

EVALUATION OF CLEANING EFFICACY BETWEEN TWO ROTARY FILES AND MANUAL K-FILE IN DECIDUOUS MOLARS: AN IN VITRO-STUDY

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ABSTRACT

Aim: The purpose of the current study was to evaluate the cleaning efficacy of manual files compared to two different pediatric rotary endodontic files.

Methodology: The study was conducted as an in-vitro study, on thirty extracted primary molar teeth. Teeth were randomly divided into three groups; Group I: Manual K-files, Group II: Kedo-S Square rotary files and Group III: Kedo S-SG Blue rotary files. Teeth were firstly injected by india ink using insulin syringe then canals were prepared by the files. After canal instrumentation with files, the teeth were subjected to decalcification, dehydration, and clearing till teeth became transparent for scoring and evaluation of amount of ink removed.

Results: There was a significant difference between Manual group and the two rotary groups (p value <0.001) with mean value (2.67±0.48), (1.47±0.89), and (1.47±0.93), for manual, Kedo S-Square and Kedo S-SG Blue respectively.

Conclusion: Pediatric rotary files showed better cleaning efficacy compared to manual K-files and they can be considered as alternative to hand instrumentation.

KEYWORDS: primary molars, rotary files, pulpectomy, India ink

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INTRODUCTION

It's important to preserve primary teeth till the time of their physiological exfoliation. They play an important role in mastication, aesthetics, and phonetics. They also prevent future oral habits in children and help in proper eruption of succeeding permanent dentition in its ideal position.¹

Pulp therapy is the choice of treating restorable primary teeth with pulp involvement, and pulpectomy is the best choice to treat teeth that show signs of irreversible inflammation of the pulp or teeth with necrotic pulp tissues.² The main objective of root canal treatment is the elimination of microorganisms, and this is achieved through mechanical removal of inflamed pulp tissues, remaining non vital tissues and infected debris followed by chemical irrigation of the canals. Hence, cleaning and shaping is a very important step to eliminate organic debris and achieve a successful pulpectomy procedure.³

Challenging problems maybe present when performing root canal therapy in primary molars like difficulty in preparation of canals with different variations, long preparation time and specific behavior management requires advances to up to date techniques.⁴

Rotary Ni-Ti files were established into dentistry to overcome the burdens of the manual files. In permanent teeth, the use of rotary files has shown to be more efficient in curved root canals. They grant more flexibility and enhance automated instrumentation.⁵

Rotary files used in permanent dentition are long in length which makes its use in primary dentition more difficult because pediatric patients have limited mouth opening. Accordingly, new especially designed Ni-Ti rotary files were manufactured for primary teeth with shorter length to facilitate and fasten their instrumentation.⁶

Methodology:

Thirty maxillary second primary molar teeth were collected from outpatient clinics in Pediatric Dental Public Health, Faculty of Dentistry, Ain Shams University, and other private clinics without knowing the patients they belong to. Teeth chosen in the study were with minimum 7mm in root length without showing any signs of internal or external resorption. Teeth were washed and cleaned under running water to remove any soft tissue residuals and they were stored at room temperature in sterilized water until experiments were conducted.⁷

An access cavity was performed coronally in the tooth with a round bur size #4 and access opening was obtained with short diamond stone till complete deroofting. The pulp tissue was removed with a sharp spoon excavator, then the root canals were located. Working length was determined with a #10 or #15 file, the file was introduced into the canal until its tip was visible at the apex and the working length was determined 1 mm short of the apex. Organic debris in the pulp chamber and root canals were removed by 1% sodium hypochlorite and saline irrigation solution. Afterwards, the canals were irrigated with normal saline, then with paper points drying the canals, and the roots were isolated with petroleum gel from the outside surface of the tooth. Subsequently, india ink dye was inserted coronally in the canals using an insulin syringe until it leaked out from the apical foramen. The ink was reapplied couple of times into the canals to warrant the complete staining of the canals, the teeth were then stored in wet at room temperature for 48 hours.⁸

The selected thirty molar teeth were divided into 3 groups randomly using research randomizer software so that each group consisted of 10 teeth, mesiobuccal and palatal canals were only instrumented in root canals (with total 60 canals). They were divided according to the file used for the preparation, Group (I): canals were instrumented using manual K-files up to size #40 through step-back technique, Group (II): The canals were prepared

with a rotary Kedo S -Square P1 file (Reeganz Dental Pvt Ltd) which is a single file system used for primary molars, Group(III): preparation of the canals was completed with Kedo-S SG Blue rotary files system (Reeganz Dental Pvt Ltd); where D1 is used for narrow mesiobuccal canal and E1 is used for wide palatal canal. The root canals were irrigated with 1% sodium hypochlorite then saline solution after each instrumenting file, also #10 size K-hand file was inserted at the beginning and after each file to check the patency of the root canals. The pulp chambers of all the prepared teeth were then filled with temporary cement and the apical ends were sealed with wax. It must be mentioned that a pilot study was carried out at the beginning of this study.

