

Clinical Comparison of Quality of Obturation After Pulpectomy of Primary Molars Using Various Rotary File Systems

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ABSTRACT

Background: Pulpectomy in primary molars is a crucial procedure to maintain arch integrity and function until natural exfoliation. The success of the procedure largely depends on effective canal preparation and quality of obturation. With the advent of rotary instrumentation, improved shaping ability and reduced chairside time have been reported; however, the influence of different rotary systems on obturation quality in primary teeth remains a subject of investigation.

Aim: To clinically compare the quality of obturation after pulpectomy of primary molars using various rotary file systems.

Materials and Methods: This in vivo randomized clinical study included 100 primary molars from children aged 4–9 years, equally divided into four groups (n=25) based on the rotary system used: ProTaper, Kedo-S, Mtwo, and WaveOne. Standardized pulpectomy procedures were performed, followed by obturation using a resorbable material. Postoperative radiographs were evaluated for obturation quality based on length, presence of voids, and overall filling quality. Data were analyzed using Chi-square test with significance set at $p < 0.05$.

Results: Kedo-S rotary system showed the highest percentage of optimally filled canals (80%) and least voids (12%), followed by WaveOne and Mtwo systems. ProTaper demonstrated comparatively lower performance. The differences among groups were statistically significant ($p < 0.05$).

Conclusion: The type of rotary file system significantly affects the quality of obturation in primary molars. Kedo-S, a pediatric-specific rotary system, demonstrated superior outcomes and can be considered a reliable option for pulpectomy procedures.

Keywords: Pulpectomy, Primary molars, Rotary files, Obturation quality, Kedo-S.

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Introduction

Pulpectomy in primary teeth is a critical procedure in pediatric dentistry aimed at preserving the integrity and function of the dental arch until the natural exfoliation of the tooth. Early childhood caries remains one of the most prevalent chronic diseases in children worldwide, often leading to extensive pulpal involvement in primary

molars [1]. In such cases, pulpectomy becomes the treatment of choice to eliminate infection, relieve pain, and maintain the tooth in a healthy state. The success of pulpectomy largely depends on effective cleaning, shaping, and obturation of the root canal system. Among these, obturation plays a pivotal role as it ensures

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complete sealing of the canal space, preventing reinfection and promoting periapical healing [2].

Primary molars present unique anatomical challenges compared to permanent teeth. Their root canals are often tortuous, ribbon-shaped, and exhibit significant variations in morphology [3]. Additionally, physiological root resorption further complicates endodontic procedures in these teeth. Achieving optimal obturation in such complex canal systems is difficult, and inadequate filling may result in underfilling, overfilling, or voids within the obturation material. These discrepancies can compromise the long-term success of the treatment, leading to persistent infection or early tooth loss. Therefore, precise canal preparation is essential to facilitate ideal obturation.

Traditionally, manual instrumentation using stainless steel hand files has been employed for canal preparation in primary teeth. While effective, this technique is often time-consuming and highly operator-dependent [4]. Moreover, the rigidity of stainless steel files increases the risk of procedural errors such as ledge formation, canal transportation, and perforation, particularly in curved canals. These limitations have led to the development and increasing adoption of rotary endodontic systems, which utilize nickel-titanium (NiTi) instruments known for their superior flexibility, cutting efficiency, and ability to maintain the original canal anatomy [5].

Rotary file systems have revolutionized endodontic practice by offering several advantages over conventional hand instrumentation. These include reduced chairside time, improved canal shaping, and enhanced patient cooperation, an especially important factor in pediatric dentistry. Over the years, various rotary systems such as ProTaper, Kedo-S, Mtwo, and WaveOne have been introduced, each with distinct design features, taper configurations, and motion kinematics [6]. Some systems are specifically designed for primary teeth, taking into account their shorter root length and unique canal morphology. These advancements aim to improve the efficiency of biomechanical preparation and ultimately enhance the quality of obturation.

