

Comparison of Rotary and Manual Techniques for Pulpectomy Treatment in Primary Teeth

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ABSTRACT

Aim: Primary teeth present anatomical and morphological challenges during endodontic procedures. Rotary file systems were recently developed to overcome these endodontic challenges with primary teeth and to reduce the treatment period. The use of rotary file systems is increasingly popular as an alternative to conventional manual techniques. The introduction of several file systems raises the question of whether there are any appreciable variations in success rates. The objective of this review is to analyze multiple current studies that compare the use of rotary and manual instruments concerning the following subtopics: antimicrobial activity, quality of obturation, cleaning efficiency and instrumentation time, clinical and radiographic success, assessment of post-operative discomfort, and extrusion of apical debris.

Material and Methods: The last five years' worth of publications (2018-2023) was the main focus of the literature review. The Google Scholar and PubMed databases were searched using the primary search phrases. This review examined case reports, in vitro studies, randomized controlled trials, and systematic review studies that investigated the use of manual and rotary file systems in primary teeth.

Results: The outcomes of studies comparing rotary and manual instrument systems across various categories have been provided.

Conclusion: This review will guide to dentists under various criteria in evaluating the benefits and possible causes of different instrument systems used during and after the pulpectomy treatment applied to primary teeth.

Süt Dişlerinin Kanal Tedavisinde Kullanılan Döner ve Manuel Tekniklerinin Karşılaştırılması

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ÖZET

Amaç: Süt dişlerinin endodontik tedavileri sırasında birtakım anatomik ve morfolojik zorlukları mevcuttur. Son yıllarda kullanılan döner eğe sistemleri süt dişlerinin endodontik girişimlerinin mevcut zorluklarını aşmak ve tedavi süresini kısaltmak için geliştirilmiştir. Günümüzde döner eğe sistemlerinin kullanımı, geleneksel manuel tekniklere alternatif olarak giderek daha popüler hale gelmektedir. Birçok döner eğe sisteminin geliştirilmesi ve piyasaya sunulması, başarı oranlarında herhangi bir farkın olup olmadığı sorusunu da gündeme getirmektedir. Bu derlemenin amacı; döner ve manuel aletlerin kullanımını antibakteriyel aktivite, obtürasyon kalitesi, kök kanal sistemini temizleme verimliliği ve enstrümantasyon süresi, klinik ve radyografik başarı, postoperatif ağrı değerlendirme ve kök kanal sisteminin dışına apikal debris taşması gibi alt başlıklar açısından karşılaştıran çeşitli mevcut çalışmalarını analiz etmektir.

Gereç ve Yöntemler: Literatür taramasının ana odak noktasını, son beş yılın (2018-2023) yayınları oluşturmaktadır. Google Scholar ve PubMed veri tabanları, temel arama kelimeleri kullanılarak taranmıştır. Bu derlemede; süt dişlerinde manuel ve döner eğe sistemlerinin kullanımını araştıran vaka raporları, in vitro çalışmalar, randomize kontrollü çalışmalar ve sistemik derlemeler incelenmiştir.

Bulgular: Çeşitli başlıklar altında değerlendirilen döner eğe sistemi ve manuel eğe sistemlerini karşılaştıran çalışmaların sonuçlarına yer verilmiştir.

Sonuçlar: Bu derleme, diş hekimlerine, süt dişlerine uygulanan pulpektomi tedavisi sırasında ve sonrasında kullanılan farklı enstrüman sistemlerinin faydalarını ve olası nedenlerini değerlendirme konusunda çeşitli kriterler altında rehberlik sağlayacaktır.

