri Ramachandra Institute of Education and Research. The study was ethically approved by the Institutional Advisory Committee of the Sri Ramachandra Institute of Education and Research in Chennai.

Sample Size Calculation and Distribution

Using a power calculation, a sample size of 50 was derived considering the previously reported studies that yielded 80.0% power ([Type II error = 0.20] and 5% Type I error probability [= 0.05]) in detecting the true statistically signatory difference between two rotary instrumentation for each tooth across the two study groups. These selected teeth were numbered in sequence and the online randomization application used was www.randomiser.org for the two sample groups of 25 teeth each.

Storage and Selection of the Samples

The collection, storage, sterilization, and handling of the extracted teeth compliance with the guidelines and regulations of the Occupational Safety and Health Administration.[10] Fifty human primary mandibular first molars extracted not relevant to this study were compromised in the overall sample of the research and stored in 10% formalin. The teeth were extracted due to poor prognosis and over-retention beyond the age of exfoliation. The inclusion criteria for the study are primary mandibular first molars with a minimum of 7 mm root length without any evidence of defects or abnormal morphology. Teeth with inadequate root length (<7 mm), teeth showing radiographic evidence of calcified canals, and presence of visual perforations were excluded from the study. Using the sectioning disk, all the sampled teeth had their crowns cut off horizontally at the CEJ level. In a block of wax of standardized size, the sectioned roots were placed. As it is rounded, short, and conical apically, the distal roots of the primary mandibular molar have been selected.[11] Standard access cavities were made with a diamond bur (BR 40, MANI, INC, Japan). The distal root canal for all the teeth were negotiated by number 10 stainless steel file.

Sample Preparation

The 50 teeth from each group were randomly assigned to two experimental groups containing 25 teeth. The group I was instrumented with E1 Kedo-S files (Reeganz Dental Care Pvt. Ltd. India) with X Smart Endodontic motor (Dentsply Maillefer, Switzerland) were used to prepare the canal at a speed of 300 rpm and a torque of 2.2 N cm. Group II was instrumented with 21-mm-long Mtwo basic sequence Ni–Ti rotary files (VDW, Munich, Germany) driven by an X Smart Endodontic motor (Dentsply Maillefer, Switzerland) at a speed of 300 rpm and a torque of 1.2 N cm were used. The canals were prepared for the full length by single length technique without early coronal enlargement. Three Mtwo basic sequence instruments (10/0.04, 15/0.05, and 20/0.06) were used in primary teeth. Each instrument was used five times and then discarded. The canals were irrigated with 3 mL of 5.25% NaOCl solution for all groups after each file was used. During instrumentation, lubrication was obtained using Glyde (Dentsply, Maillefer) and 1 mL of 17% ethylenediaminetetraacetic acid was used for 1 minute after instrumentation, followed by a final flush of 3 mL of NaOCl. All irrigation procedures were performed with a 27-gauge needle.

Sample Scanning

On the modeling wax sheet, all the teeth were arranged, and teeth were scanned before and after preparation with cone-beam computed tomography. (Planmeca ProMax® 3D Mid) with a standard field of view = 80 × 80 mm; voxel size of 200 mm; 90 kV and 10 mA; exposure time of 12 s; and slice thickness of 0.4 mm. CBCT images were analyzed with the Romexis® digital imaging software, version 3.5.2 (Planmeca, Helsinki, Finland). The CEJ was taken as a reference point. The preparation of the canal has been assessed at three levels. At 2 mm below the CEJ, the cervical level was measured. At 4 mm below CEJ, the middle level was analyzed. At 6 mm below CEJ, the apical level was determined (Fig. 1).

A formula A1-A2 is used after the root canal preparation to measure the dentin removal of the mesial side of the root. Where A1 is the shortest distance in the axial section between the mesial periphery of the canal and the mesial periphery of the root of the noninstrumented canal, A2 is the shortest distance in the axial section between the mesial periphery of the canal and the mesial periphery of the root of the instrumented canal. The formula B1-B2 is used to determine the removal of dentin from the distal side after the preparation of the root canal. The shortest distance between the distal periphery of the canal and the distal periphery of the root of the noninstrumented canal is B1, and the shortest distance between the distal periphery of the canal and the distal periphery of the instrumented canal in axial sections is B2 (Fig. 2).[12] The time for instrumentation (instrumentation and irrigation) was measured by a digital chronometer. Any discontinuity at the apical level was deemed to be a lateral perforation on the surface of the cross-section slices of the teeth samples.