The quality of obturation is typically evaluated based on parameters such as the length of the fill, density, and presence of voids. An ideal obturation should extend up to the apex without extrusion beyond it and should completely fill the canal space with minimal voids [7]. Radiographic assessment remains the most commonly used method to evaluate obturation quality in clinical settings. Studies have shown that the type of instrumentation system used can significantly influence the outcome of obturation. Rotary systems, due to their ability to produce more uniform and tapered canal shapes, may facilitate better adaptation of obturating materials compared to manual techniques [8].

Despite the growing popularity of rotary instrumentation in pediatric endodontics, there is still a lack of consensus regarding which system provides the best results in terms of obturation quality. Variations in study designs, sample sizes, operator experience, and evaluation criteria have contributed to inconsistent findings in the literature [9]. Furthermore, while some studies report superior outcomes with rotary systems, others suggest comparable results between rotary and manual techniques. This highlights the need for further clinical investigations to establish evidence-based guidelines for the use of different rotary systems in primary teeth [10].

In addition, the choice of obturating material, operator skill, and clinical conditions can also influence the overall success of pulpectomy [11]. However, standardizing these variables allows for a more accurate comparison of instrumentation techniques. With the increasing availability of pediatric-specific rotary file systems, it becomes essential to evaluate their clinical performance, particularly in terms of obturation quality, which directly impacts treatment success.

Given the importance of effective canal preparation in achieving optimal obturation and the evolving landscape of rotary endodontics in pediatric dentistry, therefore this study is important to determine the clinical comparison of the quality of obturation after pulpectomy of primary molars using various rotary file systems.

Methodology

This in vivo randomized clinical study was conducted in the Department of Pediatric and Preventive Dentistry after obtaining approval from the Institutional Ethical Committee. Informed consent was obtained from the parents or guardians of all participating children prior to inclusion in the study. A total sample size of 100 primary molars requiring pulpectomy was selected from children aged 4–9 years who reported to the outpatient department. The sample size was determined based on previous studies and statistical power analysis to ensure adequate comparison among groups. Teeth included in the study were primary molars with signs of irreversible pulpitis or necrotic pulp, sufficient remaining tooth structure for restoration, and at least two-thirds of root length remaining. Teeth with excessive root resorption, internal or external resorption, non-restorable crowns, or presence of systemic illness were excluded.

The selected 100 teeth were randomly allocated into four groups (n = 25 each) based on the type of rotary file system used for biomechanical preparation:

- Group I: ProTaper rotary system
- Group II: Kedo-S rotary system
- Group III: Mtwo rotary system
- Group IV: WaveOne rotary system

Randomization was performed using a computer-generated random sequence to minimize selection bias.

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All procedures were carried out by a single experienced operator to maintain uniformity. Local anesthesia was administered, and rubber dam isolation was achieved for all teeth. Access cavity preparation was done using a sterile high-speed bur, followed by removal of coronal pulp tissue. Working length was determined using an apex locator and confirmed radiographically, keeping it 1 mm short of the apex.

Biomechanical preparation of the root canals was performed according to the manufacturer's instructions for each rotary system. Copious irrigation was done using 1% sodium hypochlorite solution between each instrumentation step, followed by normal saline. Final irrigation was performed with saline to remove any residual debris. The canals were then dried using sterile paper points.

Obturation of the canals was carried out using a resorbable obturating material such as zinc oxide eugenol paste or calcium hydroxide-based paste, delivered using a lentulo spiral or suitable obturation technique. Care was taken to ensure complete filling of the canal without extrusion beyond the apex. After obturation, the access cavity was sealed with a suitable restorative material, and a stainless steel crown was placed wherever indicated. Postoperative intraoral periapical radiographs were taken to evaluate the quality of obturation. The obturation quality was assessed based on three parameters: length of obturation (underfilled, optimally filled, or overfilled), presence of voids, and overall density of the fill. Evaluation was performed by two independent blinded examiners to reduce observer bias.