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INTRODUCTION

Pulpectomy is a commonly employed treatment method for primary teeth, serving as an alternative to extraction in cases of irreversible pulpitis and necrosis. This procedure allows for the symptom-free retention of the relevant primary teeth within the dental arch until the physiological resorption process takes place, especially in situations where irreversible pulp pathologies preclude the possibility of reversal. Primary teeth play crucial roles such as guiding the eruption of permanent teeth, contributing to the child's jaw development, influencing speech, and contributing to aesthetic appearance. Despite these advantages, pulpectomy treatment in primary teeth has certain limitations, including the complex anatomical structure of primary teeth, the presence of numerous lateral canals, and the thin dentin structure. Moreover, the effectiveness of pulpectomy treatment is contingent upon the reduction of the existing microbiota within the root canal system, in conjunction with proficient cleaning and obturation capabilities. In contemporary practice, there has been a transition from conventional approaches and manual instruments to Nickel-Titanium rotary instruments for debridement and cleaning procedures. The primary motivation behind this transition is the potential for iatrogenic errors and longer procedural durations associated with root canal preparation using hand instruments.^{1,2} The utilization of rotary file systems in primary teeth offers various advantages, such as reduced treatment duration, the ability to shape the root canal system according to its anatomy, homogeneous application of filling material, efficient removal of debris within the root canal, and improved patient cooperation. However, there are also drawbacks, including the risk of perforation and file fracture, potential canal overflow due to excessive filling material, high costs, and the necessity for operators to receive training for these instruments.³ This literature review aims

to explore different studies comparing rotary and manual instruments across various criteria and subtopics.

MATERIAL AND METHODS

Search Strategy

The literature review primarily focused on articles published after 2018. However, studies conducted on the relevant topic in the last decade were also included. Relevant articles were collected through comprehensive searches on Google Scholar and PubMed, following the specified publication year limitations. The following key search terms were used for all databases: “rotary instruments in primary teeth,' 'manual and traditional instrumentation,' 'pulpectomy treatment in primary teeth,' 'comparison of rotary file system and manual system”.

Selection Criteria

This review examined case reports, in vitro studies, randomized controlled trials, and systematic review studies that investigated the use of manual and rotary file systems in primary teeth.

Inclusion Criteria

Randomized controlled trials comparing rotary and manual file systems in primary teeth under various criteria, case reports evaluating the instrumentation phase of pulpectomy treatment and articles including in vitro and in vivo studies conducted on two different file systems were included in the review study.

Exclusion Criteria

Studies comparing the effectiveness of manual and rotary file systems on permanent teeth were excluded from this review.

DISCUSSION

Pulpectomy treatment is a comprehensive procedure that involves mechanical cleaning of the infected pulp tissue in the root canals of primary teeth, followed by

effective disinfection and irrigation of the canal system, proper shaping of the canal system according to its anatomy, and finally filling it with a resorbable material.⁴ In contemporary practice, there is a transition from traditional manual instruments to the current rotary file systems in the pulpectomy treatment of primary teeth. However, the technical success of rotary and manual file systems in pulpectomy treatment has not yet been definitively determined.²

Antimicrobial Activity

The primary objective of the pulpectomy procedure is to diminish bacterial density within the root canal system, effectively controlling existing infections. However, the complex anatomy of primary teeth, often featuring lateral canals, poses challenges to achieving adequate root canal disinfection.⁴ Successful shaping necessitates careful instrument selection, prompting a growing preference for rotary instruments over traditional manual methods due to their efficiency and reduced treatment duration.

In a study focused on the microbial evaluation of root canals after biomechanical preparation, 45 primary molar teeth were categorized into three groups to compare manual and rotary instrument systems. Post-instrumentation, all three systems exhibited a significant reduction in microbial density. The group employing rotary instruments (Kedo-S) demonstrated greater efficacy in reducing microbial load, followed by traditional H-files and K-files, with no statistically significant difference observed among the groups.⁵ Similarly, Subramaniam et al.⁶ assessed microbial loads in primary molars across three groups (Group A: Rotary Ni-Ti files, Group B: Hand Ni-Ti files, and Group C: Hand stainless steel files). Following root canal instrumentation, all three groups demonstrated a substantial reduction in microbial flora, concluding that rotary NiTi files were as effective as traditional hand instruments in reducing root canal microflora significantly.

In a 2020 study, Elmancy et al.⁷ specifically evaluated the removal of *Enterococcus faecalis* after instrumentation in the root canal system of primary molars, comparing rotary and manual instruments. Post-instrumentation, the rotary instrument system proved more effective in reducing the count of *Enterococcus faecalis* compared to manual files.

