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Original Research Article

Comparative evaluation of pediatric rotary file system and a single file technique on the quality of root canal preparation on deciduous teeth: a combined *in-vivo* and *in-vitro* study

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ABSTRACT

Background: Pulpectomy is the conservative treatment that retains and preserves the primary tooth in the dental arch in its function and non-pathologic state until its exfoliation. Over recent years, pulpectomy has been performed using various instrumentation techniques. The aim of this study was to evaluate the instrumentation time, taper and quality of obturation using pediatric rotary file system and a single file technique.
Methods: Pulpectomy was performed on 40 patients and 40 3D printed models of primary second molar for the study. Kedo-S rotary files, Pro AF Baby Gold rotary file system, Pro Taper Sx rotary file and Neo Endo Flex Orifice Opener rotary file were used for instrumentation. Immediate post-operative digital radiographs were taken to evaluate the quality of root filing, taper of canal and root canal instrumentation time was also recorded.
Results: No significant difference was observed in taper and quality of obturation using pediatric rotary file system and a single file technique (p value > 0.05). On comparing mean instrumentation time Neo Endo Flex Orifice Opener rotary file took least time for instrumentation, the highest time taken for instrumentation was seen in Pro AF Baby Gold rotary file system, this was statistically significant (p value <0.001).
Conclusions: With the use of modified rotary file system for pulpectomy in primary teeth, reduction in the instrumentation time has been appreciated.

Keywords: Pediatric rotary file system, Pulpectomy, Single file technique

INTRODUCTION

Maintenance of primary teeth until physiological exfoliation contributes to: mastication, phonetics, aesthetics, prevents development of deleterious habits.[1] Therefore, primary teeth with pulpitis or necrosis should be considered for endodontic treatment.[2] Rotary instrumentation has made a quantum leap in the field of endodontics. These changes lead to introduction of rotary endodontics in pediatric dentistry.[3] Various rotary file systems are available in pediatric dentistry such as: Kedo S, Kedo SG, Kedo SG Blue, Kedo S Square, Pedo Flex, Pro AF Baby Gold, Prime Pedo endo kit.[2]

Recently, the concept of single file systems has been initiated and is currently being discussed for its applicability in endodontics.[4] The functioning and structure of Pro Taper Sx rotary file (Dentsply), Neo Endo Flex Orifice Opener rotary file (Orikam Healthcare

Pvt. Ltd.) in rotary file system of adults is similar to that of pediatric rotary file system.

Till date a few clinical trials have been conducted to demonstrate the efficacy of the various pediatric rotary file systems, and hand file systems. However, there is no comparative study in literature, that have been conducted to evaluate the instrumentation time, taper and quality of obturation using pediatric rotary file systems and modified rotary file systems.

Hence, the present study aimed to comparatively evaluate the instrumentation time, taper and quality of obturation using Kedo-S rotary files (Reeganz Dental Care Pvt. Ltd.), Pro AF Baby Gold rotary file system (Dentalyze), Pro Taper Sx rotary file (Dentsply) Neo Endo Flex Orifice Opener rotary file (Orikam Healthcare Pvt. Ltd.) for pulpectomy in primary molars.

METHODS

The current study is a randomized control trial conducted in the Department of Pedodontics and Preventive dentistry of Ahmedabad Dental College and Hospital, Gujarat, India from 6th August 2021 to 23rd September 2022. After obtaining the ethical clearance from the institutional review board and written consent from parents, a total of 40 patients, aged between 4 to 9 years and 40 3D printed models of maxillary and mandibular primary second molar will be selected for the study based on inclusion and exclusion criteria.

In vitro

Inclusion criteria

40 3D printed models of maxillary and mandibular primary second molar.

Pulpectomy was performed by a single operator who was well-trained in using the different file systems that are used in the current study. Roots of all the models were sealed with modelling wax. Pre-operative digital intraoral periapical radiographs of models were taken prior to the procedure. No.6 round bur was used in a high-speed hand piece for access opening. No.10 size K-file was used to determine the canal patency. Working length was determined using Ingle's method (1975)[5] and was confirmed with radiograph. The cleaning and shaping was done using one of the four systems selected randomly.

Group 1 (n=10): The canals were instrumented using Kedo-S pediatric rotary file system (Reeganz Dental Care Pvt. Ltd.).

Group 2 (n=10): The canals were instrumented using Pro AF Baby Gold rotary file system (Dentalyze).

Group 3 (n=10): The canals were instrumented using Pro Taper Sx rotary file (Dentsply).

Group 4 (n=10): The canals were instrumented using Neo Endo Flex Orifice Opener rotary file (Orikam Healthcare Pvt. Ltd.).

After cleaning and shaping the canals were irrigated with saline. The root canals were then dried and filled with Metapex (Meta Biomed Co. Ltd.). The teeth were then permanently restored using type II Glass ionomer cement (GC). A post-operative digital intraoral periapical radiograph was taken.

In vivo

Approval for the study was obtained from the Ethical Committee of Ahmedabad Dental College and Hospital.

