ORIGINAL RESEARCH PAPER

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QUALITY OF ROOT CANAL OBTURATION IN PRIMARY MOLARS FOLLOWING INSTRUMENTATION WITH ROTARY AND MANUAL FILES– A PRELIMINARY REPORT

KEY WORDS: manual files, obturation, primary molars, rotary files

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ABSTRACT

Aim: To evaluate the root canal obturation in primary molars following root canal instrumentation with rotary and manual file systems. **Methods:** A total of 30 primary molars requiring pulpectomy were selected from children aged 4-6 years. The teeth were grouped into 3 groups (Groups 1,2 and 3) of 10 teeth each. In groups 1, 2 and 3 cleaning and shaping was done using Pro AF Baby Gold pediatric rotary file system, HERO Shaper rotary file system, and manual Ni-Ti K files, respectively. Root canals were obturated using zinc oxide eugenol cement carried with engine driven lentulo spiral. Radiological evaluation of quality of root obturation was done immediately. **Results:** Group 2 showed the significantly superior quality of obturation than groups 1 and 3. In mandibular teeth, group 2 showed superior obturation in mesiobuccal and mesiolingual root canals than in groups 1 and 3. However, it was not significant in maxillary root canals. **Conclusions:** The quality of root canal obturation was superior in the root canals instrumented with the HERO Shaper rotary file system followed by Pro AF Baby Gold pediatric rotary file and manual Ni-Ti K files.

INTRODUCTION

Preservation of primary teeth is the principal goal of pediatric dentistry. Retaining primary teeth is essential to maintain arch length integrity and for proper guidance of erupting permanent teeth. All efforts are made to preserve the primary teeth, so that they function as designated. Despite various advances in pediatric preventive dentistry, many children lose their teeth earlier than its stipulated time. To preserve the primary teeth, many therapeutic procedures have been suggested by the researchers depending on the extent of inflammation/infection of the pulp tissue.[1,2]

Pulpectomy is carried out when inflammation of the pulpal tissue extends up to the radicular pulp or non-vital pulp tissue or exposure of pulp tissue due to traumatic injuries. The procedure consists of complete removal of the inflamed and infected pulp tissue along with debris from the root canal followed by instrumentation the root canals and finally obturating with an antimicrobial, resorbable paste to ensure a three-dimensional seal so that recurrence of bacterial infection is prevented.[1] The endodontic treatment of deciduous teeth is more challenging due to the anatomical variations of their root canal systems and their close proximity to the developing permanent tooth, added with the difficulty of management of their behavior.[2]

Routinely instrumentation of the primary root canal has been carried-out using manual file system. The use of this file system is time-consuming and may lead to iatrogenic errors.[3] The development of Nickel-Titanium (Ni-Ti) instruments brought a change in the traditional design and taper of the files which led to the introduction of rotary endodontics. Rotary file systems are faster and have better cleaning ability than manual instruments. They clean and shape the narrow and torturous root canals of primary tooth more efficiently and results in superior obturation quality.[4-11] The design and high flexibility of rotary files allow instruments to closely adapt to the root canal path, especially in curved canals.[12,13] Barr et al was the first to use the rotary instruments in primary teeth and stated that the use of rotary files results in superior and uniform obturation.[7] Since then, many rotary endodontic systems have been recommended for instrumentation of root canals of primary teeth.[12-16]

High Elasticity in Rotation (HERO) Shaper rotary files is the rotary file system that incorporate a conical design together with high flexibility and constant taper. Although this file system is manufactured for permanent teeth, the modification in the design makes it more suitable to be used in primary teeth.[17,18] Recently to meet the demand of pediatric endodontists, array of pediatric rotary file systems have been introduced, one such system is Pro AF Baby Gold pediatric rotary file system. The shorter working length, reduced taper, and lesser number of files make the pediatric rotary file systems to be used with more comfortability for both operators as well as children.[19-21]

The aim was to evaluate and compare the quality of root canal obturation following root canal instrumentation of primary molars with Pro AF Baby Gold pediatric rotary file system, HERO Shaper rotary file system, and manual Ni-Ti files.