Additionally, a 2021 study by Sankar and Jeevanandan⁸ included 30 children aged between 4 to 8 years, dividing pulpectomy treatment into two groups based on the instrument system. Results indicated that the Ni-Ti rotary instrument system exhibited a higher potential for reducing microbial load compared to manual K-type files, with this difference being statistically significant.

Obturation Quality

The success of pulpectomy treatment is contingent upon the meticulous filling of the root canal anatomy, as high-quality obturation prevents future bacterial leakage, thereby enhancing the long-term success of the procedure. Adequate cleaning and shaping of the canals are crucial for achieving proper obturation. While there may not be a significant difference in the success of apical, middle, and coronal shaping between rotary and manual files, the impact of these file systems on obturation has been investigated using various criteria.⁹

In a study by Preethy et al.¹⁰ 45 teeth were divided into three groups, and the canals were filled with calcium hydroxide and iodoform-based filling pastes after irrigation and shaping with three different file systems. The obturation quality was assessed as optimal, overfilled, or underfilled. While no statistically significant difference in obturation quality was noted among the utilization of manual K files, ProTaper Gold rotary files, and Kedo-S rotary files, both rotary file types demonstrated a superior optimal filling rate.

Another similar study reported that

ProFile rotary files achieved superior obturation quality and reduced obturation time compared to manual instrumentation.¹¹ In a study emphasizing numerical data, statistically significant differences were found. For the manual technique, out of 20 teeth, 10 (50%) were optimally filled, 8 (40%) were underfilled, and 2 (10%) were overfilled. In contrast, for the rotary technique, out of 20 teeth, 16 (80%) were optimally filled, 2 (10%) were underfilled, and 2 (10%) were overfilled.¹² Lastly, Pawar et al.⁹ conducted a study dividing 75 primary molars into three groups based on the rotary file system used, comparing instrumentation time and obturation quality. According to their findings, utilizing the XP Endo Shaper system resulted in optimal obturation quality and reduced treatment time compared to the Kedo-S rotary file system and manual K-type file system.

Cleaning Efficiency and Instrumentation Time

Pulpectomy in primary teeth aims to eliminate pulp remnants and infected dentin from the root canal system, facilitating thorough cleaning and shaping. This process allows irrigation solutions to reach the apical third and creates an optimal space for filling. Traditional hand instruments have been the predominant choice for cleaning and shaping root canals. However, the advantages of rotary instruments, such as speed, shape memory, and flexibility, contribute to improved cleaning efficiency and reduced treatment time.¹³

In a study by Kalita et al.¹³ teeth were randomly divided into three groups, each consisting of 40 teeth. The research revealed that Kedo-S rotary files exhibited significantly better cleaning effectiveness in the coronal, middle, and apical thirds of root canals compared to ProTaper and K files. The study observed maximum cleaning in the middle third of root canals across all groups, with the minimum cleaning observed in the apical third. Additionally, both rotary systems showed shorter instrumentation times compared to

manual techniques. Similarly, in another study utilizing micro-computed tomography, the cleaning efficiency of the ProTaper rotary system was compared to that of manual K-files. The results showed that ProTaper rotary files left fewer uncleaned root canal surfaces in the coronal, middle, and apical sections compared to manual K-files.¹⁴

Conversely, Jeevanandan's¹⁵ study reported that the average instrumentation time with the pediatric rotary file system Kedo-S was significantly shorter than that with manual K files. This study indicated the superiority of pediatric rotary files over manual files in terms of obturation quality and procedural time. Another study comparing instrumentation time achieved a significant time gain in the rotary file group compared to the manual technique.¹⁰ In Crespo et al.'s¹¹ study, where the time factor was compared, significantly shorter instrumentation times with rotary files were reported compared to manual files, yielding similar results. This reduction in treatment time is likely to foster increased collaboration between patients and clinicians, contributing to enhanced treatment quality.

