

Comparison of the quality of obturation using single file system and conventional rotary system in primary teeth:

A randomized controlled study

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Abstract

Introduction: Primary teeth act as a natural space maintainer and guide the eruption of permanent teeth. The carious primary tooth may require pulpectomy to maintain the healthy state of tooth until its normal exfoliation. Pulpectomy can be performed with files, reamers, sonic instruments or mechanical apparatus, and with nickel-titanium rotary file systems. The use of rotary system aids in uniform preparation and adequate debridement of root

canals. Exclusive Single file rotary systems for primary teeth have been developed over time to overcome disadvantage of the existing rotary files.

Aim: To compare the quality of obturation in single file system and conventional rotary system in primary teeth.

Methodology: In this randomized controlled study, pulpectomy was performed on a total of 20 children aged 5-9 years, who were randomly divided based on the instrumentation technique into two groups viz. 1) Single

file system 2) Conventional rotary system. All the teeth were obturated with metapex. The obturation quality was assessed by Coll and Sadrian criteria as optimal, over and under-filled. And the data were analyzed using descriptive and inferential statistics using Fisher's Exact Test.

Results: The obturation quality observed using single file system was comparable to conventional rotary system

Conclusions: Single file rotary system could be an effective alternative to conventional rotary system in children.

Key words: Pulpectomy, Reciprocating motion, Reciproc, Single file system

Introduction

Primary teeth act as a natural space maintainer and guide the eruption of permanent teeth to their optimal position in the dental arch. They preserve the integrity of primary dentition which will aid in mastication, prevent aberrant tongue movement, prevent speech problems, maintain esthetics, prevent psychological effects associated with tooth loss, and maintain the normal eruption of the succedaneous teeth^[1]. A carious tooth might require pulpectomy, to save the tooth and the primary aim of pulpectomy in deciduous teeth is to debride the root canal and maintain the non-pathologic state until the exfoliation of the tooth^[2]. The biologic aim involves removal of necrotic pulp, bacteria and bacterial toxins with instrumentation and irrigation and filling the sterile canal with a resorbable material^[3]. Root canal preparation can be performed with files, reamers, burs, sonic instruments or mechanical apparatus, and with nickel-titanium (Ni-Ti) rotary file systems. Hand preparation techniques may cause iatrogenic errors like ledging, zipping, canal transportation etc. and are time consuming^[4]. The time taken for the treatment is a significant factor in pediatric dentistry considering the short attention span of children. Rotary instrumentation was introduced in dentistry with

the aim of achieving a quality treatment within a short period of time.^[5]

Rotary instrumentation was introduced for primary teeth by Barr *et al.* in 2000.^[6] Rotary instrumentation poses its own advantages and disadvantages in both primary as well as permanent teeth. The use of rotary system aids in uniform preparation and adequate debridement of root canals. Exclusive rotary file systems for primary teeth have been developed over the time to overcome the disadvantage of the existing rotary files. Single file rotary instrumentation were further developed for cleaning and shaping in primary teeth, they are also known to be less time consuming.^[8] This proves as an advantage for biomechanical preparation of primary teeth having shorter, thinner, curved roots, and ribbon-shaped morphology as compared to permanent teeth.^[9] Most of the previous studies comparing rotary instrumentation with hand files used the root canal system for permanent teeth. Furthermore, not many comparisons have been done on the most common root canal rotary system i.e. reciprocating single file and conventional rotary.

Hence, this study was done with the aim to compare the quality of obturation using single file system (Reciproc file, VDW, Munich, Germany) and conventional rotary system (protaper file, Dentsply Maillefer, Switzerland) in primary teeth.

Material And Method

The present study was a randomized controlled single-blinded clinical trial. The ethical approval for the study was obtained from the Institutional Review Board of VSPM's Dental College and Research center, Nagpur. The sample size was calculated using the results of the previous pilot study done using 10 participants in each group.

All the patients aged between 5-9 years, requiring pulpectomy were included in the study. The necrotic

primary molars indicated for single visit pulpectomy, with minimum of 2/3rd root structure remaining and sufficient crown structure were included in the study. Uncooperative children, children with systemic illness, acute apical periodontitis, tooth with more than 2/3rd of physiological resorption, pathological mobility, tooth with necrotic pulp and children presenting with abscess or cellulitis were excluded from the study.

At baseline children were screened and those children meeting the inclusion criteria were included in the study after obtaining informed consent from the parents. The purpose of the study was explained in vernacular language to the parents. Randomization was done using the computer generated sequence of random numbers. The assessor was blinded about the treatment protocol for each group. Since the type of treatment provided, was known to the operator, the operator could not be blinded.