Method of teeth decalcification:

Teeth were placed in a glass jar containing 7% hydrochloric acid (HCL).^{9,10} The acid solution was changed on daily basis to keep its efficiency until the teeth were decalcified totally (for two days).^{10,11} Then, they were placed under running water till complete wash of any acid away from its surface.⁴

Method of teeth dehydration:

Teeth were then subjected to dehydration by placing them in a series of ethyl alcohol concentrations.^{6,8,12}

70% alcohol for 16 hours (changed every eight hours), 80% alcohol, 95% alcohol, 100% alcohol respectively each for 8 hours.

Assessment of ink removal:

Firstly, teeth were sectioned buccolingually, and were placed in a glass petri dish containing methyl salicylate and examined under a stereomicroscope ($\times 10$ magnification, Olympus, Japan) in Oral Pathology Department, Ain Shams University. The examination was done by two blind observers (Kappa score= 0.727) according to a 4-points score system which evaluates ink removal along the root canal walls as follows, **Figure(1):**⁷

- 0=** Total clearing, the canal was completely clean and without ink.
- 1=** Almost complete ink removal, (traces of ink found in some areas\ more than 50% ink removal)
- 2=** Partial ink removal, (less than 50% ink removal\ ink found on some walls in some areas larger than pinpoint or as interrupted short lines of ink less than 0.5mm on the walls).
- 3=** No ink removal.

Each root is evaluated separately, the root was divided into three thirds (coronal, middle, and apical) then evaluated and scored blindly by two different operators.

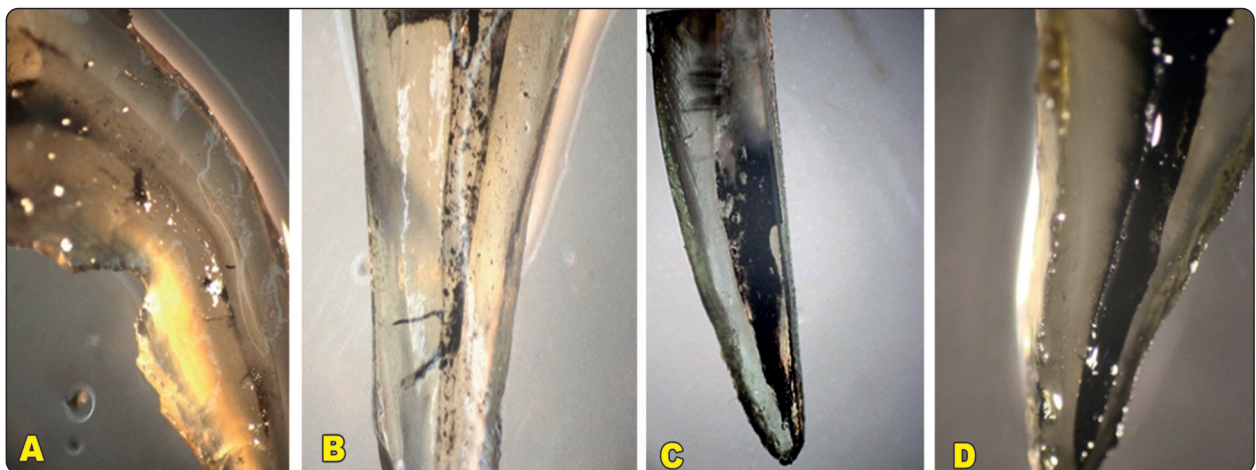


Fig. (1) Clearing Scores; (A) Score 0= complete cleaning of the canal, (B) Score 1= more than 50% ink removal, (C) Score 2= less than 50% ink removal (D) Score 3= ink not removed.

RESULTS

The samples evaluated in the present study consisted of 60 root canals in extracted primary maxillary second molar teeth, the highest value revealed the least cleaning efficacy. The results were reported as shown in Table (1) and Figure (2).

There was a significant difference between different groups (p value <0.001). The highest value was found in manual files (2.67 ± 0.48), followed by Kedo S-Square (1.47 ± 0.89), and Kedo S-SG Blue (1.47 ± 0.93). Post hoc pairwise comparisons explained that manual k-files to have significantly greater value than the other two groups ($p < 0.001$).

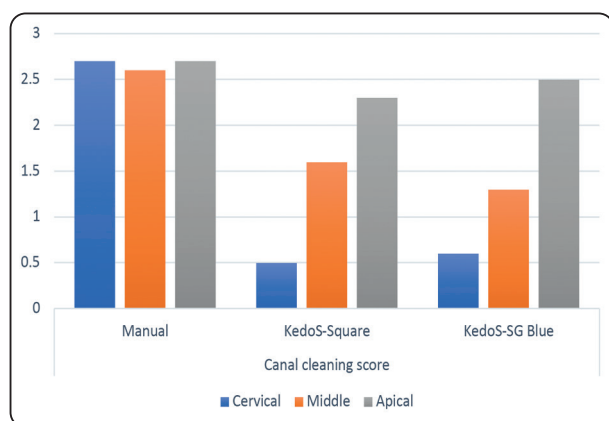


Fig. (2) Bar chart showing average canal cleaning score for different sections.

