

Comparative Assessment of Efficiency and Obturation Quality of Kedo-S Plus and Kedo-SH Files During Pulpectomy in Primary Mandibular Molars: An Observational Study

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ABSTRACT

Aim: This research aims to evaluate and compare the efficiency and obturation quality of Kedo-S plus and Kedo-SH files during pulpectomy in deciduous molars.

Materials and Methods: The study involved children aged 4–8 years who required pulpectomy for thirty deciduous lower molars. They were randomly divided into two groups: Group I used Kedo-SH files, and Group II used Kedo-S Plus files. A stopwatch recorded the instrumentation time, while Coll and Sadrian criteria assessed the obturation quality. Statistical analysis was performed with the independent t-test and Chi-square test.

Results: The mean instrumentation time for Group I was 190.1 seconds, significantly longer than Group II's 110.1 seconds, with a p-value of < 0.0001. However, no statistically significant differences were found in obturation quality between the two groups.

Conclusion: The Kedo-S Plus group demonstrated reduced instrumentation time compared to the Kedo-SH group while maintaining comparable obturation quality.

INTRODUCTION

Primary teeth play a vital role in a child's dental health, as their loss can lead to pain, space loss, reduced arch circumference, and tooth loss. This can result in complications such as impaired masticatory function, malocclusion from delayed or abnormal eruption of permanent teeth due to space loss, and can hinder a child's growth and development through poor nutritional intake.

Moreover, these issues can foster a negative attitude toward dental care in adulthood, worsening the situation.¹ Pulp canal therapy involves the removal of pulpal and necrotic tissue, followed by canal preparation and obturation with an appropriate resorbable material. Successful biomechanical preparation is critical, as it allows proper irrigation to reach the apical third of the root. The primary objective is to thoroughly debride the root canal and maintain the affected tooth in a healthy state until it naturally exfoliates. Traditionally, hand files

have been used for chemomechanical preparation during pulpectomy procedures.^{2,3}

Using hand files for canal preparation in deciduous teeth can be challenging due to the narrow, curved canals and ongoing physiological resorption. This method may hinder proper filling, extend treatment time, and lead to iatrogenic complications such as ledging, zipping, canal transfer, and apical blockage. The extended duration of treatment can negatively affect the child's behavior during the procedure.⁴

To address these challenges, Nickel-Titanium (Ni-Ti) rotary instruments have been developed for canal preparation in deciduous teeth. According to Barr et al., using Ni-Ti rotary files in these teeth reduced preparation time and facilitated a more consistent, funnel-shaped obturation.⁵

Ongoing research in pediatric endodontics has led to the development of various file systems that offer improved efficacy and additional advantages. While numerous studies have compared Kedo-S Plus rotary files with other hand and rotary files, as well as Kedo-SH manual files with different file types, there is a lack of comparative studies specifically between Kedo-SH manual files and Kedo-S Plus rotary files. As a result, we planned a comparative study to evaluate the efficiency and subsequent obturation quality between Kedo-S plus rotary files and Kedo-SH manual files during pulp canal therapy in deciduous molars.

Materials and Methods: This *in vivo* investigation was a randomized comparative study designed to evaluate the efficiency and obturation quality of Kedo-S Plus rotary files versus Kedo-SH manual files during pulp canal therapy in 30 deciduous molars. Subjects were randomly selected from patients visiting the Outpatient Department. The study included children aged 4 to 6 years, of both genders, who had a Frankel's behavior rating scale of 3 or 4 and no history of systemic conditions. Eligible participants had deciduous molars indicative of irreversible pulpitis, no anatomical defects or unusual morphology, two-thirds of the roots present, coronal radiolucency approaching or involving the pulp and widening of the periodontal ligament (PDL) space suggestive of irreversible pulpitis, and moderate root structure.

Children with a Frankel's behavior rating scale of 1 or 2, special healthcare needs, a sinus tract, extensive loss of tooth structure, root caries, cracked teeth, radiographic evidence of internal or external root resorption, periapical pathology, calcific canals, furcal involvement, severe root angulation, or resorbed roots were excluded from the study. After selecting the subjects, the entire procedure was explained to both the parents and children, and informed consent was obtained from the accompanying parent or guardian. An oral screening was conducted, followed by the recording of a detailed case history. Participants suspected of having irreversible pulpitis underwent radiographic examination to confirm the diagnosis. Subsequently, the subjects were divided into two groups: Group I received treatment with the Manual Kedo-SH file, while Group II was treated with the Rotary Kedo-S Plus file.

The teeth were anesthetized using an inferior alveolar nerve block with a local anesthetic solution, after applying a topical local anesthetic gel (Lox 2% Jelly, Neon Laboratories Ltd). A total of 1.8 mL of 2% lignocaine hydrochloride with 1:200,000 adrenaline (Ligocin 2%, Welox Pharma) was injected at a rate of 1 mL per minute. Once the anesthetic took effect, the treated tooth was isolated with a rubber dam.

After excavating the caries, an opening to the root canal was created using a mini-head airtor and a BR-46 round diamond bur. The pulp chamber was then completely deroofed with an EX-24 diamond bur. A 2% taper No. 10 size stainless steel (SS) K-file was used to locate the canal, and Ingle's radiographic method was employed to determine the working length (WL).