Single visit pulpectomy was performed for all primary teeth (Fig.1). Local anesthesia was administered using Lignocaine Hydrochloride [1:200000 concentration], injected with a 2ml syringe containing 20mm 27G needle. The subjective and objective signs of the local anesthesia were verified before the continuation of the further treatment procedure. Rubber dam (GDC Marketing, Hoshiarpur, Punjab, India) isolation was done for all the pulpectomy procedures (Fig.2). Access cavity was made using no 4 round carbide bur after initial caries removal. The roof of the access cavity was removed using safe ended diamond tapered fissure. The initial orifice was located using explorer which was followed by working length determination using no 15 hand K file. The working length was determined using the radiographic method and was kept 1mm short of radiographic apex. Based on the randomization protocol, the type of instrumentation was chosen for a particular tooth. Rotary instrumentation was preceded by initial hand

instrumentation up to no 20 K-file in both groups. In Group 1 Pulpectomy with conventional rotary Protaper file using X-smart plus endodontic motor (Dentsply Maillefer, Switzerland) (Fig.3) was done and in Group II Pulpectomy with reciprocating single file Reciproc file (VDW, Munich, Germany) using R-smart plus REBORNENDO endodontic motor (Fig.4) was done.

In the ProTaper Universal group, instruments were used in a modified crown-down movement according to the manufacturer's instructions. File was passively introduced with in-and-out movement in the apical direction until reaching the working length. An electrically-driven motor (X-Smart, Dentsply/Maillefer, Ballaigues, Switzerland) with auto-reverse function mode with a torque of 2.5 Ncm, 300 rpm was used to prepare the tooth of this group. In the Reciproc group, a R25 Reciproc file having a size 25 at the tip and a taper of 0.08. Slow in-and-out pecking motion was done, according to the manufacturer's instructions. The flutes of the instrument were cleaned after three in-and-out movements (pecks). These instruments were used only once and discarded after instrumentation of each tooth. An electrically-driven motor (R-smart plus REBORNENDO endodontic motor) with reciprocating function mode and a torque of 3 Ncm, 300 rpm was used to prepare the tooth of this group.

The canals were then irrigated with 2.5% sodium hypochlorite and normal saline after use of every file and dried using sterile paper points(Fig.5). The obturation was done using Metapex by gently pushing with cotton pellets. A post-obturation radiograph was taken to assess the quality of obturation. An assessor was assigned who was blinded regarding the type of instrumentation protocol used. She graded each radiograph as optimal, over and underfilled based on the criteria given by Coll and Sadrian(Fig.6). The obturation was considered as over in case of beyond the apex. Obturation 2mm short of

radiographic apex was considered as under obturation. Obturation at or within 1 mm of radiographic apex was considered as optimal obturation. The data was entered in a spreadsheet.



Fig.1: Tooth required pulpectomy



Fig.2: Isolation under rubber dam



Fig.3: X-smart plus endodontic motor



Fig.4: R-smart plus RebornEndo



Fig.5: canal irrigation



Fig.6 Obturation with metapex

Statistical Analysis

Statistical analysis was done by using descriptive and inferential statistics using Fisher's Exact Test and software used in the analysis were SPSS 24.0 version and GraphPad Prism 7.0 version and $p < 0.05$ is considered as level of significance.

Results

The total sample size was 20 out of which 10 were girls and 10 were boys in the age group of 5 to 9 years with mean age 6.15 years [table 1] [graph 1.1 and 1.2].

The distribution of teeth as per the quality of obturation i.e. underfilled, optimal and overfilled in the two treatment groups were compared using Fischer exact test. On comparing the obturation quality, between both the file systems - optimal obturation was observed in 46% of cases of rotary file and 53% of reciprocating file group. The difference in the distribution of optimal filled obturation was statistically insignificant in the two treatment groups. Though, there was statistically significant difference in percentage of overfilled canals between the two file system. [Table 2][graph2].

The quality of obturation of the individual canal of each tooth was also assessed. On comparing the obturation quality in mesiobuccal canal [maxillary and mandibular teeth] 46 % obturation by rotary file and 53% obturation by reciprocating file showed optimal obturation. The difference in the distribution of optimal filled obturation of the mesiobuccal root canals [maxillary and mandibular teeth] was statistically insignificant in the two treatment groups. Also 100 % obturation by rotary file showed overfilled and 100 % obturation by reciprocating file showed underfilled obturation The overfilled and underfilled obturation quality of their respective group showed statistically significant difference between them. [table 3][graph3].

