*MAR Dental Sciences & Oral Rehabilitation (2025) 5:7*

*Research Article*

# Comparative Evaluation of Cleaning Efficacy of Two different Commercially Available file systems. An In Vitro Study.

Gurpreet Kaur [*1], Nagham Adwar Naif Raeealbelha[2], Rabia Singh [3], Mandeep Kaur Baath [4]

1. BDS, Rayat-Bahra Dental College and Hospital, Kharar, Mohali, Punjab, India.

2. BDS, University of Mosul, Mosul, Iraq.

3. BDS, Dasmesh Institute of Research and Dental Sciences, Faridkot, Punjab, India.

4. BDS, Guru Nanak Dev Dental College and Research Institute, Sunam, Punjab, India.

[*]**Correspondence to**: Gurpreet Kaur, BDS, Rayat-Bahra Dental College and Hospital, Kharar, Mohali, Punjab, India.



Received: 07 Jan 2025

Published: 18 Jan 2025

***Abstract***

***Background:*** *Proper cleaning of root canals is crucial in endodontic treatments to prevent infections and ensure long-term success. Deciduous molars, having unique anatomical challenges, require precise techniques to remove debris effectively. Manual files, traditionally used, are compared to modern rotary systems like Kedo-S files, designed to enhance cleaning efficiency. This study aims to evaluate the efficacy of these tools using India ink-stained root canals in deciduous molars.*

***Aim:*** *The aim of this study was to compare the cleaning efficacy of manual and rotary endodontic files in deciduous molars, specifically their ability to remove India ink, used as an indicator of debris, from the root canals.*

***Material and Method:*** *Forty recently extracted deciduous molar teeth were selected, with their root canals stained with India ink. These teeth were randomly divided into two groups of 20: Group 1 was prepared using manual K files, and Group 2 with Kedo-S rotary files. Following instrumentation, each tooth was sectioned into coronal and apical parts, which were then examined under a stereomicroscope to assess cleaning efficacy by scoring the presence of residual India ink.*

***Result:*** *In the coronal sections, manual K files scored 8.2 ± 1.11 while Kedo-S rotary files scored 4.52 ± 1.23. In the middle sections, the scores were 9.35 ± 1.12 for manual K files and 5.96 ± 1.23 for Kedo-S rotary files. These results indicated that the Kedo-S rotary files demonstrated superior cleaning efficacy compared to the manual K files in both coronal and apical sections. Higher scores indicated more residual debris, and thus, the lower scores of Kedo-S rotary files highlighted their better performance in cleaning the root canals.*

***Conclusion:*** *The conclusion of this study was that Kedo-S rotary files are more effective than manual K files in cleaning the root canals of deciduous molars. This superior cleaning efficacy was statistically significant, as confirmed by the Student t-test and ANOVA, with a p-value of less than 0.05. This difference was particularly notable in the coronal and middle sections of the root canals, affirming the effectiveness of Kedo-S rotary files over manual K files in endodontic treatment.****Keywords:*** *Pulpecotmy, Cleaning, Kedo-S, K-file*

## Introduction

The successful cleaning and shaping of root canals are fundamental elements of endodontic therapy, especially within the realm of pediatric dentistry. The unique anatomical intricacies of deciduous molars present practitioners with distinct challenges that require meticulous attention. These challenges stem from the complex and variable morphology of the root canal systems in deciduous teeth, which often includes accessory canals, irregular shapes, and resorption phenomena. Efficient removal of debris and infected tissue from these complex root canal systems is critical to preventing residual infection. This thorough cleaning promotes tissue healing and ensures the long-term success of the therapy.[1-3]

Traditionally, manual K files have been regarded as the gold standard in root canal instrumentation. Their extensive use and popularity can be attributed to several factors, including simplicity, cost-effectiveness, and wide availability. Manual K files allow dentists to manually clean and shape the root canals, giving them direct tactile feedback during the procedure. This feedback is highly valued by many practitioners, as it allows for a more controlled and nuanced approach to canal preparation. The tactile sensation helps in identifying intricate areas within the canal that may require additional attention.[4]

With advancements in dental technology, rotary endodontic systems have emerged as a significant enhancement in the field. These systems offer potential improvements in the speed and effectiveness of root canal cleaning. Among these innovative tools, Kedo-S rotary files have been specifically designed with the aim of enhancing the efficiency of root canal preparation, particularly in pediatric patients. The design of Kedo-S rotary files promises quicker and potentially more effective removal of debris compared to traditional manual methods. These files are engineered to navigate the complex anatomy of deciduous molar canals more efficiently, potentially reducing the time and effort required for thorough cleaning.5

