

Review Article

Rotary endodontics in primary teeth: A comprehensive review

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ABSTRACT:

Root canal treatment in primary teeth can be challenging specifically during canal preparation, which is one of the key steps in root canal therapy. The traditional instrumentation technique remains the “gold standard” for primary teeth, making the procedure more time-consuming which adversely affects both clinicians and patients. Use of nickel-titanium (Ni-Ti) rotary files have been implemented for use in pediatric endodontics. This article reviews the use of nickel-titanium rotary file system in primary teeth.

Received: 26 May, 2024

Accepted: 29 June, 2024

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This article may be cited as: Masih M, Mantri S, Paul B, Dube K, Hirani D, Singhai S. Rotary endodontics in primary teeth: A comprehensive review. J Adv Med Dent Sci Res 2024;12(7):62-66.

INTRODUCTION

Early loss of necrotic primary molars due to caries or other factors, such as trauma, is a critical issue in children which often leads to space loss. Management of such teeth with irreversible pulpitis is pulpectomy.^[1] Hand instrumentation for root canal preparation is mostly used in primary teeth, however, there are restrictions regarding patient cooperation and time consumption. Hence, in modern-day practice, more and more clinicians are migrating towards rotary endodontics.^[2] Rotary instrumentation has made a significant rise in the recent era of endodontics. Barr et al. conducted the first study to demonstrate the use of Ni-Ti rotary files in primary molars.^[3] Studies state that they pose minimal risk of ledging and transportation.^[4] The high flexibility of Ni-Ti files allows the instruments to closely follow the root canal path, especially in curved canals.^[5]

There are different designs of Ni-Ti instruments available. Manufacturers focus on their cleaning efficacy for root canal treatment, simple procedures, and decreased chair time, which is principally important in children. Several designs for taper, blades, grooves, and tips have been proposed.^[6] The shaft designs are grouped according to taper into two categories: progressive and constant. Reportedly instruments with progressive taper can shape canals more quickly than constant taper instruments.^[7] In the

progressive ProTaper system, the shaping files (S) have an increasing taper in the coronal direction, whereas the finishing files (F) have a decreasing taper. It has been asserted that the increasing tapered instruments have enhanced flexibility in the middle region and at the tip, while the decreasing tapered instruments provide a larger taper in the apical region but make them stiff.^[6]

According to authors who advocated rotary system in primary teeth suggested the following steps for pulpectomy, it commences with a standard access cavity preparation and removal of coronal tissue.^[3,8] Ni-Ti rotary system is chosen according to that which approximates the canal size. Pre-treatment radiography is taken to determine the working length and the file is inserted into the canal while rotating till the working length. The rotating file is then withdrawn along with the pulp tissue and dentinal debris. Sequentially larger files are used to clean and shape the canal until last file binds. Overextension of Ni-Ti rotary file results in an enlarged apical foramen that may lead to an overflow of obturation paste. Sterile water or chlorhexidine is used to keep the canals moist.

Frequent inspection of each file for flute unwinding or distortion is important, and the files with these features should be discarded immediately. If no flute distortion is ascertained, discard the file after using it

on five primary teeth. After irrigation, the canals are dried and filled with zinc oxide eugenol using hand files to push the paste just short of the apex.

Shashikiran et al. compared the Ni-Ti rotary PROFILE and hand K files on root canal preparation of primary and permanent molars for their efficacy in preparation time, instrumentation failure, and shaping the canals. They deduced that PROFILE 0.04 taper 29 series prepared the canal rapidly than conventional K file.^[9]

Kuo et al., suggested the clinical procedure for pulpectomy as follows - under local anesthesia and rubber dam isolation, the pulpectomy begins with complete caries excavation, a standard access opening, and coronal pulp tissue removal.^[10] The shelf of dentin overlying the most canal orifice is reduced using a high-speed round bur until the entire canal orifice is visible. The working length is determined approximately 1 mm short of the root apex. Before instrumentation, the pulp chamber is irrigated with 2.5% sodium hypochlorite. A number 10 k file is first used to locate the canals, followed by using ProTaper SX file into the canal to about 3 mm beyond the root canal orifice with a slight buccolingual brushing motion to remove any remaining overlying dentin and to improve straight-line access. The S2 file is then inserted into the canal while rotating until the working length. Pulp stumps are often wrapped around the S2 file when it is withdrawn which is uncommonly found in stainless steel files. Copious irrigation with 2.5% sodium hypochlorite and normal saline is used after each file change. The root canals are dried with sterile paper points and subsequently filled with a resorbable calcium and iodoform paste. With teeth already undergoing physiological root resorption (less than one-third), greater taper (8–5.5%) and apical size of 25 of the F2 file might be a better option than S2.