METHODS

Primary molars requiring pulpectomy were selected from normal, healthy, and co-operative children aged four to eight years. The nature and objectives of the study were explained to the parents of the participating children and their informed written consent was obtained. The participants' confidentiality was ensured with the use of identification numbers, and their records were maintained by the principal investigator alone. Intraoral examination of each child was carried out and for the tooth indicated for pulpectomy, a standardized intraoral periapical radiograph was obtained. The sample inclusion criteria covered teeth that exhibited one or more of the following features: 1) carious pulp exposure diagnosed with irreversible pulpits, 2) vital or non-vital primary molars without a sinus tract, 3) an absence of internal or external pathological root resorption, 4) radiographic signs of pulpal or inter-radicular involvement, or 5) the presence of two-thirds of root length.[2, 7, 14, 21-22] The exclusion criteria covered teeth with any of the following characteristics: 1) an abscess or sinus tract due to dental caries, 2) non-restorability, 3) pulpal floor perforation, 4) root resorption of more than one-third, or 5) an excessive pathologic loss of bone support with a loss of normal periodontal attachment. Additionally, children who had special care needs, had limited or lacking cooperative

abilities, or required sedation/general anesthesia for behavior management were also not included.[7,14,21-22]

Based on the previous studies[20-22] the sample size was calculated with 95% power using G Power analysis. Thus, the estimated sample size was 45 which were rounded off to 50. As this was a preliminary study, 20% of the sample size of the parent study was considered. Thus, the study comprised of 10 teeth in a group.

Following the administration of local anesthesia (2% lignocaine, Lignox, Bangalore, India), dental caries and overhanging enamel were removed with a #330 high-speed bur under a water spray. The coronal pulp was accessed using a #8 round bur, and the entire roof of the pulp chamber was removed. Using sterile and sharp spoon excavator, necrotic pulp tissue from the pulp chamber was removed. Straight-line access was established and pulp tissue was extirpated from the root canals using #10 H files (Mani, Inc, Tochigi, Japan). No 10 size K file (Mani, Inc, Tochigi, Japan) was used to obtain the patency of the root canals. The working length was kept 1mm short of the radiographic apex. Computer-generated randomization was used to sort these primary molars into three groups (Group 1, Group 2, and Group 3), each consisting of 10 teeth, according to the type of instrumentation to be used for root canal preparation. The root canals of teeth in group1, were instrumented using Pro AF Baby Gold (Kids-e-Dental, India), pediatric rotary files following the manufacturer's instructions. In group 2, the root canals were instrumented with HERO Shaper rotary file system (Micromega, Geneva, Switzerland) along with a coronal enlarging file (Endoflare-Micromega, Geneva, Switzerland) provided with the file system. Endoflare file was used to pre-enlarge the coronal third of the root canals. Following, the root canals were instrumented with rotary files upto working length according sequence recommended by manufacturer. The rotary file systems of groups 1 and 2 were used with an endodontic motor (X-Smart, Dentsply Maillefer, OK, USA) at 300rpm and 2.2 Ncm torque. In group 3, root canals were instrumented with manual Ni-Ti K files (Dentsply, Switzerland). The file that reached the working length and provided the resistance was selected as the initial file for instrumentation. The root canal instrumentation was carried out with pull back motion and enlarged up to three sizes more than initial file. To maintain the standardization, in all the groups, each file was used for up to five teeth. In all groups, root canals were intermittent irrigated with 5ml of normal saline. During the root canal preparation, as a lubricating paste EDTA gel 17% (RC help, Prime dental products, Pvt. Ltd) was used.

Following complete root canal preparation, saline was used for final irrigation, and the root canals were dried with absorbent paper points. The root canals of the primary molars in all three groups were obturated with zinc oxide eugenol cement (Zinc Oxide BP, Eugenol BP, Associated Dental Products Ltd.) using a Lentulo spiral mounted on a slow-speed handpiece. The selected Lentulo spiral was one size smaller than the last-used file size and for better handling it was cut to half its length with a pair of sharp scissors. A homogenous mixture of zinc oxide eugenol was mixed in a powder: liquid ratio of 1:1. The prepared paste was carried into the root canal using a slow-speed handpiece rotating in a clockwise direction, which was then gently withdrawn from the root canal while still rotating. A rubber stopper was used to keep the Lentulo spiral 1 mm short of the working length. This process was repeated five to seven times for each root canal until the canal orifice was filled with the paste. [1, 24] The pulp chamber was cleaned with a moist cotton pellet and then restored with type II glass ionomer cement (GC, India). The final restoration with stainless steel crowns (3M ESPE, St. Paul, MN, USA) was carried out in a second appointment within one week of obturation. All the participants were instructed to report any symptoms following the procedure, such as pain or swelling.