On comparing the obturation quality in mesiolingual canal of the mandibular molars /distobuccal canal of the maxillary molars 46 % obturation by rotary file and 53% obturation by reciprocating file showed optimal obturation. The difference in the distribution of optimal filled obturation of the mesiolingual canal of the mandibular molars /distobuccal canal of the maxillary molars was statistically insignificant in the two treatment groups. Also both the file system showed 50% of overfilled and under filled obturation and their difference was statistically insignificant. [table 4][graph 4].

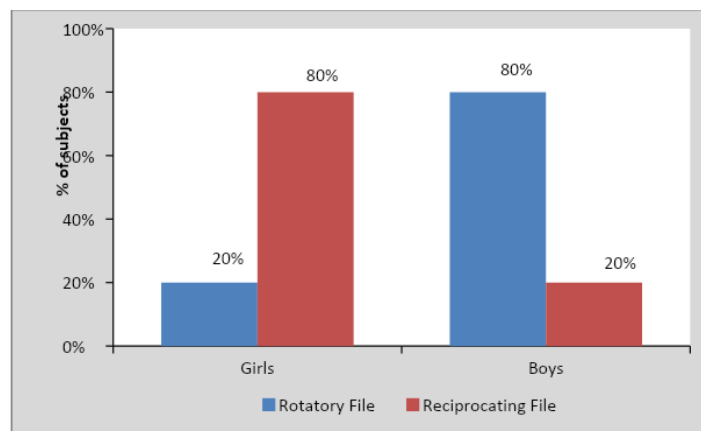
On comparing the obturation quality in palatal canal of maxillary molars/distal canal of mandibular molars 46 % obturation by rotary file and 53% obturation by reciprocating file showed optimal obturation. The difference in the distribution of optimal filled obturation of the palatal canal of maxillary molars/distal canal of mandibular molars was statistically insignificant in the two treatment groups. Also 100 % obturation by rotary file showed underfilled and 50% obturation by reciprocating and rotary file showed overfilled obturation The underfilled obturation quality showed statistically

significant difference between the two file system. While The overfilled obturation quality showed statistically insignificant difference between the two file system [table 5][graph5].

Table 1: Demographic variables describing age and distribution of girl and boy participants in each group

	Rotatory File	Reciprocating File
Girls	2(20%)	8(80%)
Boys	8(80%)	2(20%)
Mean Age(yrs)	6.10±1.44	6.20±1.31
Range	5-8 yrs	5-8 yrs

Graph 1: Demographic variables describing age participants in each group



Graph 2: Demographic variables describing distribution of girl and boy participants in each group

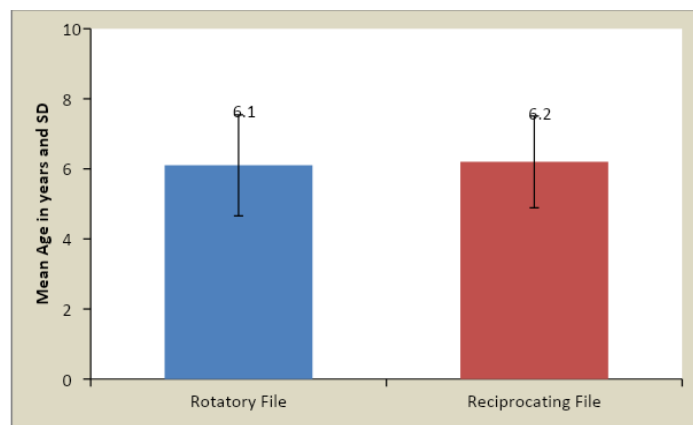


Table 2: Distribution of teeth as per quality of obturation in the two treatment groups

Obturation Quality	Rotatory File	Reciprocating File	Total	p-value
Optimal	7(46.67%)	8(53.33%)	15	0.47,NS
Over Filled	2(66.67%)	1(33.33%)	3	0.0001, S
Under Filled	1(50%)	1(50%)	2	-
Total	10(50%)	10(50%)	20	-

Graph 2: Distribution of teeth as per quality of obturation in the two treatment groups