Clinical and Radiographical Success

The success of pulpectomy treatment is typically assessed at intervals such as 3, 6, 12, and 24 months, considering both clinical and radiographic perspectives. Evaluation criteria for the clinical success of the treatment should include attention to the absence of clinical scenarios such as percussion sensitivity, the formation of an abscess or fistula, and abnormal mobility.

A study conducted in 2015, comparing clinical success rates, employed two rotary file systems and one manual file system. During the 12-month follow-up period, the RaCe rotary file system exhibited the highest success rate, followed by the ProTaper rotary file system and the manual K-file system, respectively.¹⁶ Likewise, another set of proportional data on

this topic was reported by Morankar et al.¹⁷ in their study conducted in 2018, where they used Hyflex rotary files and manual K-files. According to their study, the clinical success rates for the 24-month follow-up period were reported as 85.2% for rotary (Hyflex CM) and 92.3% for manual techniques. Data obtained from radiographic follow-ups is one of the success criteria for pulpectomy treatment. These data include criteria such as the presence of internal or external resorption, the presence of radiolucency following treatment, and whether there is any increase in the width of pre-existing radiolucency. The two studies mentioned above have also determined radiographic success rates following the use of manual and rotary files in pulpectomy treatment. In the study by Morankar et al.¹⁷ it was indicated that the rotary file system was found to be slightly more successful compared to the manual technique. However, the 12-month follow-up results of Elheeny et al.¹⁶ reported that both rotary file systems exhibited a superior success rate compared to the manual technique.

A recent controlled grouping study conducted by Babu and Kavyashree¹⁸ in 2021 presented data on the radiographic and clinical comparison of rotary and manual files. The highest radiographic success rate was recorded for the Kedo-S pediatric rotary file system after a two-year follow-up period. Following this, in order, were the HERO rotary file system and the traditional K-type Ni-Ti file system.

In all three conducted studies, pulpectomy treatments performed with rotary file systems reported higher clinical and radiographic success rates compared to pulpectomy treatments performed with manual files.¹⁶⁻¹⁸ Nevertheless, it has been consistently emphasized in nearly all studies on this topic that the success rate depends on various criteria such as effective shaping, adequate irrigation, and a filling method that conforms to standards.

In summary, the success of pulpectomy

treatment is primarily determined by a series of procedures and appropriate treatment planning.

Post-operative Pain Assessment and Apical Debris Extrusion

The postoperative pain experience following pulpectomy treatment has a significant impact on the assessment of the success of the treatment, both for permanent and primary teeth. The postoperative pain experience commonly observed in children is often associated with increased anxiety during or after the treatment. Nevertheless, achieving minimal postoperative pain experience remains one of the primary objectives of an optimal pulpectomy.¹⁹

Necrotic dentin and pulp tissues, inaccessible microorganisms, and irrigation fluids used during pulpectomy treatment can potentially overflow from the apical area during the root canal shaping and cleaning phase. The accumulation of debris and these materials in the periapical tissues due to overflow can lead to undesirable conditions such as delayed healing, post-operative pain, and inflammation following treatment.²⁰

Several studies have been conducted to compare the amount of debris overflowing from the apex in pulpectomy treatments performed with manual files or rotary instruments, considering the impact of accumulated waste in periapical tissues on postoperative pain. Pawar et al.²¹ described the objective of their study as evaluating the debris extrusion from the apex during the shaping of primary canine teeth using three different endodontic file systems. In this study, manual K-type files, Kedo-S rotary files, and XP-endo-type rotary files were utilized. Debris extruded during the procedure was collected and examined. The two rotary file types used significantly extruded less debris compared to the manual K-type files. A separate study that reached a similar conclusion reported that the use of three different rotary file systems of the new generation resulted in less debris extrusion from the apex compared to manual files.²² Similarly, in a study conducted by