Immediate post-operative radiographs were taken with a dental x-ray unit operating at 60kvp, 6mA, 0.3 seconds, and 15mm. Radiographs were evaluated for quality of root canal obturation by two examiners who were blinded for the type of technique used. Kappa test was performed for the examiners and the score obtained was 0.88. A lower ranking was given, if there was a disagreement between them. Quality of obturation of the teeth was graded as underfilled, optimal, or overfilled.[2,25] Length of obturation in each root canal was also recorded.[2]

SPSS software were used to analyze the obtained data.

RESULTS

A total of 22 mandibular teeth and 8 maxillary teeth were treated with pulpectomy (Table-1).

Quality of obturation of teeth:

In group 1, 1(10%), 6(60%), and 3(30%) teeth were underfilled, optimally filled and overfilled, respectively. In group 2, all 10(100%) teeth were optimally filled. In group 3, 5(50%), 4(40%) and 1 (10%) tooth were underfilled, optimally filled and overfilled, respectively. In comparison, there was a statistically significant difference in the quality of obturation among all the groups (P<0.028). Group 2 showed the significantly superior quality of obturation than group 1 and 3. Group 1 showed better quality of obturation than group 3(Table-2).

Length of root canal obturation: Maxillary Teeth:

In group 1, 3(37.5%) canals of each of mesial, distal and palatal were optimally filled, 1(12.5%) mesial canal was overfilled, and 1 (12.5%) distal canal and 1 (12.5%) palatal canal were underfilled. In group 3, 2(25%) mesial, 3(37.5%) distal and 4(50%) palatal canals were optimally filled and 2(25%) mesial and 1(12.5%) distal canal were underfilled. (Table-3) Mandibular **Teeth:** In group 1, 5(22.73%) mesiobuccal, 4 (18.8%)of each mesiolingual, and distal canal were optimally filled and 1(4.54%) of each mesiobuccal, mesiolingual, and distal canal were underfilled. One (4.54%) of each mesiolingual and distal canal was overfilled. In group 2, 10(45.45%) of each mesiobuccal and mesiolingual and 9(40.9%) distal canals were optimally filled and 1(4.54%) distal canal was underfilled. In group 3, 1(4.55%) of each mesiobuccal and mesiolingual and 3(13.64%) distal canals was optimally filled. Four(18.8%) of each mesiobuccal and mesiolingual and 2(9.1%) distal canals were underfilled. One(4.54%) of each mesiobuccal, mesiolingual, and distal canal was overfilled. (Table-3). On comparison of length of root canal obturation in primary mandibular teeth, there was a significant difference with group 2 showing superior obturation in mesiobuccal (P< 0.007) and mesiolingual (P<0.011) root canals than in groups 1 and 3 However, it was not significant in maxillary root canals.

DISCUSSION

The success of pulpectomy depends on the proper instrumentation of root canals as well as on the quality of obturation. The ideal obturation should ensure the root canals with complete obturation without overfill or underfill and with minimal or no voids.[26] However, optimal obturation of primary root canals is difficult because of anatomical variations of the root canals of primary teeth. Recently introduced rotary files can effectively shape torturous and irregularly shaped root canals of primary teeth. The use of rotary instruments reduces the iatrogenic errors due to its flexibility and the design. They closely adapt to the root canals following the original root canal path which results in a more conically prepared canals, favoring a superior quality of root canal obturation.[1,27]

Although the HERO Shaper files are manufactured to use in permanent teeth, the modifications in their design favors its use in primary teeth.[17,18] Recently array of pediatric rotary file systems have been introduced into the market and their clinical efficiency have been reported.[21,28-30] However, studies

evaluating the clinical efficiency of Pro AF Baby Gold are very few.