Before the commencement of study, the parents were clearly explained the purpose of study and informed consent was obtained from the parents of patients participating in the study.

Inclusion criteria

Subjects between 4 to 9 years of age, maxillary and mandibular primary second molar that are indicated for pulpectomy, and patient with the following clinical and radiographic characteristics were included in study.

Clinical characteristics

Clinical characteristics were teeth with deep carious lesion with pulpal exposure leading to spontaneous pain or tender on percussion; presence of chronic apical abscess or sinus tract; teeth which can be restored.

Radiographic characteristics

Coronal tooth structure-Radiographic evidence of a deep carious lesion or lesion approximating the pulp.

Pre-operative digital intraoral periapical radiographs of the teeth indicated for pulpectomy were taken prior to the procedure. The teeth were anesthetized with 2% Lignocaine with and isolated using rubber dam (API). No.6 round bur was used in a high-speed hand piece for removing the caries and for access opening. No.330 pear-shaped bur was used to completely de-roof the pulp chamber. N0.10 size K-file was used to determine the canal patency. Working length was determined using Ingle's method (1975) and was confirmed with radiograph. The cleaning and shaping was done using one of the four systems selected randomly.[5] The canals were irrigated with saline. The root canals were then dried & filled with Metapex (Meta Biomed Co. Ltd.). The teeth were then permanently restored using type II Glass ionomer cement (GC). A post-operative digital intraoral periapical radiograph was taken.

Group 1 (n=10): The canals were instrumented using Kedo-S pediatric rotary file system (Reeganz Dental Care Pvt. Ltd.).

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Group 3 (n=10): The canals were instrumented using Pro Taper Sx rotary file (Dentsply).

Group 4 (n=10): The canals were instrumented using Neo Endo Flex Orifice Opener rotary file (Orikam Healthcare Pvt. Ltd.).

After cleaning and shaping the canals were irrigated with saline. The root canals were then dried & filled with Metapex (Meta Biomed Co. Ltd.). The teeth were then permanently restored using type II Glass ionomer cement (GC). A post-operative digital intraoral periapical radiograph was taken. All the teeth were evaluated based on:

Quality of obturation (Coll & Sadrian - 1996)[6]

Score 1: All the canals were filled more than 2 mm short of apex.

Score 2: One or more of the canals having obturating material ending at the radiographic apex or up to 2 mm short of the apex.

Score 3: Any canal showing obturating material extending beyond the radiographic apex.

Voids: Obturated canals showing voids (presence/absence).

Instrumentation time: The time taken during instrumentation of files was recorded in seconds using stop watch.

Taper of canal: It was evaluated using pre-operative and post-operative radiograph by two different examiners who were blinded to the file system.

Statistical analysis

Statistical analysis was done using Chi square test to compare four groups, one-way ANOVA to compare the time of instrumentation and Kappa test for interobserver variability.

RESULTS

Majority of the teeth showed score 2 criteria in all 4 groups while comparing quality of obturation between 4 groups, no significant difference was observed by examiner 1 and examiner 2 (p value >0.05) (Table 1).

Table 1: Quality of obturation.

Examiners	Quality of obturation	Groups				P value
		Group 1 N (%)	Group 2 N (%)	Group 3 N (%)	Group 4 N (%)	
Examiner 1	Score 2	16 (80.0)	13 (65.0)	13 (65.0)	18 (90.0)	0.187 (NS)[ǂ]
	Score 3	4 (20.0)	7 (35.0)	7 (35.0)	2 (10.0)	
Examiner 2	Score 2	16 (80.0)	13 (65.0)	13 (65.0)	18 (90.0)	0.187 (NS)[ǂ]
	Score 3	4 (20.0)	7 (35.0)	7 (35.0)	2 (10.0)	

[ǂ]NS = Non-significant (p value>0.05; Chi square test)

Table 2: Presence and absence of voids in obturation.

Examiners	Voids	Groups				P value
		Group 1 N (%)	Group 2 N (%)	Group 3 N (%)	Group 4 N (%)	
Examiner 1	Voids present	3 (15.0)	4 (20.0)	7 (35.0)	6 (30.0)	0.446 (NS)[ǂ]
	Voids absent	17 (85.0)	16 (80.0)	13 (65.0)	14 (70.0)	
Examiner 2	Voids present	3 (15.0)	4 (20.0)	7 (35.0)	5 (25.0)	0.491 (NS)[ǂ]
	Voids absent	17 (85.0)	16 (80.0)	13 (65.0)	14 (75.0)	

[ǂ]NS = Non-significant (p value>0.05; Chi square test)

Majority of the teeth showed absence of voids in all 4 groups while comparing presence and absence of voids in obturation between 4 groups, no significant difference was observed by examiner 1 and examiner 2 (p>0.05) (Table 2).

Majority of the teeth showed adequate taper in all 4 groups while comparing adequacy and inadequacy of taper of canals between 4 groups, no significant difference was observed by examiner 1 and examiner 2 (p>0.05) (Table 3).