Thakur et al.²³ in 2017, using a manual Kfile and three different rotary file systems, they found that the SAF rotary file system resulted in the least debris extrusion, while manual files exhibited the highest amount of debris extrusion. Another study, conducted by Preethy et al.²⁴ similarly reported the debris extrusion rate of manual instruments compared to rotary file systems. They also observed that manual files exhibited the highest debris extrusion rate from the apex. An additional study from 2019, like other studies comparing debris extrusion from the apex, also reported the highest rate of debris extrusion in manual techniques.²⁵

As reported in the studies presented above, it has been observed that the highest amount of apical debris is extruded as a result of instrumentation with manual files, in contrast to different rotary file systems. Examining the impact of file systems on post-operative pain, many studies have indicated that rotary instruments extrude debris in lesser amounts from the apex compared to manual files, indirectly suggesting a positive effect on post-operative pain narratives. However, it's worth noting that there are studies in the literature specifically investigating post-operative pain associated with both manual files and rotary file systems. For instance, Panchal et al.¹⁹ conducted a study in which they performed pulpectomy treatment on primary molar teeth using two manual files, as well as Kedo-S rotary files. The results of their treatments showed that the pediatric rotary file system, Kedo-S, resulted in fewer postoperative pain narratives at 6 and 12-hour intervals compared to manual K and H-type files. However, this post-operative pain narrative did not exhibit a significant difference in the 24, 48, and 72-hour follow-up periods. Similarly, Nair et al.²⁶ reported that utilizing two rotary file systems (Kedo-S and MTwo rotary systems) for root canal shaping resulted in less postoperative pain compared to shaping with the manual file system. Another study on this subject was conducted in 2017. In this comprehensive

study, the presence of postoperative pain in treatments performed using manual techniques and rotary file systems was evaluated at 6, 12, 24, 48, 72 hours, and one week after the treatment. The study concluded that excluding the results evaluated at 72 hours and one week, patients who underwent shaping with manual instruments reported a more intense postoperative pain narrative compared to those prepared with Revo-S rotary files. Although postoperative pain decreased over time in both groups, the study concluded that there was a greater presence of postoperative pain following pulpectomy performed with hand instruments compared to those performed with rotary file systems.²⁰ As an example of a recent study in 2023, Thakur et al.²⁷ aimed to compare postoperative pain following pulpectomy treatment using two different rotary systems and a manual K-type instrument. In their study, teeth were instrumented with XP-Endo files, and compared to the other investigated file types, less postoperative pain was reported within 6 and 12 hours. However, at 24, 48, and 72-hour intervals, no significant difference in postoperative pain was reported among the three groups. Additionally, the number of children requiring any analgesic medication was the lowest in the XP-Endo group, followed by the Kedo-S group, and lastly, the manual K-file group.

After pulpectomy treatment, it is known that the incidence of postoperative pain in children is not very low. Minimizing the perception of pain holds unquestionable importance in the field of pediatric dentistry. The possibility of any treatment leaving lasting impressions on children during and after the procedure, and its potential to affect future dental treatments, should be taken into consideration.²⁸

The studies conducted have shown a significant reduction in the occurrence of apical debris extrusion and postoperative pain history with treatment protocols shifting from

traditional methods towards rotary instrument systems.

CONCLUSION

One of the critical stages in pulpectomy treatment for primary teeth is the shaping of the root canals. Over the years, various instrument systems have been preferred to enhance the effectiveness of canal shaping. The popularity of Ni-Ti rotary instruments has significantly increased in contemporary practice due to their ability to shape the canals without the need for excessive pre-curve, their shape memory, and their measurable reduction in treatment duration. However, rotary instruments do come with disadvantages, such as reduced tactile sensitivity, the need for technical skills and knowledge, and increased costs. Despite these drawbacks, their capacity to achieve anatomically suitable treatment outcomes for primary teeth and the reduction in chair time have led to their increasing preference over manual instruments.

Ethical Approval

An ethics statement was not required for this study type and no human or animal subjects or materials were used.

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Conflict of Interest

The authors deny any conflicts of interest related to this study.

Author Contributions

Design: GT, PSÖ, SD, Data collection and processing: GT, PSÖ, Analysis and interpretation: GT, PSÖ, SD, Literature review: GT, PSÖ, Writing: GT,SD.

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