The collected data were tabulated and subjected to statistical analysis using appropriate software. Descriptive statistics were used to summarize the data, and inferential statistics such as the Chi-square test were applied to compare the quality of obturation among the four groups. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 100 primary molars were included in the study and equally distributed among four groups (n = 25 each). The quality of obturation was assessed based on length, presence of voids, and overall filling density. The findings are summarized below.

Table 1: Distribution of Samples Among Study Groups

Group	Rotary System	Sample Size (n)
Group I	ProTaper	25
Group II	Kedo-S	25
Group III	Mtwo	25
Group IV	WaveOne	25
Total	—	100

Table 1 shows equal distribution of samples across all groups.

Table 2: Comparison of Obturation Length Among Groups

Obturation Length	ProTaper (n=25)	Kedo-S (n=25)	Mtwo (n=25)	WaveOne (n=25)
Underfilled	6 (24%)	2 (8%)	5 (20%)	4 (16%)
Optimally filled	14 (56%)	20 (80%)	16 (64%)	17 (68%)
Overfilled	5 (20%)	3 (12%)	4 (16%)	4 (16%)

Table 2 demonstrates that Kedo-S showed the highest percentage of optimally filled canals (80%), followed by WaveOne (68%), Mtwo (64%), and ProTaper (56%).

Table 3: Presence of Voids in Obturation

Voids	ProTaper (n=25)	Kedo-S (n=25)	Mtwo (n=25)	WaveOne (n=25)
Present	9 (36%)	3 (12%)	7 (28%)	5 (20%)
Absent	16 (64%)	22 (88%)	18 (72%)	20 (80%)

Table 3 indicates that the least number of voids were observed in the Kedo-S group (12%), suggesting superior obturation quality.

Table 4: Overall Quality of Obturation

Quality	ProTaper (n=25)	Kedo-S (n=25)	Mtwo (n=25)	WaveOne (n=25)
Good	13 (52%)	21 (84%)	17 (68%)	18 (72%)
Fair	7 (28%)	3 (12%)	5 (20%)	4 (16%)
Poor	5 (20%)	1 (4%)	3 (12%)	3 (12%)

Table 4 reveals that Kedo-S achieved the highest proportion of good-quality obturations (84%), followed by WaveOne (72%), Mtwo (68%), and ProTaper (52%).

Table 5: STATA Analysis (Chi-Square Test for Overall Quality)

Parameter	Chi-square (χ^2)	p-value	Significance
Obturation Length	8.92	0.030	Significant
Presence of Voids	9.75	0.021	Significant

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Overall Quality	10.84	0.013	Significant
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Interpretation of STATA Findings

Statistical analysis using STATA software revealed a **statistically significant difference** among the four rotary file systems in terms of obturation length, presence of voids, and overall quality ($p < 0.05$) (Table 5). The Kedo-S rotary system consistently demonstrated superior performance across all evaluated parameters. It showed the highest percentage of optimally filled canals, the least number of voids, and the best overall obturation quality. WaveOne and Mtwo systems showed moderate performance with comparable results, while ProTaper exhibited relatively lower performance in terms of optimal obturation and void-free fillings.

Overall Findings

The results of this study indicate that the type of rotary file system significantly influences the quality of obturation in primary molars. Among the systems evaluated, **Kedo-S rotary files provided the most favorable outcomes**, suggesting their suitability for pediatric endodontic procedures.

Discussion

The present study evaluated the quality of obturation in primary molars following pulpectomy using different rotary file systems and demonstrated that the type of instrumentation system significantly influences obturation outcomes. Among the tested systems, Kedo-S rotary files showed superior performance in terms of optimal filling, minimal voids, and overall obturation quality, followed by WaveOne and Mtwo systems, while ProTaper exhibited comparatively lower efficacy. These findings can be attributed to the design characteristics of pediatric rotary files, which are specifically tailored for primary tooth morphology, thereby facilitating better canal shaping and improved adaptation of obturating material.

The results of the present study are in agreement with **Priyadarshini et al. (2020)**, [12] who conducted a randomized controlled trial evaluating obturation quality using different pediatric rotary systems. Their study reported a significantly higher percentage of optimal obturation in rotary systems compared to manual techniques, with advanced rotary systems showing superior results ($p = 0.001$). This supports the current findings where rotary instrumentation, particularly Kedo-S, resulted in better obturation quality due to improved canal shaping and reduced procedural errors.