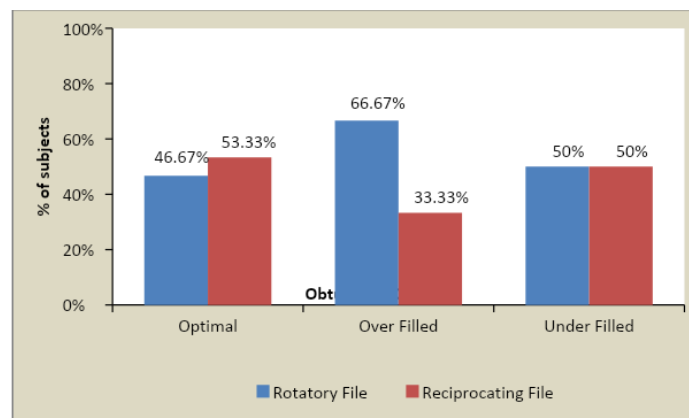


Table 3: Distribution of mesiobuccal canals as per quality of obturation in two groups

Obturation Quality	Rotatory File	Reciprocating File	Total	p-value
Optimal	7(46.67%)	8(53.33%)	15	0.47,NS
Over Filled	2(100%)	0(0%)	2	0.0001, S
Under Filled	0(0%)	1(100%)	1	0.0001, S
Total	9(50%)	9(50%)	18	-

Graph 3: Distribution of mesiobuccal canals as per quality of obturation in two groups

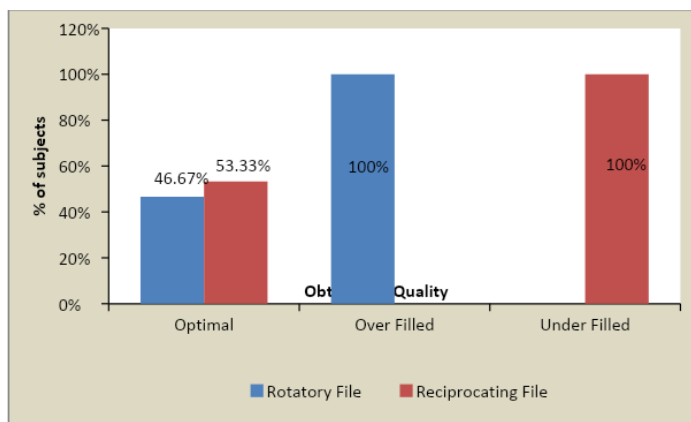


Table 4: Distribution of mesiolingual canal of the mandibular molars /distobuccal canal of the maxillary molars as per the quality of obturation in the two groups

Obturation Quality	Rotatory File	Reciprocating File	Total	p-value
Optimal	7(46.67%)	8(53.33%)	15	0.47,NS
Over Filled	1(50%)	1(50%)	2	-
Under Filled	1(50%)	1(50%)	2	-
Total	9(47.37%)	10(52.63%)	19	-

Graph 4: Distribution of mesiolingual canal of the mandibular molars /distobuccal canal of the maxillary molars as per the quality of obturation in the two groups

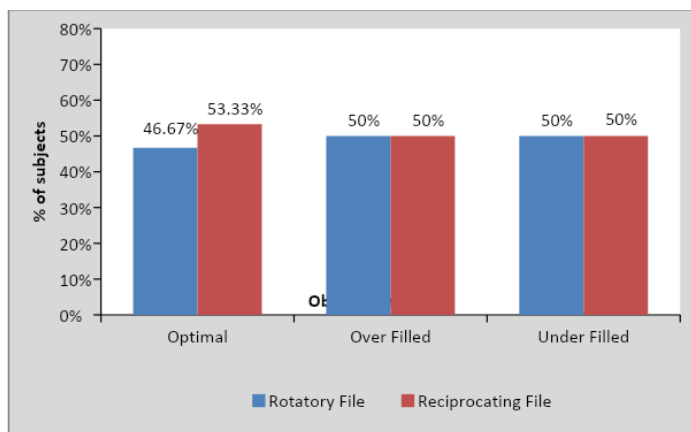
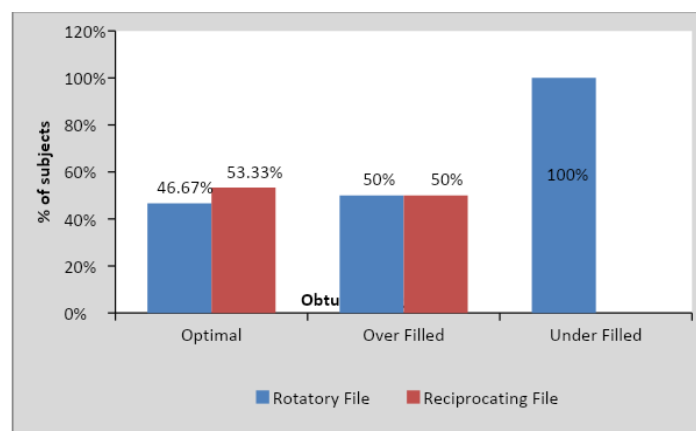