The K3 Endo Ni-Ti rotary file system introduced in 2002 are designed with a wide radial land, which is meant to make the instrument more resistant to torsional and rotary stresses. It also has a feature “radial land relief”, which aids in protecting the file from “over engagement”, in the canal; thus reducing the chances of instrument separation or distortion to occur. According to Ankrum et al., this file has a variable core diameter designed to increase its flexibility, it also has a safe-ended tip to decrease the incidence of ledging, perforation, and zipping.^[11] Several studies have shown that Ni-Ti rotary instruments can effectively produce a well-tapered root canal form which is sufficient for obturation, with minimal risk of transporting the original canal.^[12] Guelzow et al. compared various parameters of root canal preparation using a manual technique and six different rotary Ni-Ti instruments and concluded that all Ni-Ti systems maintained the canal curvature and were more rapid than a standardized manual technique. ProTaper instruments create more regular canal diameters.^[13] Elmsallati et al. proposed that K3 Rotary System produces minimum wear of

root canal walls, which is an interesting aspect in the endodontic preparation of primary teeth.^[14] Francin et al. evaluated apical displacement and the time needed for instrumentation of root canals of primary molars by the K3 rotary system and manual K files and found a significantly shorter time for the rotary system.

A newer generation Ni-Ti rotary files appeared with the Mtwo endodontic instruments. Its specific design and flexibility maintain the original root canal curvature and these instruments are effective and safe, hence cleaning can be completed in less time in permanent teeth.^[15] Azar et al. compared the cleaning efficacy of manual K files with two rotary systems: - Mtwo and ProTaper for root canal preparation in primary molars and came to a conclusion that all three systems showed equally acceptable cleaning ability in primary molar root canals. They modified the sequence of three ProTaper instruments slightly to prepare the canals. Root canals were prepared in a crown-down method with three instruments in the sequence from S1 in the coronal third of the root canal, S2 in the middle third, and F1 till the working length.^[16] Pinheiro et al. used a hybrid technique for preparation of the canals in primary molars with the ProTaper system and K-files (Dentsply Maillefer). Root canals were initially prepared by manual instrumentation using a size 15K-file followed by S1 and S2 of the rotary system; then instrumenting again with manual instrumentation with size 15 and 20K-files followed by rotary using a system F1. Final instrumentation was done with manual instrumentation with size 25K-file and F2 using a rotary system.^[17]

Another new generation of files is Flex-Master files, with round passive tips, a modified cross-section, a convex triangular shape having sharp cutting edges, and no radial lands. They resemble K-file configuration enhancing dentine cutting effectivity in permanent teeth.^[18] Makarem et al. conducted a randomized controlled clinical trial of pulpectomy in the primary second molar teeth and achieved superior radiographic findings and less chair time with the Flex-Master system. Bahrololoomi et al. also suggested the Flex-Master system for preparation of primary root canals during pulpectomy.^[19] Hero 642 system^[20] and its new variant Hero Shaper having increased helix angle from tip to shank have improved efficiency, flexibility, and strength in root canal treatments of permanent teeth.^[21] Kummer et al., prepared the root canals using the Hero 642 system and a reducing 50:1 handpiece. Preparation was done with 21 mm nickel-titanium instruments with 2% and 4% tapers using the crown down technique. The protocol determined for instrumentation comprised a kit with 3 instruments: (1) Hero 642 taper 0.04, size 30, 2 mm short of the working length; (2) Hero 642 taper 0.02, size 35, until the working length; (3) Hero 642 taper 0.02, size 40, until the working length. Each

Hero instrument was inserted into the canal with a gentle push and pull motion.

