Original Article

Comparison of Cleaning Efficacy and Instrumentation Time of Reciproc and Mtwo Rotary Systems in Primary Molars

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Abstract

Background and Aim: Pulpectomy of primary teeth is commonly performed with hand files and instruments. However, it is a time consuming procedure. Compared to hand files, rotary instrumentation has more advantages. The purpose of this in vitro study was to compare the cleaning efficacy and time taken for instrumentation of deciduous molars using Reciproc and Mtwo rotary systems.

Materials and Methods: In this experimental study, 96 canals of 28 extracted primary molars with at least two-thirds of intact roots, with no previous treatment and 7-12 mm length were selected. After access cavity preparation, size #15 K-file was introduced into the root canal and India ink was injected with an insulin syringe. Then, 96 samples were randomly divided into two experimental groups and one control group. In group I (n=44), root canals were prepared with Reciproc; in group II (n=44), Mtwo files were used for instrumentation, and in group III, eight samples were considered as negative controls. After clearing and root sectioning, the removal of India ink in the cervical, middle, and apical thirds was scored. Data were analyzed using Student's t-test and Mann-Whitney U test.

Results: There was no significant difference between the experimental groups regarding cleaning efficacy at the apical third of root canals ($P>0.05$). The coronal and middle thirds scored higher in the Reciproc group ($P<0.05$). Instrumentation with Reciproc rotary files was significantly less time consuming ($P<0.001$).

Conclusion: Using new systems such as Reciproc file for pulpectomy of primary teeth is beneficial.

Key Words: Tooth, Deciduous, Pulpectomy, Instrumentation, Root Canal Preparation

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Introduction

Loss of necrotic primary molars, which may lead to space loss is an important concern in pediatric dentistry. Although the morphology of root canals of primary teeth makes endodontic treatment difficult [1], pulpectomy of primary teeth with severe pulp involvement should be considered as the treatment of choice. When the tooth is painless with no mobility and sinus tract, or any signs of inflammation or infection, the pulpectomy is believed to be successful [2]. Bacteria and their by-products play an essential role in the initiation and perpetuation of pulpal and periapical diseases [3]. The primary objectives of cleaning and shaping of the root canal system include removal of soft and hard tissue containing bacteria, providing a path for irrigants to reach the apical third, providing space for medicaments and subsequent obturation and finally retaining the integrity of radicular structure [2]. Thus, success of

pulpectomy depends on elimination of irritants by means of cleaning and shaping of the root canal [4].

Root canal preparation is commonly performed with files, reamers, burs, sonic instruments or mechanical instruments, and with nickel-titanium (NiTi) rotary systems. Since most of the manual preparation techniques are time consuming and may lead to iatrogenic errors (i.e. ledge formation, zipping, canal transportation and apical blockage) [5], much attention has been paid to root canal preparation techniques with NiTi rotary instruments. Root canal instrumentation may be facilitated with the efficient use of theses mechanical techniques, especially in canals that are difficult to negotiate with hand instruments [1]. Advantages of these techniques may include better cleaning and shaping of the canals, which promotes a more uniform paste fill. Disadvantages include equipment cost and the learning curve necessary to become proficient with the techniques [6]. Numerous studies have confirmed that they could efficiently create smooth, predetermined funnel-form shapes, with minimal risk of ledge formation and transportation [3,7-9]. Rotary instrumentation in curved root canals of permanent molar teeth has been shown to be time efficient, with lower risk of flare-ups [10,11]. NiTi files do not need precurving due to their elastic memory, and they are motor-activated. The probability of root canal deformation is reduced due to its elastic memory and radial land that keeps the file at the center of the root canal via wall support and inactive tips [12,7]. Although root canal instrumentation can be more easily and predictably accomplished, effective cleansing of the entire root canal system using NiTi rotary instruments has not been demonstrated [3]. The basic dilemma is that all rotary instruments are centered in root canals during rotation and leave unclean areas and potentially infected tissue in fins and isthmuses [13]. Reciproc files have some advantages such as less time-consuming nature, less file usage, no cross-contamination, safety regarding file breakage and being user friendly [14].

Despite the advantages of rotary instrumentation and studies performed on primary molars, there are no clear guidelines or instructions for suitable instrumentation of these teeth. Some authors showed no difference between rotary systems [15], while others revealed better cleaning efficacy and shorter time with WaveOne (reciprocating movement) than Mtwo and ProTaper (continuous movement) [16,17]. However, Pinheiro et al. [18] showed that WaveOne and ProTaper were equally effective in reducing Enterococcus faecalis count in primary molars. Regarding the advantages of new single file systems and lack of studies about their application in primary teeth, the aim of this study was to compare the cleaning efficacy and time efficiency of Reciproc and Mtwo rotary files.