Table 5: Distribution of palatal canal of maxillary molars/distal canal of mandibular molars as per the quality of obturation in the two groups

Obturation Quality	Rotatory File	Reciprocating File	Total	p-value
Optimal	7(46.67%)	8(53.33%)	15	0.46,NS
Over Filled	1(50%)	1(50%)	2	-
Under Filled	1(100%)	0(0%)	1	0.0001,S
Total	9(50%)	9(50%)	18	-

Graph 5: Distribution of palatal canal of maxillary molars/distal canal of mandibular molars as per the quality of obturation in the two groups



Discussion

Success for pulpectomy in primary teeth is attributed to the cleaning and debridement of root canal, followed by an apt restoration. The success of an endodontic procedure depends on proper mechanical debridement and obturation quality.^[11] The present randomized controlled trial holds its uniqueness in using single file rotary for primary teeth. There are many in vitro studies done on primary teeth comparing different rotary instrumentation systems with manual instrumentation.^[6,7,12,13] To the best of our knowledge there are no in vivo studies comparing rotatory ProTaper file and reciprocating reciproc file. Thus this randomized, controlled, single blinded trial was conducted to evaluate the quality of obturation between ProTaper and reciproc file.

Children aged 5 to 9 years of age were chosen for the study because at this age, they are highly susceptible to dental caries due to change in food habits.^[16] Pulpectomy is a treatment of choice to preserve these necrotic primary teeth. Most of the commercially available files utilized to shape root canals are manufactured from nickel-titanium (Ni-Ti) and are mechanically driven in continuous rotation. In continuous rotation file rotates 360° continuously within the root canal. On the other hand, reciprocation is defined as any repetitive back-and-forth motion, which has been clinically utilized to drive stainless steel files since 1958. In 1985, Roane et al. introduced the balanced force technique using instruments in rotational reciprocation for the preparation of curved root canals. They were the first to report the use of hand files with unequal clockwise and counter-clockwise movements in reciprocation.^[15] In 2008, Yared introduced engine-driven single file reciprocation for the preparation of curved canals. Single-file reciprocating shaping technique utilizing unequal clockwise and counterclockwise angles is over four times safer and almost three times faster than using multiple rotary file to achieve same final shape. This is due to reduction in torsional stress. This motion also prevents the taper lock phenomenon by asymmetrical repeating of clockwise and counterclockwise motion.^[14]

Among the systems using NiTi instruments, the Universal ProTaper system is one of the most popular systems. Its main feature is the convex triangular cross-section, absence of radial guide, inactive tip and multiple tapers.^[17] All these features allow the instrument to be guided through the trajectory of the root canal; increasing cutting capacity and reducing advancement of the instrument in the apical direction, thereby reducing the screwing-in effect.^[17] Due to these characteristics, this type of rotary

system was used for comparison with the Reciproc system in this study.

Although the reciprocating systems with a single instrument have clear advantages over rotary systems with multiple instruments the results of the present study showed that the cleaning capacity of the two systems is similar. **Sharma p. et al.** in their Comprehensive Review stated that Reciproc R25 offers greater flexibility and resistance to cyclic fatigue.^[14] **Dagna A. et. al.** conducted a study on cyclic fatigue resistance of three niti single-file systems after immersion in EDTA and concluded that Reciproc R25 showed the highest cyclic fatigue resistance in all groups.^[14] **Carvalho F. et.al.** compared cleaning effectiveness by histological analysis of a reciprocating single-file system with ProTaper rotary instruments concluded that both file system provide similar cleaning efficacy.^[17]

The similar obturation quality presented by the two systems evaluated in this study may also be attributed to the fact that taper of the F2 ProTaper Universal instrument and Reciproc R25 is 8% in the first 3 mm and 0.25 mm at the tip, which promotes root canal shaping with similar geometrical shapes, despite the differences in cross-section.^[18] This may explain the similar obturation quality obtained in this study, despite the different kinematics.

According to the results of the present in vivo study, it may be concluded that reciprocating single-file system and continuous rotary instrumentation system promoted similar obturation quality. However, clinically other aspects have to be taken into consideration when selecting the instrument, such as preparation time, which could decrease when using the single-file (Reciproc Group). Thus, simultaneously the time available for irrigation and chemical debridement of the root canal system is also reduced. Further investigations are warranted to assess this aspect in further detail.

Conclusion Despite the limitations of the present in vivo study, it may be concluded that reciprocating single-file system and continuous rotary instrumentation system have similar obturation quality.

Conflicts of interest and Financial support

The authors have no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or material discussed in the manuscript.

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