DISCUSSION

Pediatric Endodontics has been performed for years using conventional hand instrumentation and is considered a gold standard method. However, manual techniques are time consuming causing fatigue to both the operator and the pediatric patients which has a significant impact on behavior management.¹³ Rotary Ni-Ti files are considered at the forefront advances in the endodontic treatments of primary teeth,¹⁴ and they were firstly launched by Barr et al in 2000.¹⁵

The usage of files with greater tapers should permit more apical deposition of the irrigant, enabling easy removal of pulp tissue, bacteria, necrotic debris, and dentin by the cleaning effect of both physical instrumentation and chemical irrigation.¹⁶

Canal cleaning is very important to ensure removal of any debris and necrotic tissue remnants¹⁵, thus the aim of this study was to compare the cleaning efficacy of manual K files and two different pediatric rotary files. There were previous studies that have already comparatively evaluated the effectiveness of rotary Ni-Ti with hand instruments in the cleaning of root canals.¹⁷ In our study, we used india-ink injection and teeth clearing

TABLE (1)

Root section	Canal cleaning score (mean \pm SD)			p-value
	Manual	KedoS-Square	KedoS-SG Blue	
Cervical	2.70 \pm 0.47 ^{Aa}	0.50 \pm 0.51 ^{Bc}	0.60 \pm 0.50 ^{Bb}	<0.001*
Middle	2.60 \pm 0.50 ^{Aa}	1.60 \pm 0.50 ^{Bb}	1.30 \pm 0.47 ^{Bb}	<0.001*
Apical	2.70 \pm 0.47 ^{Aa}	2.30 \pm 0.47 ^{Aa}	2.50 \pm 0.51 ^{Aa}	0.053ns
p-value	0.717ns	<0.001*	<0.001*	
Overall	2.67 \pm 0.48 ^A	1.47 \pm 0.89 ^B	1.47 \pm 0.93 ^B	<0.001*

Means with different upper and lower case superscript letters within the same horizontal row and vertical column respectively are significantly different *; significant ($p \leq 0.05$) ns; non-significant ($p > 0.05$)

technique for this purpose, this technique makes the teeth clear and transparent; therefore, the pulp space and canal walls become more observable.⁹ A Pilot study was carried out to confirm that the irrigation solution could not remove dye solely, and the ink is stable during the experiment steps

The results of cleaning efficacy measures pointed that there was an overall difference between manual and rotary groups, but no significant difference was found between the two different rotary files. Kedo S-Square and KedoS -SG Blue rotary files showed better cleaning efficacy.

Kedo-S Ni-Ti rotary files are characterized by gradual increase in taper promoting coronal enlargement and straight access. This variation in the taper gives better canal preparation, enhanced cleaning efficiency and it preserves the inner wall of the root surface.⁷ The difference in the cleaning capacity could be due to various factors, one of which is the technique used by the operator. K files instrumentation depends on the experience and the skill of the operator and also the motion of the hand during root canal preparation while rotary instrumentation does not depend on the operator skills only. A file with 0.25 tip size and 4% taper is required for sufficient canal preparation in apical and middle thirds whereas in the cervical one-third a file with 6% taper promotes better canal preparation.¹⁸

Stainless steel K-Files are stiffer than Ni-Ti instruments thus they tend to be straightened in the root canal, in this manner they partially contact the anti-curve portion of the canal and hence results in reduction of the cleaning efficacy.

These findings were supported by **Musale et al 2014**¹⁹, **Devi et al.2016**²⁰, **Katge F et al.2019**⁶ and **Kalita et al 2021**.⁷ But generally, and in spite of the similarity of our results others, we emphasize that there were many different methodologies between the current study and the previous ones; including the techniques used to evaluate canal cleaning, the type of rotary system used, and the sequence and number of instruments during preparation.

In contrast to our study, **Azar et al.2012**²¹ conducted that there were no statistically significant differences in the cleaning efficiency between manual and rotary instruments. **Ramezanali et al.2015**⁹ showed no significant difference in the cleaning efficacy of the two rotary system and manual K-files. **Mehlawat R et al. 2019**²² showed no statically significant difference in cleaning efficacy among test groups in all thirds of root canals.

CONCLUSION

Within the limitations of our current study, the results showed overall better cleaning efficacy with both rotary pediatric rotary files than manual K-files. However, no significant difference was found in the cleaning capacity of the apical third. Still, further studies are needed to assess the instrumentation time needed by Kedo-S files and conducting their use clinically.

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