Materials and Methods

In this experimental study, 28 (13 maxillary and 15 mandibular) extracted primary molars with at least two-thirds of intact root, and 7-12 mm length were cleaned in water and stored in 0.5% sodium hypochlorite for one hour. The reasons for extraction were carious lesions with great amount of bone loss, resorption of one root with intact remaining roots and over-retained primary molars. The institutional ethical committee of Shahed University approved the study (IR Shahed REC. 1395.35). Radiographs were taken and 64 mesial and distal roots were selected. Coronal access cavity was prepared with round diamond burs (Mani Inc., Tokyo, Japan). After irrigation of the root canals with normal saline, a size #15 K-file (Dentsply Maillefer, Ballaigues, Switzerland) with a suitable diameter was introduced into the root canal and the canal length was determined at 1 mm from the apex or root bevel [19]. A K-file was introduced into the root canal and 1-2 mL of India ink was injected with an insulin syringe into the orifice until the ink extruded from the apical foramen. The ink was reapplied after diffusion and drying as reported by Silva et al. [19]. The roots were then randomly divided into two experimental groups.

Group I (44 canals): The root canals were prepared with Reciproc 25/0.08 (VDW GmbH, Munich, Germany)

Group II (44 canals): The root canals were instrumented with Mtwo files (VDW GmbH, Munich, Germany). The instrumentation sequence was 10/0.04, 15/.05, 20/.06 and 25/.07.

Rotary files were discarded after four times of use [15]. The rotary systems were driven with VDW

Silver Reciproc, Sirona Endo Motor (VDW GmbH, Munich, Germany).

Group III as control (8 canals): Root canals were not instrumented and considered as the control group. In groups I and II, the root canals were prepared by the same operator (who was a postgraduate student of pediatric dentistry); 1.0% sodium hypochlorite was used for irrigation between the use of files. The instrumentation time was measured for both techniques.

The teeth were cleared for cleaning efficacy analysis so the teeth were placed separately in jars with a lid, containing 7% chloridric acid for two days. The acid was refreshed every 24 hours until the teeth were completely decalcified. The teeth were washed under running water and dehydrated in 70% alcohol (for 16 hours, changed every eight hours), 80% alcohol (for eight hours), 95% alcohol (for eight hours) and 100% alcohol (for eight hours). After dehydration, the teeth were placed in methyl salicylate [15].

At first, the canals were cut at the cement enamel junction and at 1 mm above the working length (2 mm upper than the apex or root bevel) with a #11 scalpel, so that the apical section could be observed. Then, the roots were cut from the mid part of the remaining canal (middle section) and cement enamel junction for assessment of cervical section. After clearing, each section was placed on a 1.5×2-inch red wax sheet for easy observation. The removal of India ink from the cervical, middle, and apical thirds was analyzed with a stereoscopic at ×40 magnification and scored: 0=complete cleaning (Figure 1a); 1= more than 50% of ink removal (Figure 1b); 2= less than 50% of ink removal of total intra-canal space (Figure 1c); and 3= no ink removal (Figure 1d). An endodontist, who was blinded to the groups, was asked to interpret the sections.

The results of instrumentation time were analyzed using the Student's t-test. The results of cleaning efficacy of the two groups were analyzed statistically with the Mann-Whitney U test.

Results

Under ×40 magnification, the prepared canal walls showed variable amounts of ink remnants in the canals. The scores of ink distribution in the coronal, middle and apical thirds are shown in Figure 1a, Figure 1b and Figure 1c, respectively. No ink removal (Figure 1d) was noted in the negative control group. Mann-Whitney U test showed no statistically significant differences in cleaning efficacy in the apical third of the two groups (P=0.06); but the coronal and middle thirds showed significantly better cleanliness in group 1 than 2 (P=0.001 and P=0.01 respectively; Table 1). The distribution of cleaning efficacy in the coronal, middle and apical thirds is shown in Table 2. The mean time spent for two rotary root canal preparations was 57.5±27.7 and 167.8±30.7 seconds, respectively. The difference between them was significant (P<0.001).

