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ROTARY ENDODONTICS IN PEDIATRIC DENTISTRY- A COMPREHENSIVE REVIEW

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INTRODUCTION

The goal of pulp therapy in the primary dentition is to retain the primary tooth as a fully functional part of the dentition, allowing at the same time for mastication, phonation, swallowing, and the preservation of the space required for the eruption of the permanent tooth[1,2]. The premature loss of primary teeth may cause changes in the chronology and sequence of eruption permanent teeth. Maintenance of primary teeth until physiological exfoliation prevents deleterious habits in children[3].

The primary objectives of cleaning and shaping the root canal system are removing soft and hard tissue containing bacteria, providing a path for irrigants to the apical third, supplying space for medicaments and subsequent obturation, retaining the integrity of radicular structure[1].

Pulpectomy treatment is stressful and heavier treatment for the child and is more complicated due to anatomical complexities that are not found in the permanent tooth[3].

In addition to these, in primary teeth it is important to preserve the tooth until its natural exfoliation time, thus preserving arch integrity. The premature loss of primary teeth may cause changes in the chronology and sequence of eruption of permanent teeth. Maintenance of primary teeth until physiological exfoliation contributes to mastication, phonation and aesthetics and prevents deleterious habits in children[2].

According to the Guidelines of the American Academy of Pediatric Dentistry pulpectomy is indicated in primary teeth with carious pulp exposures in which, following coronal pulp amputation, the radicular pulp exhibits clinical signs of hyperaemia, or evidence of necrosis of the radicular pulp with or without caries involvement[4].

Success of pulpectomy depends on elimination of irritants by means of cleaning and shaping the root canal and it is dependent on microbial reduction as a result of chemo-mechanical preparation[4].

Pulpectomy on primary teeth with severe pulpal involvement should be considered as a treatment of choice[5]. Clinical success occurs when the tooth is painless, firm, non-mobility, and without any signs of inflammation or infection[6]. The conventional instrumentation technique for primary teeth remains hand instrumentation which is time-consuming[7].

A practical pulpectomy technique for the primary dentition should include the following features: a) fast and simple procedures, with short treatment times and a minimal number of appointments; b) effective debridement of the root canals without weakening the tooth structure or endangering the underlying permanent teeth; c) few procedural complications; and d) maintaining tooth function until it is naturally shed[8].

Application Of Rotary Instrumentation Techniques In Pulpectomy Procedure:

According to Barr *et al*. in 2000[9], CrespoS *et al*.in 2008[10], pre-treatment radiograph was taken to determine the working length. A NiTi file was chosen that approximates the canal size and was inserted into the canal while rotating upto the calculated working length. Then canal preparation was subsequently done with sequentially larger files until the last file binds. Each time after withdrawal of file, it was cleaned of pulp tissue and dentinal debris using, ProFile 0.04 instruments at slow speed of 150 to 300 rpm.

As dentin of primary dentition cut more easily it is not necessary to use a "crown down" instrumentation technique. Same technique was used by Silva *et al*., in 2004[7] and Moskovitz M *et al.*, in 2006[6] in which the root canal was instrumented with rotary Profile .04 (Dentsply/ Maillefer) instruments up to a 35size file using step back technique.

A slight buccolingual brushing motion to remove any remaining overlying dentin was used by Ching Kou *et al.*, in 2006[8] using Sx file for instrumentation of canal beyond 3 mm of root canal orifice. The S2 file was then inserted into the canal while rotating up to the working length which was previously determined. Once the resistance point felt no attempt was made to go beyond to avoid risk of instrument separation. Pulp tissue was commonly wrapped around the S2 file which was uncommon with stainless steel files. Copious irrigation using 2.5% sodium hypochlorite and normal saline was done during each file. Lateral perforation was avoided by using only SX and S2 files during preparation. Because of increased taper and tip size of S1 and F series files were not used as they lead to excessive apical dentin removal in primary molars.

Nagaratna PJ *et al.*, in 2006[11] instrumented root canal using reduction gear hand piece and profile 0.04 taper 29 series rotary instruments starting from size 2 to 7. Files were inserted in the canal upto working length and then withdrawn. Using modified crown down technique, Bahrololoomi Z *et al.*, in 2007[12]performed instrumentation with 25-mm-long flexmaster Ni-Ti rotary files (VDW, Germany) having 35/0.06, 35/0.04, 30/0.06 and 40/0.02 tapers. Using gentle advance and withdrawal motion shaping of canal was done until resistance was felt and then switching to the next instrument.