In Group I, which utilized Manual Kedo-SH files, canal instrumentation was performed using Kedo-SH manual files

(Reeganz Dental Care Pvt. Ltd.) with a complete length of 16 mm and flutes extending up to 12 mm, sequentially working until the working length (WL) of the tooth was reached. Canal patency was assessed using a P1 file (white-coded stainless steel K-file with a 0.15 tip and 2% taper) in each canal. Pulpal extirpation was accomplished with a P2 file (yellow-coded stainless steel H-file with a 0.20 tip and 2% taper) in each canal. For canal preparation of the mesiolingual and mesiobuccal canals, a D1 file (red-coded nickel-titanium file with a 4-8% taper and 0.25 tip diameter) was used, while an E1 file (blue-coded nickel-titanium file with a 4-8% taper and 0.30 tip) was employed for the distal canal, following a quarter-pull turn method.

In Group II, initial canal preparation was performed using a size 15 K-file in all canals, followed by the Kedo-S Plus file (P1+) (Kedo Dental). The file was operated at 300 rotations per minute (rpm) and with a torque of 2 Newton-centimeters (Ncm) using an electronic endomotor (XSmart, DENTSPLY India Pvt. Ltd., Delhi, India). The canals were prepared utilizing the crown-down technique, employing pecking motions directed toward the apex until the working length was reached. Once the working length was achieved, a brushing motion was applied twice in both the buccal and lingual directions to remove any remaining debris from the canal.

Active instrumentation time in seconds was recorded by a trained dental assistant using a stopwatch for both groups. This measurement covered the time from when the file was inserted into the canal until it became progressively loose and passive. A 17% EDTA gel was employed during canal preparation, followed by recapitulation. The canals were irrigated with 3% sodium hypochlorite and normal saline. Canals were dried using No. 25 paper points for the mesial canals and No. 30 paper points for the distal canals before obturation with a calcium hydroxide and iodoform paste using a pressure syringe technique. An intraoral periapical radiograph was taken immediately to assess the quality of obturation. A different observer, who was unaware of the instrumentation protocol used, was assigned to evaluate the radiographs.

According to Coll and Sadrian's criteria, the observer graded each radiograph as optimal, overfilled, or underfilled.⁶ Underfilled was defined as canals where the obturating material was radiographically seen to be more than 1 mm short of the radiographic apex. Optimally filled canals had the obturating material extending up to 1 mm short of the radiographic apex, while overfilled canals showed the obturating material extruding beyond the root apex. The access cavity was restored with Type II Glass Ionomer Cement (GIC), and the tooth was coronally sealed with a stainless steel crown using luting GIC. The collected information was subsequently tabulated and sent for biostatistical analysis.

Result: Table 1 illustrates the active instrumentation time for preparing root canals in deciduous mandibular molars across both study groups. In Group I, the mean instrumentation time was recorded at 190.1 seconds, while Group II had a mean time of 110.1 seconds. The results indicate that Group I took significantly more time than Group II, with a p-value of <0.0001, demonstrating a highly significant difference. Table 2 presents the obturation quality for both groups. In Group I, among 15 subjects, 6 participants (40%) achieved optimal obturation, while 3 participants (20%) experienced underfilling, and 6 participants (40%) had overfilling. In contrast, in Group II, out of 15 participants, 10 individuals (66.7%) had optimal filling, while 3 participants (20%) were overfilled, and 2 participants (13.3%) were short obturation. The obturation quality was found to be more efficient in Group II, where 66.7% of the teeth were optimally obturated. However, upon applying the Chi-square test, no statistically significant variance was observed between the groups (p > 0.05).

Table 1: Comparative Assessment of Mean active instrumentation time between group I and group II

Group	Mean Instrument time (In Sec)	t value	p value
Group 1	190.1 ± 5.18	15.54	0.0001*
Group 2	110.1 ± 4.34		

Table 2: Comparative Assessment of obturation quality among the groups

Quality	Group I	Group II	Chi-square value	P value
Over Filled	3 (20%)	3 (20%)	5.32	> 0.05
Optimal	6 (40%)	10 (66.7%)		
Short	6 (40%)	2 (13.3%)		
Total	15 (100%)	15 (100%)		

DISCUSSION

Dental caries is a prevalent disease worldwide, even with effective preventive care in place. It's essential to raise awareness among pregnant mothers about the importance of maintaining the oral health of primary teeth as diligently as that of permanent teeth. Pediatric dentists play a crucial role in providing education, prevention, and treatment for those affected by dental caries.^{7,8} The treatment options for dental caries in primary teeth range from preventive resin restorations to pulpectomies, depending on the severity of the condition. Pulpectomy is considered an invasive procedure in children, involving several steps: administering local anesthesia, isolating the tooth, removing caries, creating an access opening, achieving canal patency, determining working length, cleaning and shaping the canal, obturating it, and providing an appropriate coronal seal.^{3,4} The cleaning and shaping step in endodontics is continuously updated through ongoing research. Traditionally, instruments were made of stainless steel, which is rigid and can make it challenging to navigate curved canals. The introduction of Nickel Titanium instruments, which are more flexible, has significantly reduced procedural errors.^{9,10}

However, if hand filing instruments are used improperly, they can lead to complications such as ledging of the canal and apical blockage caused by dentinal debris. Additionally, hand filing can be time-consuming and uncomfortable for the operator. The advent of engine-driven filing systems has been a significant advancement in endodontics.