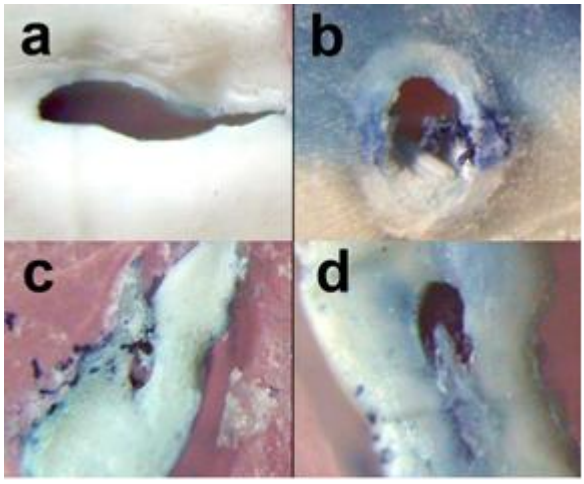

Figure 1. Histological sections showing different scores (a) Score 0, (b) Score 1, (c) Score 2, and (d) Score 3

Discussion

Several factors contribute to the clinical success of pulpectomy, such as biomechanical cleaning [2], type of restoration [20], number of visits [20] and root canal filling material [21]. Chemo-mechanical preparation of the root canal includes both mechanical instrumentation and canal irrigation, and is principally directed towards the elimination of microorganisms from the root canal system [22]. Canal preparation is one of the most important phases of primary root canal treatment and is mainly aimed at the debridement of the canals [2].

The mean time spent for the instrumentation in groups 1 and 2 was 57.5 and 167.8 seconds, respectively, concurring with the results of Pathak

Table 1. Comparison of cleaning efficacy of the two experimental groups at the coronal, middle and apical thirds

Section	P-value for cleaning efficacy
Coronal	0.001*
Middle	0.01*
Apical	0.06

*: Significant difference (P<0.05)

Table 2: Comparison of cleaning efficacy scores of Reciproc and Mtwo in the coronal, middle and apical thirds

Instrument	Canal part	Score			
		0	**1**	**2**	**3**
Reciproc	Apical	7	14	8	15
	Middle	3	24	13	4
	Cervical	17	20	4	1
Mtwo	Apical	6	14	13	11
	Middle	8	14	13	9
	Cervical	16	20	6	2

[16], Katge et al, [17] and Pinheiro et al [18]. They found that single file systems (WaveOne) are significantly less time consuming than other rotary files (Mtwo, ProTaper). Faster canal preparation has some benefits such as corporation maintenance particularly in Special Health Care Needs and younger children, in addition to less fatigue for clinicians. But, the significance of adequate exposure time for the irrigant must be emphasized, particularly in necrotic teeth given that root canal preparation is essentially a chemo-mechanical procedure [23].

In terms of cleanliness, there were no differences in the apical third of the roots between the two groups. This correlates to the results of Pathak [16] who showed no significant difference in the apical third between WaveOne and Mtwo. Also, our findings were in accordance with those of Katge et al. [17] who revealed no statistically significant difference between WaveOne and ProTaper. In the coronal and middle thirds of the roots, Reciproc showed better cleanliness than Mtwo instrumentation. These results agree with those of Pathak [16] and Katge et al [17]. Whereas, other researchers did not find any superiority between other rotary files [15,18,24]. This may relate to different rotary systems and different methodologies.

The UK National Guidelines on Pediatric Dentistry for pulpectomy procedure recommends irrigation with normal saline (0.9%), chlorhexidine (0.4%) or NaOCl solution (0.1%) [25]. According to the American Academy of Pediatric Dentistry for pulpectomy procedure [26], the chemo-mechanical procedure with an inert solution alone cannot adequately reduce the microbial count in the root canal system. The same guidelines also emphasized the importance of disinfection with irrigants such as 1% NaOCl and/or chlorhexidine for optimal bacterial decontamination of the canals

[23]. Thus, we used 1% NaOCl for irrigation. For unification of the two groups, the volume of irrigant used was the same. Although, many pulpal ramifications cannot be reached mechanically, copious irrigation during cleaning and shaping must be maintained [23]. The authors support the view that both chemical and mechanical cleaning affect root canal cleanliness.

Available NiTi rotary files are designed mostly for conical root canal shapes. However, most of the primary molar root canals are ribbon-shaped. Little is known about the impact of these design modifications on clinical outcomes of rotary instrumentation of deciduous molars. Thus, further studies with longitudinal radiographic and clinical assessment of rotary systems in primary molars are suggested.

Conclusion

Clinically, time efficiency is invaluable in endodontic treatment of primary molars, especially with an unpredictable and complex canal morphology. Young patients and their parents appreciate every minute saved with Reciproc rotary file. With respect to modified design and easy handling, using a good irrigant such as NaOCl or chlorhexidine is essential for a successful outcome.

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