Kummer TR *et al.*, in 2008[13] used Hero 642 system (MicroMega) and a 50:1 reduction handpiece (MicroMega) for canal preparation. 21 mm nickel titanium instruments with 2% and 4% taper were used with crown down technique. A kit with 3 instruments was used for instrumentation: 1) Hero 642 taper 0.04, size 30, 2 mm short of the working length; 2) Hero 642 taper 0.02, size 35, up to the working length; 3) Hero 642 taper 0.02, size 40, up to the working length. A gentle push and pull motion was used for every Hero instrument for the preparation of canal. Kim *et al.*, in 2009[14] used rotary Flex Master (VDW) instruments. Firstly, root canal orifices were enlarged with the orifice shaper "Introfile" (VDW) until the middle third of the root canal. Following this crown down preparation was performed with a 64:1 speed gear reduction handpiece.

Azar MR, Mokhtare M, in 2011[15] used 21 mm long four Mtwo instruments (10/0.04, 15/0.05, 20/0.06 and 25/0.06) using a crown down technique till the working length in primary teeth. For preparation of root canal, NiTi rotary files driven with a torque limited rotation with maximum speed of 280 rpm were used.

According to Pinheiro SL *et al.*, in 2012[16], a handpiece with an electric motor X-Smart (Dentsply) with a speed of 300 rpm and torque of 3N/cm was used for canal preparation, S1 and S2 ProTaper files were used for shaping and F1 and F2, 2N/cm torque with speed of 300 rpm were used with an anti-curvature filing method for finishing the canals. Azar MR *et al.*, in 2011[15] slightly modified the sequence of the three

ProTaper instruments for the preparation of root canals. Using a crown down method root canal cleaning was done with three instruments in the sequence from S1 for the coronal third of the root canal, S2 for the middle third, and F1 till the working length.

Pinheiro SL *et al.* in 2012[16], a hybrid technique using ProTaper system and K-files (DentsplyMaillefer) for instrumentation of canals in primary molars was used. Firstly, root canals were prepared manual instrumentation using a size 15 K-file followed by S1 and S2 of the rotary system; then again instrumentation of the root canals with manual instrumentation with size 15 and 20 K-files followed by rotary F1 system. Finally, instrumentation was done manually with size 25 K-file followed by F2 rotary system.

Ozen, B, Akgun OM, in 2013[17] used Protaper and Hero 642 for instrumentation of the canals. The Sx, S1, S2 were used in a crown down manner with the ProTaper system and followed by F1, F2 and F3 upto the working length. For Hero 642, crown down technique for preparation of canal, 2% and 4% taper files were used.

Vieyra JP, Enriquez FJ in 2014[18] used rotary Light Speed LSX instruments (Discus Dental, USA) and ProTaper file (Maillefer, Ballaigues, Switzerland) for the canal preparation. The rotary Light Speed LSX instruments used size 50 for anteriors canal preparation and to size 40 for molars canals preparation. For Protaper, canal orifice was widened using SX orifice opener rotary file and then with S1 to F2 upto the full working length.

A study done by Selvakumar H et al2016[19], 75 primary molars were selected and divided into three groups. Using spiral computed tomography, the teeth were scanned before instrumentation. Teeth were prepared using a stainless-steel K file for manual technique. All the canals were prepared up to file size 35. (.02 taper) instrumentation was done up to 35 size file. In K3 rotary files (.04 taper) the instrumentation was done up to 25 size file and simultaneously the instrumentation time was recorded. The instrumented teeth were once again scanned, and the images were compared with the images of the un instrumented canals. This study demonstrated a higher lateral perforation rate in K3 rotary files (.04 taper) (32%) followed by a stainless-steel K file (.02 taper) (16%). K3 rotary files (.02 taper) showed the least perforation (8%) among all three groups. K3 rotary files.04 tapers produced more perforation compared to the other two groups, because of the increase in the taper of the instruments and the lesser thickness of the dentinal wall of primary teeth that resulted in lateral perforation of the canal.

Prabhakar AR, Yavaga C, Dixit K, Naik S V. 2016[20] done a cone beam computed tomographic analysis of deciduous root canals using two single-file system in this study total of 24 extracted human primary teeth with minimum 7 mm root length were included in the study. Cone beam computed tomographic images were taken before and after the instrumentation for each group. Dentin thickness, centering ability, canal transportation, and instrumentation times were evaluated for each group. A significant difference was found in instrumentation time and canal transportation measures between the two groups. Wave one showed less canal transportation as compared with one shape, and the mean instrumentation time of wave one was significantly less than one shape.