Statistical Analysis

From the sample of each study group, the mean and standard deviation for dentin removal and instrumentation time were calculated. The mean values of the various sample groups were compared, and the *p*-value was calculated using T test. The Levene test was used at the significance level and was established at 0.05. Lateral perforations were estimated for each study group by using Pearson's Chi-square Test was used to calculate the *p*-value.

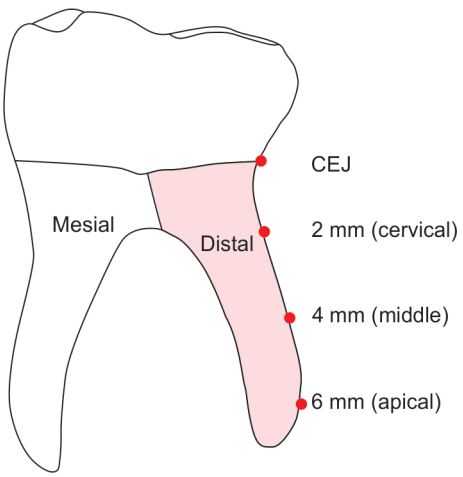


Fig. 1: Diagrammatic representation of references used for cervical, medium, and apical regions

Results

Amount of Dentin Removal

The mean and standard deviation based on the type of instrumentation in amount of dentin removal on the mesial and distal side is listed in (Tables 1 and 2). At all three levels, the statistical analysis did not reveal a significant difference between Kedo-S and Mtwo.

Instrumentation Time

A significant difference in the instrumentation time of Kedo-S and Mtwo was found. The mean instrumentation time of Kedo-S was 53.4 seconds compared with that of Mtwo which was 3 minutes 20 seconds (Table 3 and Fig. 3).

Lateral Perforation

Results regarding root perforation are summarized in (Table 4) The statistical analysis reveal a significant difference between Kedo-S and Mtwo files.

Discussion

Barr et al. first described the rotary biomechanical preparation of deciduous teeth.[2] A reasonable amount of dentin residue thickness is needed for providing adequate resistance for lateral and occlusal forces in an endodontically treated teeth.[13] The length of treatment in pediatric dentistry is very significant for the reduction of anxiety among children. The shorter duration of treatment reduces anxiety, thereby making the treatment

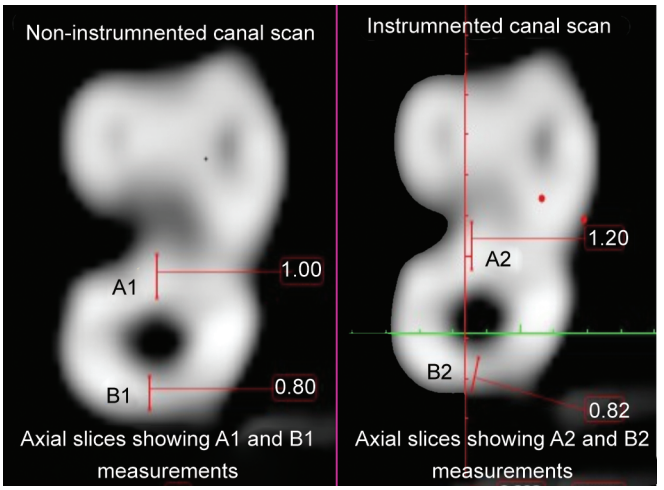


Fig. 2: Removal of dentin measurements

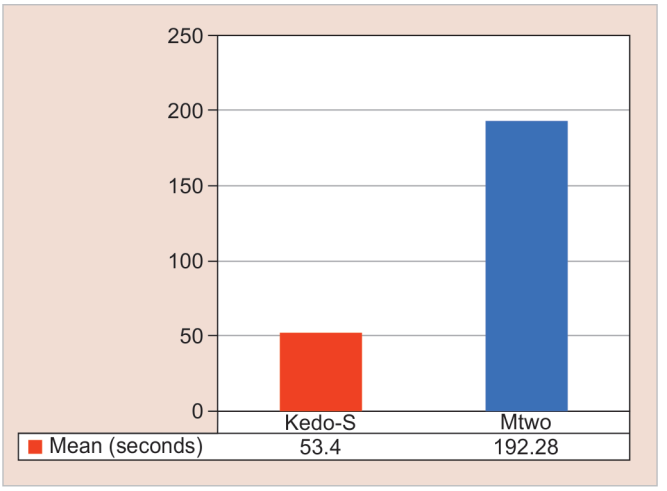


Fig. 3: Instrumentation time

Table 1: Mean comparisons of dentin removal between Kedo-S and Mtwo on the mesial side

