In Vitro Comparative Assessment of Manual K Files and Rotary File System in Root Canals of Primary Molars

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ABSTRACT

Background: Owing to their inherent stiffness, conventionally used stainless steel K-files are inefficient in the ideal cleaning and shaping of the curved and narrow root canals. Hence, NiTi instruments are widely used in pediatric endodontics due to their better cutting efficacy.

Aims: The present study was done to compare and assess the cleaning efficacy of conventional hand K-files to rotary NiTi instruments in root canal preparation in deciduous molars.

Materials and Methods: 60 extracted deciduous molars were extracted and divided into two groups: Group I (n=20): treated with conventional hand K-files and Group II (n=20) treated with 21mm rotary instruments. Teeth sections with Indian Ink removal were visualized under 40X magnification under a stereoscope. Root canal clinical efficacy was then assessed. The collected data were subjected to statistical evaluation.

Results: Highest cleaning efficacy of hand files was seen in the apical third with 83.33% (n=50) complete cleaning. This difference was statistically significant with p=0.003. On assessing the rotary instruments, it was observed that these instruments were better in cleaning middle and coronal thirds with statistically significant (p<0.001). K-files had better efficacy in cleaning the apical third with p=0.273. For the middle third, better cleaning efficacy was seen for rotary files (76.66%, n=46) compared to K-files (p=0.003). For the coronal third, complete cleaning was better with rotary files with 76.6% (n=46) cases compared to hand K-files with 60% (n=36) cases with p=0.002.

Conclusion: The present study concludes that rotary files are better in cleaning efficacy compared to hand K-files in root canal cleaning of deciduous molars. Rotary instruments have advantages of better taper, reduced appointment time, and chairside time with better shaping and success.

Keywords: cleaning and shaping, K-files, pediatric dentistry, pulpectomy, rotary files.
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INTRODUCTION

Sequence and chronology of eruption for the permanent dentition are largely altered by the premature loss of the primary teeth. This point focuses on the maintenance of teeth in the primary dentition. This preservation in pediatric subjects before physiologic exfoliation is vital for normal phonation, space loss prevention, aesthetics, and/or mastication. The Health and integrity of primary dentition are maintained by various therapies and treatments. One such therapy is pulp therapy/pulpectomies.[1]

The main aim of root canal shaping and cleaning, a step of pulpectomy is removing bacteria containing hard and soft tissues. Cleaning and shaping of root canal also allow the reach of intracanal medicaments and irrigants to the apical region of the root. Cleaning and shaping also help adequate filling of the obturating material in the root. Microbial reduction in endodontic therapy largely governs the success of the pulpectomy procedure. Microbial reduction in the pulpectomy is dependent on maintaining the original curvature of the root canal, debris and pulpal tissue removal, and biomechanical preparation.[2]

Owing to their inherent stiffness, conventionally used stainless steel K-files are inefficient in the ideal cleaning and shaping of the curved and narrow root canals. Hence, in 2000, rotary instruments made of Nickel-titanium (NiTi were introduced in pediatric dentistry. These NiTi instruments are widely used in pediatric endodontics since their introduction in 2000 due to their better cutting efficacy.[3] As these rotary instruments are highly flexible and have various designs, these instruments are efficient in narrow and curved canals. Also, the root canal errors such as apical violation, over-instrumentations, and ledge formation are lesser with rotary NiTi instruments compared to stainless steel conventional hand instruments.[4]

Rotary NiTi instrument system helps in achieving better cooperation in pediatric subjects owing to short chairside time due to better efficacy of these instruments. Also, these instruments are more favored in pediatric endodontic cases as they decrease appointment time along with allowing better compliance and cleaning on original canal anatomy. This also helps in maintaining successor tooth germ and developing teeth.[5] The data concerning the comparison of hand K-files to the rotary instrument system in pediatric subjects are scarce in the literature. Hence, the present study was done to compare and assess the cleaning efficacy of conventional hand K-files to rotary NiTi instruments in root canal preparation in deciduous molars.

MATERIALS AND METHODS

The present in vitro study was done to compare and assess the cleaning efficacy of conventional hand K-files to rotary NiTi instruments in root canal preparation in deciduous molars. The study was conducted at Department Of Pediatric And Preventive Dentistry, Hi-Tech Dental College And Hospital, Health Park, Pandra, Rasulgarh, Bhubaneswar from June 2021 to December 2021, after

obtaining clearance from the concerned Ethical committee. The study samples were constituted by the extracted molars, both mandibular and maxillary, collected from same department.