Katge F, Chimata VK, Poojari M, Shetty S, Rusawat B 2016[21] done the comparison of cleaning efficacy and instrumentation time between rotary and manual instrumentation techniques in primary teeth in which a total of 50 extracted primary molars with at least two-thirds of the root intact were washed in water and stored in 3% sodium hypochlorite solution for 1 week for disinfection on comparison between the control and experimental groups, it was proved that ink could not be removed without instrumentation. the mean scores of the remaining ink in the coronal, middle, and apical third of the canals are as shown in graph 1.in the coronal third of the root canals, h-files showed better cleaning efficacy than Mtwo files, but the difference was not statistically significant. the same results were seen even in the middle third, whereas in the apical third both the files showed the same cleaning efficacy. The mean instrumentation time was shorter for H-files as compared with Mtwo files, and the difference was statistically significant. Mokhtari N, Shirazi A, Ebrahimi M. 2017[22] done aclinical comparison of Kedo-S paediatric rotary files vs manual instrumentation for root canal preparation in primary molars. In this, in control group conventional pulpectomy was performed and in the case group working length was determined by electronic apex locator Root ZXII and instrumented with Mtwo rotary files. There were no significant differences between electronic apex locator Root ZXII and conventional method in accuracy of root canal length determination. However significantly less time was needed for instrumenting with rotary files (P=0.000). Similar results were found in the study by Jeevanandan G, Govindaraju L 2018[23] who instrumented mandibular primary molars in children of age 4–7 years with pulp necrosis with paediatric rotary files Kedo-S (experimental group) and hand K-files (control group). The instrumentation time and quality of obturation was recorded using immediate post-operative radiographs. Mean instrumentation time with paediatric rotary files Kedo-S (78.53 s) was significantly less than K-files (95.46 s) and a significant improvement in the quality of obturation ($p<0.05$) with paediatric rotary files (Kedo-S). Panchal V, Jeevanandan G, Subramanian EMG 2019[24] done a study on comparison of post-operative pain after root canal instrumentation with hand K-files, H-files and rotary Kedo-S files in primary teeth. The participants were randomly divided and distributed for instrumentation with K-file (Group 1), H-file (Group 2) and rotary Kedo-S files (Group 3). After completion of root canal procedure, the post-operative pain was evaluated at intervals of 6, 12, 24, 48, and 72 h using modified Wong Baker pain scale and compared between the groups. Post-operative pain between three groups at 6, 12, 24, 48 and 72 h were compared using Chi square test. There was decreased post-operative pain with Kedo-S rotary files as compared to other two groups. The post-operative pain decreased after 12 h for all the groups with no pain at 24, 48 and 72 h intervals.

Advantages And Disadvantages Og Rotary Endodontics In Primary Teeth

Advantages

The design and flexibility of Ni–Ti alloy instruments allow files to preserve the original anatomy of curved canals and reduce procedural errors especially in primary teeth[7,8]. In addition, because of the funnel shaped canal preparation, a more predictable uniform paste filling can be obtained in primary teeth. Rotary files also improve patient cooperation by shortening treatment time for cleaning canals[13]. This factor is clinically relevant in Pediatric dentistry because it allows faster procedures with maintenance of quality and security as well as reducing patient's and professional's fatigue. Considering that rotary files are more convenient to use, their application may be more appropriate in children with behaviour management problems[4]. The irregular canal walls of primary molars are effectively cleaned with Ni–Ti, since 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 pathway of preparation and effortless entrance of obturatory paste, less overfilling occurs. Ni–Ti files do not require pre-curvature due to their elastic memory; they are motor activated and can prepare the root canal with high speed[5]. The probability of root canal deformation is reduced due to its elastic memory and radial aspect that keeps the file in the centre of the root canal via wall support and inactive tips[7].

Disadvantages

Primary dentin is softer and less dense than that of the permanent teeth and the roots are shorter, thinner, and more curved. Root tip resorption is often undetectable. The root canal system is characterized by a ribbon shaped root morphology[4]. All of these characteristics hinder the application of Ni–Ti rotary instruments in primary teeth. The basic dilemma is that all rotary instruments are centred in root canals during rotation and leave unclean areas and potentially infected tissue in fins and isthmuses[4] of primary teeth. Therefore, in ribbon shaped canals, it is necessary to use an additional H-file (Nos. 25 or 30) combined with copious sodium hypochlorite irrigation 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 need for training to learn the technique are their disadvantages[8]. Previous training of the operator in rotary instrumentation is important to control the working length because there is reduction in tactile sensitivity during apical preparation compared with manual mechanical preparation.

General Guidlines For Using Rotary Niti Instruments

- Apply light apical pressure, the equivalent of writing with a lead pencil.
- Never force the instrument apically.
- Use copious irrigation.
- The file should be continuously engaging and disengaging the canal walls.

- Use a passive motion; do not leave the file stationary in canal.
- The instrument should be rotating when introduced into the canal.
- No more than 1mm per second of advancement down the canal.
- Use each instrument for duration of about 3-5 seconds.
- Use an electric hand piece for accurate speed and application of torque.
- Use a constant, recommended, rotational speed, never 'feather' the rheostat.

CONCLUSION

With almost a decade experience of use of rotary instruments in children and observation during follow-up examinations, we conclude that following stringent case selection, adhere to standard operation protocol of instrument selection and sequence of its use and follow-up with radiographic examination will deliver predictable success in pulpectomy in primary molars.

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