Variables	*Kedo-S Mean ± SD*	*Mtwo Mean ± SD*	*Mean difference*	*p-value*	*95% CI (lower)*	*95% CI (upper)*
Cervical	0.14 ± 0.15	0.12 ± 0.10	0.18	0.56 (NS)	–0.04	0.07
Middle	0.11 ± 0.16	0.07 ± 0.06	0.40	0.25 (NS)	–0.03	0.11
Apical	0.12 ± 0.22	0.07 ± 0.07	0.56	0.25 (NS)	–0.04	0.15

p value = Significant *p*-value, *p* value < 0.05 = Statistically significant; SD, standard deviation; CI, confidence interval; NS, not significant

Table 2: Mean comparisons of dentin removal between Kedo-S and Mtwo on the distal side

Variables	*Kedo-S Mean ± SD*	*Mtwo Mean ± SD*	*Mean difference*	*p-value*	*95% CI (lower)*	*95% CI (upper)*
Cervical	0.14 ± 0.16	0.09 ± 0.06	0.04	0.04 (NS)	-0.02	0.11
Middle	0.14 ± 0.17	0.09 ± 0.076	0.14	0.05 (NS)	-0.01	0.13
Apical	0.14 ± 0.16	0.08 ± 0.07	0.08	0.06 (NS)	-0.01	0.14

p value = Significant *p*-value, *p* value < 0.05 = Statistically significant, SD, standard deviation; CI, confidence interval; NS, not significant

Table 3: Comparison of instrumentation time between Kedo-S and Mtwo

	Mean	*Standard deviation*	*p-value*
Kedo-S (n = 25)	53.40	6.305	< 0.00* (Sig.)
Mtwo (n = 25)	192.28	38.952	

*$p < 0.05$, statistically significant; Levene's test for equality of variances

Table 4: Lateral perforation

Perforation	*Kedo-S file (n = 25)*		*Mtwo file (n = 25)*		*p value **
	No of teeth	%	No of teeth	%	
Apical	3	12	7	28	0.04 (Sig)

*Pearson's Chi-square test was used to calculate the *p*-value.

protocol optimal.[14] CBCT has recently been put to good use in endodontics as it enables the amount of dentin removed to be measured in a nondestructive method.[15] Therefore, the purpose of the study is to use Kedo-S and Mtwo files using CBCT to determine the amount of dentin removal, instrumentation time, and lateral perforation.

On the mesial and distal surface, no significant difference in the amount of dentin is removed between the Kedo-S and Mtwo files at all the three levels which is in accordance with the results obtained by Prabhakar AR in a similar study comparing wave one and one shape single file system in primary teeth.[16] The extent to which dentin is eliminated indicates the aggressiveness of the instrument.

The time required for Kedo-S rotary files during canal preparation was shorter than Mtwo files in primary teeth, which was statistically significant and consistent with the results obtained by Govindaraju L et al. and Panchal V et al.[17,18] This can be credited to the flute length of the Kedo-S file, which is approximately 12 mm[5] and we used a single file in Kedo-S (E1) while in the Mtwo file three sequences used.

In the Mtwo files, the perforation was higher than in the Kedo-S files in the apical area. The results obtained in this study are consistent with a study by Selvakumar et al. which revealed that 2% taper K_3 showed less perforation than 4% taper K_3 in primary teeth.[19] Primary tooth perforation is common in the apical region due to the thinness of the dentinal walls of these sections, resulting in perforation-sensitive areas that should be considered during treatment planning.[20]

There were limitations to this research. It was preferable to compare the results with a conventional file. Since the instrumentation time taken by rotary files relative to that of stainless steel hand instruments is already established, we concentrated on the Kedo-S file which is an exclusively pediatric file with a well-tested Mtwo file which maintains the original curvature of the root canal which are efficient and safe.[8,9] Another drawback of the study is that all parameters have been determined in distal canals.

The benefit of the study was that the procedure was conducted in the natural teeth by a single operator in order to enhance the outcomes to clinical conditions and the use of high-precision software.

Conclusion

The following conclusions are based on the evaluation of the results of the present study

- There are no statistically significant differences in the amount of dentin removed compared to the mesial and distal side at all three levels in the Kedo-S and Mtwo files.
- Preparation of canals with a Kedo-S rotary files reduces instrumentation time and perforation compared to Mtwo files.
- Additional research to evaluate the various other aspects of the Kedo-S rotary file is required to evaluate its use under clinical conditions.

Clinical Significance

The overall length of the Kedo-S is smaller (16 mm), so the use of Kedo-S rotating files is well suited for pediatric dentistry, particularly in the treatment of uncooperative children. This study focuses on the use of Kedo-S files in primary teeth as it requires less instrumentation time and provides substantial dentin removal thus reducing the risk of lateral perforation.

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