Table 3: Taper of canals.

Examiners	Taper	Groups				P value
		Group 1 N (%)	Group 2 N (%)	Group 3 N (%)	Group 4 N (%)	
Examiner 1	Adequate taper	16 (80.0)	16 (80.0)	16 (80.0)	17 (85.0)	0.970 (NS)[ǂ]
	Inadequate taper	4 (20.0)	4 (20.0)	4 (20.0)	3 (15.0)	
Examiner 2	Adequate taper	18 (90.0)	16 (80.0)	16 (80.0)	17 (85.0)	0.970 (NS)[ǂ]
	Inadequate taper	2 (10.0)	4 (20.0)	4 (20.0)	3 (15.0)	

[ǂ]NS = Non-significant (p value>0.05; Chi square test)

Table 4: Instrumentation time.

	Group 1	Group 2	Group 3	Group 4	P value
Mean instrumentation time	2.14±0.51	4.109±0.29	1.13±0.23	1.062±0.20	<0.001*

*p value <0.001 = Significant; one way ANOVA test

On comparing mean instrumentation time, Group 4 took least time (1.0616) followed by Group 3 (1.1295), Group 1 (2.1395) and the highest time taken for instrumentation was seen in Group 2 (4.1085). This was statistically significant (p<0.001) (Table 4).

Interobserver variability was seen only for taper of canals. Kappa statistics showed kappa value for taper of canals as 0.151 and Group 1 and Group 4 has good agreement; all others have excellent absolute agreement.

DISCUSSION

Till date many clinical trials have been conducted to demonstrate the efficacy of the various pediatric rotary file systems, and hand file systems. But there are not enough studies focusing on the comparative study in literature, that have been conducted to evaluate the instrumentation time, taper and quality of obturation using pediatric rotary file systems and modified rotary file systems. The age criteria used in present study was children between 4-9 years. This was keeping in mind the exfoliation rate of both, the maxillary and mandibular primary molars.

Comparison of all the four file systems was done based on the Quality of obturation and presence and absence of voids using Coll et al criteria-1996, similar criteria was chosen by Juliet et al, Lakshmanan et al, Shah et al.[6-9] The time taken during instrumentation of files was recorded in seconds using stop watch, similar criteria was chosen by Juliet et al, Lakshmanan et al.[7,8] Taper of canal was evaluated using pre-operative and post-operative radiograph by an operator who was blinded to the file system, similar criteria was chosen by Ghafoor, Robia (2014).[10]

In the present study, on comparing mean instrumentation time, Neo Endo Flex Orifice Opener rotary file (Orikam Healthcare Pvt. Ltd.) took least time with mean instrumentation time 1.0616 followed by Pro Taper Sx rotary file (Dentsply) with mean instrumentation time 1.1295, followed by Kedo-S pediatric rotary files (Reeganz Dental Care Pvt. Ltd.) with mean instrumentation time (2.1395) and the highest time taken for instrumentation was seen in Pro AF Baby Gold rotary file system (Dentalyze) 4.1085. This was statistically significant with p value <0.001.

A study was conducted by Sleiman et al (2007) illustrated through a series of 2 clinical cases the advantages of using the K3 Orifice Openers in pulpectomy of primary teeth.[11] They concluded that the Ni-Ti rotary files especially the K3 17mm orifice opener have the advantages of a fast reliable shaping technique. Results of this study is in accordance to the present study.

A study was conducted by Govindaraju et al compared the quality of obturation and instrumentation time during root canal preparation using hand files and modified rotary file systems in primary molars.[12] They concluded that no significant differences were noted with regard to the quality of obturation (p=0.791). However, a statistically significant difference was noted in the instrumentation time between the three groups (p<0.05). S2 Pro Taper Universal rotary system had significantly lesser instrumentation time when compared to that of K3 rotary system and hand file system. Results of this study is in accordance to the present study.

Root canal preparation is still the most delicate and time-consuming part in root canal treatment, especially when dealing with children. The modified rotary file systems Neo Endo-Flex Orifice Opener rotary file (Orikam Healthcare Pvt. Ltd.) and Pro Taper Sx rotary file (Dentsply) have efficiency and efficacy similar to that of pediatric rotary file system. The working duration decreases and quality of taper and obturation are indistinguishable.

Limitations of the study: The sample size selected for the study might not have been enough to obtain accurate

results. To overcome that more samples should be examined. The present study is that only two-dimensional evaluation of the quality of obturation was performed using intraoral periapical radiograph. Long term follows up is required to assess the clinical and radiographic success of the pulpectomy procedure performed using different instrumentation techniques.

CONCLUSION

The current study concludes that with the use of modified rotary file system for pulpectomy in primary teeth, marked reduction in the instrumentation time along with adequate taper and quality of obturation has been appreciated resulting in decreased chair side time and pulpectomy performed with great ease which helps dentists and children feel less tired thereby positively influencing the child's behaviour.

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