During instrumentation, for gross debridement and lubrication the root canals were irrigated with normal saline. It has a flushing action and is non-irritating to underlying tissue. If the normal saline is extruded periapically it will not cause any serious adverse event as the osmotic pressure of normal saline is similar to that of the blood.[31] During the use of rotary files, torque-controlled endomotor not exceeding the recommended speed for both the rotary file system was used. Additionally, the use of this endomotor allowed for adjustment of the torque limit for each file. This will reduce the risk of fracture of files, as they will be operated below their limit of elasticity. The handpiece was used with low speed, a continuous torque, and 150-300rpm rotation. Due to its miniature adjustable contra-angle head, there is increased visibility during root canal preparation. The simplicity of this endomotor made it more convenient to use in children.

The quality of obturation obtained in the present study using Pro AF Baby Gold pediatric rotary files was comparable with other Indian studies.[21,28-30] All the primary teeth instrumented with HERO Shaper rotary files resulted in optimally filled root canals. Studies have shown that use of rotary file systems of permanent teeth for root canal instrumentation in primary teeth results in a superior quality of obturation than manual Ni-Ti files.[32-34] Similar to other studies, the quality of obturation in primary canals instrumented with manual Ni-Ti files were inferior to other two rotary file system used.[21,28-30] Higher number of underfilled and least overfilled obturation was observed in root canals instrumented with manual file system. Root canals instrumented with manual files will be narrower compared to rotary files as the taper is only 2%, which will limit the flow of obturating material adequately. This finding is in consistent with other studies.[21, 33,34] If the exact root canal length is not maintained on the lentulo spiral, it may result in overfilling. This may be the reason for overfilling observed in root canals instrumented with pediatric rotary files and manual files.

Root canals instrumented with rotary files resulted in a superior quality of root canal obturation than manual Ni-Ti files. This could be due to a more conical form of canals prepared by rotary files.[35,36] The rotary files prepare the root canals more conically than manual files as they have an elastic memory and radial land that keeps the file in the center of the root canal.[14] Additionally, the greater taper of the rotary files would have contributed for the better quality of obturation. The use of Endoflare for pre-enlarging the coronal third of the root canal would have resulted in superior obturation. Endoflare is a separate #25 size file. It has a short blade length of 15mm and a working length of 10mm and 0.12 taper with positive cutting angle. All these features make Endoflare more suitable to use in primary teeth that has shorter root canal length. It also allows for better cutting and excellent debridement. Use of this file at the beginning of shaping results in a flare of the coronal third of the root canals. Coronal flaring removes any cervical interference from the root canal entrances and allows easy access of endodontic files to the apical portion of the root canal. The use of Endoflare is more apt in primary molars with abrupt cervical constriction and dentinal shelf covering the canal orifice.[17,18] Additionally, the increased taper of the rotary files for permanent teeth would have shaped the canal in its final conical outline more easily than the cylindrical instruments. In the present study, HERO Shaper rotary files having a taper of 4% and 6% were used. With the greater taper, the root canals prepared will be wider and conical, thus allowing the obturating material to follow easily up to the apical third. This would have resulted in a greater number of optimally filled canals. The other modifications in the design of this file system would have also contributed to the superior quality of obturation.

The use of pediatric file sytem resulted in lesser number of optimally filled canals than HERO Shaper file which is contarary to other studies. This variation of observation may be because of non pre-enlarging the coronal third or variation in the obturation technique and materials. Studies showing superior quality of obturation using the pediatric rotary file systems have used pressure syringe technique along with Metapex®.[21, 28-30]

In the present study, obturation was done using zinc oxide eugenol cement with a lentulo-spiral mounted on a slow handpiece. Zinc oxide paste carried with this instrument is less viscous and flows easily, taking the material further apically on the rotation of the instrument inside the canal.[2] Along with these, care was taken by the operator not to apply excessive pressure with each quarter-turn of the screw, which results in extrusion of the material into the canal, which would have led more root canals to be optimally filled. Knowledge, operator's skill, and experience with the file system also would have significantly influenced the results.