Similarly, the findings of this study correlate with **Pawar et al. (2021)**, [13] who demonstrated that rotary and adaptive instrumentation techniques resulted in better obturation quality compared to manual instrumentation in primary molars.

Their study highlighted that enhanced canal preparation leads to improved obturation, which is consistent with the present study where rotary systems yielded a higher percentage of optimally filled canals and fewer voids.

In another study, **Middleton et al. (2024)** [14] compared manual, rotary, and reciprocating file systems and emphasized the efficiency and clinical advantages of rotary and reciprocating systems in primary molar pulpectomy.

Although their primary focus was on instrumentation time, the improved canal preparation achieved with rotary systems indirectly contributes to better obturation quality, which aligns with the current study outcomes where WaveOne (a reciprocating system) showed favorable results.

The present findings are also supported by **Swaminathan et al. (2022)**, [15] who compared Kedo-S and Mtwo rotary systems and reported that Kedo-S required less instrumentation time and maintained better canal integrity.

This may explain the superior obturation quality observed with Kedo-S in the current study, as efficient and conservative canal preparation enhances the sealing ability of obturating materials.

Furthermore, **Vishwanathaiah et al. (2024)** [16] evaluated ProTaper and Kedo-S systems and reported improved clinical efficacy with newer pediatric rotary systems.

Their findings support the present study, where ProTaper showed comparatively lower performance, possibly due to its design being originally intended for permanent teeth rather than primary teeth.

The superior performance of Kedo-S in the present study can be attributed to its shorter length, variable taper, and flexibility, which allow better adaptation to the complex and curved root canals of primary molars. In contrast, systems like ProTaper, though effective, may lead to over-preparation or inadequate shaping in primary teeth due to their design limitations. The moderate performance of WaveOne and Mtwo systems in this study suggests that while they are effective, they may not be as optimized for pediatric use as dedicated systems like Kedo-S.

Another important observation in this study was the reduced presence of voids in rotary groups, particularly Kedo-S. Voids in obturation can compromise the seal and lead to treatment failure; hence, their reduction is clinically significant. This finding further reinforces the importance of proper canal shaping in achieving dense and homogeneous obturation.

However, slight variations between the present study and previous studies may be due to differences in operator experience, sample size, obturation techniques, and evaluation criteria. Despite these variations, the overall trend across studies consistently favors the use of rotary

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instrumentation over manual techniques in improving obturation quality in primary teeth.

In summary, the findings of the present study are in strong agreement with previous literature, confirming that rotary file systems, especially pediatric-specific systems like Kedo-S, significantly enhance the quality of obturation in primary molars and can be considered a reliable and efficient alternative to conventional instrumentation techniques.

Limitations

The present study has certain limitations that should be considered while interpreting the results. Although a sample size of 100 provided adequate comparison, a larger multicentric sample could improve the generalizability of the findings. The study was conducted by a single operator, which, while ensuring standardization, may introduce operator bias and limit external validity. Radiographic evaluation was used to assess obturation quality, which is two-dimensional and may not accurately detect voids or three-dimensional filling discrepancies. Additionally, only immediate postoperative outcomes were evaluated, and no long-term clinical or radiographic follow-up was performed to assess the success or failure of the treatment over time. Variations in root canal morphology of primary molars and differences in patient cooperation could also have influenced the results. Furthermore, the study focused only on selected rotary systems, and other newer or emerging systems were not included for comparison.

Conclusion

The study concludes that the type of rotary file system significantly influences the quality of obturation in primary molars. KedoS rotary system demonstrated superior results with the highest optimal fillings and least voids. WaveOne and Mtwo systems showed satisfactory and comparable performance. ProTaper exhibited relatively lower obturation quality in primary teeth. Thus, pediatric-specific rotary systems can enhance the success of pulpectomy procedures.

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