Musale et al. analyzed the efficacy of rotary PROFILE, ProTaper, Hero Shaper, and K file in shaping ability, cleaning efficacy, preparation time, and instrument distortion in primary molars and concluded that the rotary files prepared more conical canals in primary teeth than manual instruments. Lesser preparation time was also noticed.^[22] According to him application of protocols for permanent teeth to primary teeth may often lead to lateral perforation on the inner root surface, especially in curved molar roots. The abrupt cervical constriction, with an overlying shelf of dentin over the canal orifice results in an acutely curved root canal orifice in primary molars which should be removed to improve the straight-line access and reduce the risk of separation of instrument.^[23] Pro Taper Next has been recently introduced which consists of five files (X1–X5). It is made up of the M-wire Ni-Ti technology that is formed by thermomechanical processing. The instrument is flexible and with increased resistance to cyclic fatigue. Hence, reducing the chances of instrument separation.^[24]

Wave-One and Reciproc brands of Ni-Ti instruments advocated the single file system with the reciprocation concept. These files are made up of a special Ni-Ti alloy called M-wire which is created by an innovative thermal treatment process. This procedure has been developed using superelastic Ni–Ti wire blanks which contain substantial stable martensite for clinical use. The advantages of M-wire are increased flexibility of the instruments and resistance to cyclic fatigue.^[25] Katge et al. concluded their study on primary molar pulpectomy by stating that the reciprocating system (Wave One) and the rotary system (Pro Taper) had better cleaning efficiency when compared to manual instrumentation, especially in the coronal and middle one-third of root canals.^[26]

ADVANTAGES

Ni-Ti alloy instruments with their design and flexibility allows to preserve the original anatomy of curved canals and reduce procedural errors, especially in primary teeth.^[10,27] Additionally, resulting in the funnel-shaped canal preparation, a more predictable uniform paste filling can be obtained in primary teeth. The rotary file system also enhances patient cooperation by shortening treatment time for the preparation of the canals.^[28] This characteristic is clinically relevant in pediatric dentistry because it accounts for faster procedures with maintenance of quality and security as well as reducing patient's and professional's fatigue. Considering rotary files to be more convenient to use, their application is more appropriate in children with behaviour management challenges.^[29,30,31] The irregular canal walls of primary molars can effectively be prepared with Ni-Ti, as the clockwise motion of the rotary files pulls pulpal tissue and dentin out of the canal as the files are engaged.

Due to the conical preparation and effortless entrance of obturatory paste, less overfilling occurs. Due to their elastic memory, Ni-Ti files do not require precurvature; they are motor-activated and can prepare the root canal with high speed.^[32] The possibility of root canal deformation is less due to its radial aspect that keeps the file in the center of the root canal via wall support and inactive tips.^[33] By using rotary files, the use of Gates-Glidden drills can be avoided to remove the dentin shelf overlying the canal orifice which might cause accidental perforation of the pulpal floor or excessive removal of inner root structure especially when treating primary molars with thinner pulpal floors.^[34]

DISADVANTAGES

The dentin of primary teeth is softer and less dense than that of the permanent teeth with roots being shorter, thinner, and more curved. Root tip resorption is commonly undetectable. The root canal system has a ribbon-shaped morphology.^[29] These characteristics limit the application of Ni-Ti rotary instruments in primary teeth. The basic conundrum is that rotary instruments are centered in root canals during rotation and leave unclean areas and potentially infected tissue in fins and isthmuses of primary teeth.^[35,29] Hence, in ribbon-shaped canals, it is necessary to use an additional H-file (Nos. 25 or 30) combined with copious irrigation with sodium hypochlorite to remove any loose pulp tissue with a brushing motion and to ensure that all the root canals are cleared and ready for filling. The high cost of Ni–Ti rotary systems and expertise for the technique are their disadvantages. Prior training of the operator in rotary instrumentation is important to control the working length because there is a significant reduction in tactile sensitivity during apical preparation compared with mechanical preparation.^[10,36,37,38]

CONCLUSION

The main objective of pulpectomies is the removal of organic debris in the primary teeth. This goal can be attained by manual or rotary Ni-Ti instruments. With the preparation time being less in the rotary system it is an important clinical factor in pediatric patient management.

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