These engine-driven files are produced by various manufacturers worldwide and come in different metallurgies, lengths, diameters, and cross-sections. Operators choose their files based on the canal's anatomy and length, which can vary significantly in primary dentition.^{11,12}

Until 2017, there were no specific rotary files designed for pediatric endodontics. The first rotary file system tailored to the anatomy of primary dentition canals was the Kedo-S. A new pediatric file, the fifth-generation Kedo-S Plus, has been assessed by some researchers for its effectiveness in canal centering, the volumetric changes following cleaning and shaping, and its impact on apical extrusion of debris, which is a key factor in postoperative pain.¹³

The present study aimed to evaluate and compare the efficiency and obturation quality of Kedo-S Plus and Kedo-SH files during pulp canal therapy in deciduous molars, a critical procedure considering the unique anatomical and physiological characteristics of primary teeth. This discussion will focus on the significant findings of the study, their implications for clinical practice, and the limitations and avenues for future research.

Efficiency of Instrumentation: The results of this study revealed a significant difference in the mean instrumentation time between the two groups, with the Kedo-S Plus files demonstrating a shorter average time of 110.1 seconds compared to 190.1 seconds for the Kedo-SH files. This substantial difference (p -value < 0.0001) suggests that Kedo-S Plus files may provide a more efficient approach to canal preparation and are particularly beneficial in a pediatric population, where time efficiency is crucial due to the challenges of managing young children in a dental setting.

Reduced instrumentation time not only enhances patient comfort but also decreases the overall treatment duration, which can lead to improved clinical outcomes and satisfaction for both the dentist and the patient. The efficiency of the Kedo-S Plus files can be attributed to single file system, their design and material composition, allowing for smoother and swifter canal navigation.

This may result in less fatigue for the clinician and a more pleasant experience for young patients who may have difficulties maintaining comfort during longer procedures.¹⁴

Obturation Quality Assessment: While the primary focus was on the efficiency of the files, it is noteworthy that no statistically significant differences were observed in the obturation quality between the two groups, as assessed by the Coll and Sadrian criteria. This finding indicates that despite the differences in instrumentation time, the quality of canal obturation achieved with both Kedo-S Plus and Kedo-SH files remains comparable. High-quality obturation is essential for the long-term success of pulpectomy, as it prevents reinfection and ensures the effective sealing of the root canal system.

The lack of significant differences in obturation quality reinforces the notion that while instrumentation efficiency is critical in pediatric endodontics, it does not compromise the essential outcome of adequate canal sealing. Dentists can confidently choose Kedo-S Plus files for their efficiency without fearing a reduction in obturation quality, aligning with clinical best practices.

Clinical Implications: The findings of this study have practical implications for pediatric dentists. Time is often a critical factor in managing young patients, and the ability to use a file system that allows for quicker instrumentation without compromising obturation quality can lead to enhanced clinical outcomes. Additionally, with the increasing emphasis on minimizing discomfort and anxiety in child patients, the Kedo-S Plus files may serve as a valuable tool in advancing pediatric endodontic treatment efficiency.

Limitations of the Study: This study had several limitations that should be acknowledged. The sample size, while sufficient for statistical analysis, was relatively small, and this may impact the generalizability of the findings. Future studies with larger sample sizes are necessary to validate the results further. The study's design also did not account for potential confounding variables, such as the operator's experience level, which could influence instrumentation time and obturation results.

Additionally, the follow-up period was not extended, which leaves questions regarding the long-term outcomes of the two file systems. Research encompassing longer follow-up intervals would provide valuable insight into the durability of the obturation and the clinical success rates associated with each file system.

Future Research Directions: Further studies could explore various aspects of pediatric endodontics associated with file systems, including the evaluation of different materials, designs, and techniques in a larger cohort. Investigating the impact of different tooth anatomies on file performance, as well as considering the psychological aspects of pediatric patients during treatment, would also provide a more holistic view of optimal practices in this area.

Exploring the cost-effectiveness of Kedo-S Plus files compared to Kedo-SH files could also enhance practice management decisions for pediatric dentists. Understanding the economic implications alongside clinical outcomes would assist dental practitioners in making informed decisions while considering practice sustainability.

CONCLUSION

In summary, this study successfully highlighted the efficiency of Kedo-S Plus files in pulpectomy for deciduous molars, demonstrating significantly reduced instrumentation time compared to Kedo-SH files while maintaining comparable obturation quality. These findings encourage the continued exploration of advanced tools and methodologies in pediatric

dentistry, ultimately aiming for enhanced patient experience and treatment success. As we move forward, further research is essential to validate these findings and improve pediatric endodontic practices consistently.

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