On comparison of length of root canal obturation between the maxillary and mandibular teeth, mandibular root canals were obturated superiorly than maxillary root canals. The anatomical variations between mandibular and maxillary teeth, increased accessibility to mandibular teeth and uneven distribution of type of teeth could have caused this variation.

Assessment of quality of obturation using 2-dimensional radiographic image, small sample size, and unequal distribution of type of teeth between the groups could have been a potential limitation of this study. The use of 3-dimensional image (Cone Beam Computed Tomography) will give a volumetric assessment of each root canal. Further investigations are in progress consisting of large sample size and long term follow up of root canal obturation to shed light on long term success.

CONCLUSION

The quality of root canal obturation was superior in the primary molars instrumented with HERO Shaper rotary file system followed by Pro AF Baby Gold pediatric rotary file system and manual Ni-Ti files.

Table-1: Distribution Of Primary Molars Among The Three Groups

File system	Primary Maxillary Teeth				Primary Mandibular Teeth				Total no of teeth
	Right side		Left side		Left side		Right side		
	First molar 54 n(%)	Second molar 55 n(%)	First molar 64 n(%)	Second molar 65 n(%)	First molar 74 n(%)	Second molar 75 n(%)	First molar84 n(%)	Second molar85 n(%)	
Group 1 (n=10)	2 (20)	1(10)	1(10)	-	1(10)	2(20)	-	3(30)	10
Group 2 (n=10)	-	-	-	-	3 (30)	3(30)	1(10)	3(30)	10
Group 3 (n=10)	-	1	2	1	1	2	2	1	10
Total (n=30)	02	02	03	01	05	07	03	07	30
	Total = 08				Total = 22				

Table-2: Comparison of quality of obturation among the three groups

Groups	Under fill n (%)	Optimal fill n (%)	Overfill n (%)	P value
Group 1 (n=10)	1(10)	6(60)	3(30)	0.028*
Group 2 (n=10)	0	10(100)	0	
Group 3 (n=10)	5 (50)	4(40)	1(10)	
Total (n=30)	6(20)	20 (67)	4 (13)	

Table-3: Comparison of length root canal obturation between the root canals in primary maxillary teeth

Root Canals	Total no. of root canals (24)	Length of root canal obturation	Groups			Total n(%)	P value
			Group 1 n (%)	Group 2 n (%)	Group 3 n (%)		
Mesio-buccal	08	Underfill	0	-	2(25)	02 (25)	0.231
		Optimal fill	3(37.5)	-	2(25)	05 (62.5)	
		Overfill	1(12.5)	-	0	01 (12.5)	
Disto-buccal	08	Underfill	1(12.5)	-	1(12.5)	02 (25)	1
		Optimal fill	3(37.5)	-	3(37.5)	06 (75)	
		Overfill	0	-	0	0	
Palatal	08	Underfill	1(12.5)	-	0	01 (12.5)	0.285
		Optimal fill	3(37.5)	-	4(50)	07 (87.5)	
		Overfill	0	-	0	0	

Table-4: Comparison of length root canal obturation between the root canals in primary mandibular teeth

Root Canals	Total no. of root canals (66)	Length of root canal obturation	Groups			Total n (%)	P value
			Group 1 n (%)	Group 2 n (%)	Group 3 n (%)		
Mesio-buccal	22	Underfill	1(4.54)	0	4(18.18)	05 (22.72)	0.007*
		Optimal fill	5(22.73)	10(45.45)	1(4.55)	16 (72.73)	
		Overfill	0	0	1(4.55)	01 (4.55)	
Mesi-lingual	22	Underfill	1(4.54)	0	4(18.18)	05 (22.72)	0.011*
		Optimal fill	4(18.18)	10(45.48)	1(4.54)	15 (68.20)	
		Overfill	1(4.54)	0	1(4.54)	02 (9.08)	
Distal	22	Underfill	1(4.54)	1(4.54)	2(9.10)	04 (18.18)	0.452
		Optimal fill	4(18.18)	9(40.90)	3(13.64)	16 (72.72)	
		Overfill	1(4.54)	0	1(4.54)	02 (9.10)	

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