The inclusion criteria for the study were freshly extracted deciduous molars from either maxillary or mandibular arch with at least the remaining two-thirds root. The teeth with less remaining root were excluded from the study. After final inclusion, extracted teeth were stored in formalin till further processing. A total of 60 extracted deciduous mandibular and maxillary molars with at least the remaining two-third root were stored for 1 week following cleaning with water. The storage media was 0.5% sodium hypochlorite.

After removing from the storage media, caries was removed from the sample teeth and root canal access was made from the coronal area with copious irrigation using normal saline. Following this, K-file no.15 was inserted in the canal to determine the working length, which was kept 1mm short of the anatomic root apex. 2ml Indian Ink was injected from access until it leaked from the apex. The teeth were then divided into two groups: Group I (n=20): treated with conventional hand K-files and Group II (n=20) treated with 21mm rotary instruments. Till working length, instruments were used from 10/.04 to 25/0.6 sequentially.

Following biomechanical preparation, for 3 days, teeth were placed in 5% nitric acid and 5% formic acid for decalcification. This was followed by cleaning in water and drying in alcohol. The coronal portion was then removed till CEJ and 2mm short of the anatomic apex (1mm above working length). The middle section of the remaining tooth part was done and the sections with Indian Ink removal were visualized under 40X magnification under a stereoscope. To assess root canal clinical efficacy, the following scoring criteria were followed: score 0 for total cleaning, score 1: >50% removal of ink, score 2: <50% removal of ink, and score 3: for no removal of the ink.

The collected data were subjected to the statistical evaluation using SPSS software version 21 (Chicago, IL, USA) and t-test for results formulation. The data were expressed in percentage and number, and mean and standard deviation. The level of significance was kept at $p<0.05$.

RESULTS

The present in vitro study was done to compare and assess the cleaning efficacy of conventional hand K-files to rotary NiTi instruments in root canal preparation in deciduous molars. On assessing the cleaning efficacy of convention hand K-files at apical, middle, and coronal third, it was seen that these files were least efficacious in cleaning the middle third 50% (n=30) cases followed by coronal third 60% (n=36) cases. The highest cleaning efficacy of hand files was seen in the apical third with 83.33% (n=50) complete cleaning. This difference was statistically significant with p=0.003. On assessing the rotary instruments, it was observed that these instruments were better in cleaning middle and coronal thirds with a score of 0 and complete cleaning in 76.7% (n=46) cases. In the apical third, complete cleaning was seen in 73.33% (n=44) cases. This cleaning difference was also statistically significant with $p<0.001$(Table 1).

Concerning cleaning efficacy in the apical third, it was seen that hand K-files had better efficacy in cleaning the apical third with 83.33% (n=50) complete cleaning cases, whereas, for rotary NiTi files, this efficacy was in 73.33% (n=44) cases. Also, <50% ink removal was seen in6.66% 9n=4) cases using K-files and 3.33% (n=2) cases using rotary files. However, the difference was statistically non-significant with p=0.273 (Table 2).

For the middle third, better cleaning efficacy was seen for rotary files (76.66%, n=46) compared to K-files (50%, n=30) for complete cleaning. <50% cleaning was seen in 6.66% (n=4) and 3.33% (n=2)

subjects with hand and rotary files respectively. This cleaning efficacy difference was statistically significant (p=0.003) (Table 3).

For cleaning efficacy in the coronal third, complete cleaning was better with rotary files with 76.6^% (n=46) cases compared to hand K-files with 60% (n=36) cases. Also, <50% cleaning was seen in 23.33% (n=14) K-file cases and 3.33% (n=2) cases with rotary files. This difference was also statistically significant with p=0.002 (Table 4).

DISCUSSION

The present in vitro study was done to compare and assess the cleaning efficacy of conventional hand K-files to rotary NiTi instruments in root canal preparation in 60 deciduous molars. The study results showed that the cleaning efficacy of K-files was the least in cleaning the middle third 50% (n=30) cases followed by coronal third 60% (n=36) cases. The highest cleaning efficacy of hand files was seen in the apical third with 83.33% (n=50) complete cleaning. This difference was statistically significant with p=0.003. Concerning rotary instruments, it was observed that these instruments were better in cleaning middle and coronal thirds with a score of 0 and complete cleaning in 76.7% (n=46) cases. In the apical third, complete cleaning was seen in 73.33% (n=44) cases. This cleaning difference was also statistically significant with p<0.001. These results were consistent with the findings by Guelzow A et al[6] in 2005 and Pathak S[7] in 2016 where similar results were reported by the authors on comparing rotary and hand files.