The study presented aimed to evaluate the cleaning efficacy of manual K files relative to Kedo-S rotary files in the preparation of deciduous molar root canals. The specific objective of this study was to assess the capability of each instrumentation method to remove India ink, which was utilized as a marker of debris, from the root canals. India ink serves as a valuable proxy for evaluating the thoroughness of debris removal, an essential component of a successful endodontic treatment. By using a visible marker like India ink, researchers can clearly quantify and compare the effectiveness of each instrumentation technique in cleaning the intricate canal systems of deciduous molars.

## Material and Method

The study aimed to compare the cleaning efficacy of manual K files and Kedo-S rotary files in the root canals of deciduous molars. Forty recently extracted deciduous molar teeth, selected based on predefined inclusion criteria to ensure uniform tooth morphology and condition, were divided into two groups: Group 1, prepared with manual K files (n=20), and Group 2, prepared with Kedo-S rotary files (n=20).

A conventional coronal access cavity was meticulously prepared in the tooth utilizing a small round bur. Subsequently, the coronal pulp was excised using a precise spoon excavator, and the root canals were identified. The radicular pulp was extirpated with a fine broach, and the working length was measured using a #10 file. The file tip was examined under magnification, and the final working length was determined to be 1 mm shorter than the measured length. The pulp chamber and root canals were extensively irrigated with 2.5% sodium hypochlorite and saline solution to effectively remove organic debris. Before instrumentation, root canals were stained with India ink to simulate debris, ensuring a controlled evaluation environment.

Group I: Manual preparation of the root canals was accomplished using 21 mm K files (Dentsply), employing a step-back technique. Group II: The biomechanical preparation of the root canals was executed utilizing Kedo-S rotary files (Reeganz Dental Pvt Ltd) with a crown-down technique. The set consists of three NiTi files (D1, E1, U1) with a total length of 16 mm and an adjusted working length of 12 mm. These files exhibit a variably variable taper. Specifically, the mesiobuccal and mesiolingual canals of mandibular molars, as well as the distal and mesial canals of maxillary molars, were prepared initially with a D1 rotary file, followed by an E1 file when necessary. The palatal and distal canals were exclusively prepared using E1 files.

After instrumentation, canals in both groups were longitudinally sectioned to expose inner surfaces and any remaining stained debris. The sections were examined under a stereomicroscope to assess and score the extent of India ink removal in the coronal, middle, and apical thirds of the root canal.

The evaluation of the root canal cleaning was performed using a scoring system provided by Silva et al. (2004)[6] This system categorizes the cleaning efficacy based on the amount of remaining India ink within the root canals after instrumentation. The scoring criteria are as follows:

Score 0: Whole ink removal (the canal is completely clean with no ink remaining in any part of the root canal).

Score 1: Almost complete ink removal (only small traces of ink are found in some areas).

Score 2: Fractional ink removal (ink is present on some walls in areas larger than pinpoints or as interrupted short lines of ink less than 0.5 mm on the walls).

Score 3: No ink removal (substantial amounts of ink, larger than 1 mm, are present in some areas of the canal walls).

The higher the score, the poorer the cleaning efficacy of the instrument used. Consequently, a lower score indicates that the instrument achieved more efficient cleaning by removing more ink from the canal walls.

## Result

A comprehensive study was conducted to evaluate the effectiveness of Kedo-S rotary files compared to manual K files in cleaning root canals of deciduous molars. The primary focus was on assessing the cleanliness of the root canals in different sections: coronal, middle, and apical. The results indicated a clear preference for Kedo-S rotary files over manual K files.

The manual K files demonstrated higher average cleaning scores across all three sections of the root canal. Specifically, in the coronal section, the manual K files had an average cleaning score of 8.2 with a standard deviation of ±1.11. The middle section showed a higher score of 9.35 with a standard deviation of ±1.12, and the apical section had an average score of 8.95 with a standard deviation of ±1.01.

In contrast, the Kedo-S rotary files presented significantly lower cleaning scores. For the coronal section, the average score was 4.52 with a standard deviation of ±1.23. The middle section had an average score of 5.96 with a standard deviation of ±1.23, and for the apical section, the average score was 4.67 with a standard deviation of ±0.60. (Table 1)

The statistical analysis of these findings underscored the significance of the differences between the two types of files. The p-value was found to be less than 0.05, confirming that the differences in cleaning effectiveness between the Kedo-S rotary files and the manual K files were statistically significant and not due to random chance.

These findings suggest that while manual K files are traditionally used and provide a higher cleaning score, indicating more debris and tissue removal, Kedo-S rotary files offer a more efficient and potentially less operator-dependent alternative. The lower scores for the Kedo-S rotary files suggest they are not as effective at cleaning to the same standard as manual K files.

The study's implications are significant for clinical practice, particularly in pediatric dentistry. The use of rotary files could enhance the efficiency of endodontic procedures within the constraints of child patients' cooperation and time in the dental chair. However, further research might be needed to fully understand the practical applications and to optimize the use of rotary file systems for even better outcomes

**Table I: Comparison of cleaning score of various root sections**

| Group | Root Sections | | |
|---|---|---|---|
| | **Coronal** | **Middle** | **Apical** |
| **Group I** | 8.2 ± 1.11 | 9.35 ± 1.12 | 8.95 ± 1.01 |
| **Group II** | 4.52 ± 1.23 | 5.96 ± 1.23 | 4.67 ± 0.60 |
| **P Value** | <0.05* | <0.05* | <0.05* |

## Discussion

The results of this study provide significant insights into the comparative efficacy of manual K files and Kedo-S rotary files for cleaning root canals in deciduous molars. The superior cleaning performance demonstrated by the Kedo-S rotary files in both the coronal and middle sections support the growing preference for rotary systems in pediatric endodontics. This can be attributed to the inherent design and mechanical advantages of rotary systems, which allow for more efficient debris removal and consistent canal shaping.

The manual K files, although traditionally effective, showed significantly higher average cleaning scores, indicating more residual debris. This could be due to their less aggressive cutting and inability to maintain a consistent canal shape across all sections, especially in the intricate anatomy of deciduous molars. Additionally, manual preparation can be more time-consuming and technique-sensitive, often leading to operator fatigue and potential inconsistencies.[9,10]

The findings from the stereomicroscopic analysis and the statistically significant differences ($p<0.05$) confirmed through Student t-test and ANOVA emphasize the effectiveness of the Kedo-S rotary files. These rotary files likely combine optimal cutting efficiency with better canal conformation, enhancing cleaning efficacy.

However, it’s important to acknowledge some limitations. The study's use of India ink as a debris surrogate, while common, may not perfectly replicate clinical conditions with varied organic and inorganic debris. Moreover, the in vitro setting lacks the biological factors present in vivo, such as dentinal fluid and patient movement, which can affect instrumentation outcomes.[9-11]

Future research should aim to include larger sample sizes and consider clinical trials to validate these findings further. Additionally, investigating different rotary file systems and their impact on various tooth types in a clinical setting could deepen understanding and provide a broader basis for treatment recommendations.

## Conclusion

In conclusion, this study underscores the advantages of Kedo-S rotary files over manual K files in cleaning root canals of deciduous molars. The research highlights several key benefits associated with the use of rotary instruments in pediatric endodontics.

Firstly, Kedo-S rotary files are designed with unique geometries that facilitate efficient debris removal and thorough cleaning of the root canal system. Their rotational motion and consistent cutting efficiency allow for more effective debridement compared to manual K files, which rely on a push-pull motion that may be less efficient and more time-consuming.

Secondly, the use of rotary files significantly reduces the time required for root canal preparation. This is particularly advantageous in pediatric dentistry where patient cooperation can be limited. Shorter treatment times not only improve patient comfort and compliance but also reduce the overall stress and fatigue experienced by the dental practitioner.

Additionally, incorporating rotary systems into pediatric endodontic protocols can enhance treatment outcomes by minimizing the likelihood of incomplete cleaning, which is a common precursor to post-treatment infections. The superior cleaning ability of rotary files helps in achieving a more predictable and successful endodontic treatment.

In summary, the adoption of Kedo-S rotary files in the management of deciduous molar root canals offers significant improvements in treatment efficiency and patient outcomes. The switch from manual to rotary systems could represent a valuable progression in pediatric endodontics, leading to enhanced therapeutic success and overall patient satisfaction.

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