The cleaning efficacy in the apical third with K-files was better with 83.33% (n=50) complete cleaning cases, whereas, for rotary NiTi files, this efficacy was in 73.33% (n=44) cases. Also, <50% ink removal was seen in6.66% 9n=4) cases using K-files and 3.33% (n=2) cases using rotary files. However, the difference was statistically non-significant with p=0.273. These results were in agreement with the results of the studies by Azar MR et al[8] in 2011 and Musale PK et al[9] in 2014 where better cleaning efficacy of conventional files in apical third was reported by the authors.

On assessing the middle third, better cleaning efficacy was seen for rotary files (76.66%, n=46) compared to K-files (50%, n=30) for complete cleaning. <50% cleaning was seen in 6.66% (n=4) and 3.33% (n=2) subjects with hand and rotary files respectively. This cleaning efficacy difference was statistically significant (p=0.003). For cleaning efficacy in the coronal third, complete cleaning was better with rotary files with 76.6^% (n=46) cases compared to hand K-files with 60% (n=36) cases. Also, <50% cleaning was seen in 23.33% (n=14) K-file cases and 3.33% (n=2) cases with rotary files. This difference was also statistically significant with p=0.002. These results were comparable to the findings by Schafer E et al[10] in 2016 and Katge F[11] in 2016 where better cleaning efficacy of rotary files was described by the authors in comparison with the hand K-files.

CONCLUSION

Within its limitations, the present study concludes that rotary files are better in cleaning efficacy compared to hand K-files in root canal cleaning of deciduous molars. Rotary instruments have advantages of better taper, reduced appointment time, and chairside time with better shaping and success. This also improves patient compliance. However, the present study had few limitations including a smaller sample size, geographical area biases, in vitro design, and single-institution nature. Hence, more studies in vivo are warranted to reach a definitive conclusion.

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TABLES

	Cleaning efficacy in Group I (conventional K-files)				
Area	**Score 0**	**Score 1**	**Score 2**	**Score 3**	**p-value**
Apical (%)	83.33	10	6.66	0	0.003
(n)	50	6	4	0	
Middle (%)	50	43.33	6.66	0	
(n)	30	26	4	0	
Coronal (%)	60	16.66	23.33	0	
(n)	36	10	14	0	
	Cleaning efficacy in Group II (rotary NiTi files)				
Area	**Score 0**	**Score 1**	**Score 2**	**Score 3**	**p-value**
Apical (%)	73.33	23.33	3.33	0	
(n)	44	14	2	0	<0.001
Middle (%)	76.66	20	3.33	0	
(n)	46	12	2	0	
Coronal (%)	76.66	20	3.33	0	
(n)	46	12	2	0	

Table 1: Comparison of the cleaning efficacy of K-files to rotary instrument system in the different anatomic areas of teeth

	Cleaning efficacy				
Apical third	**Score 0**	**Score 1**	**Score 2**	**Score 3**	**p-value**
Hand K-files	83.33	10	6.66	0	0.273
	50	6	4	0	
Rotary NiTi Files	73.33	23.33	3.33	0	
	44	14	2	0	

Table 2: Comparison (Intergroup) of the cleaning efficacy of K-files to rotary instrument system in apical thirds

	Cleaning efficacy				
Middle third	**Score 0**	**Score 1**	**Score 2**	**Score 3**	**p-value**
Hand K-files	50	43.33	6.66	0	0.003
	30	26	4	0	
Rotary NiTi Files	76.66	20	3.33	0	
	46	12	2	0	

Table 3: Comparison (Intergroup) of the cleaning efficacy of K-files to rotary instrument system in middle thirds

	Cleaning efficacy				
Coronal third	**Score 0**	**Score 1**	**Score 2**	**Score 3**	**p-value**
Hand K-files	60	16.66	23.33	0	0.002
	36	10	14	0	
Rotary NiTi Files	76.66	20	3.33	0	
	46	12	2	0	

Table 4: Comparison (Intergroup) of the cleaning efficacy of K-files to rotary instrument system in coronal thirds