

Microbiological Evaluation Of Root Canals After Biomechanical Preparation With Manual And Rotary File System - Randomised Clinical Trial

Research Article

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Introduction

The main objective of endodontically treatment involves proper biomechanical preparation that results in the effective reduction of microbial load followed by proper obturation [1]. Studies have shown that complete debridement and disinfection significantly reduces the microorganisms in the root canal system [2]. Pathogens such as *Enterococcus faecalis*, *Peptostreptococci* are frequently observed in primary teeth when endodontic treatment has failed [3] this important finding regarding the prime role of bacteria in the pathogenesis of pulp and periapical lesions [4, 5] elimination of infection from the root canals became the objective of endodontic management [6].

Root canal preparation in primary teeth has been routinely carried out using hand instruments, which are time consuming and may lead to iatrogenic errors such as ledging and perforation [7]. Most of these procedural errors, such as broken instruments, perforations, overfilling, under filling, ledges and so on are the direct cause of endodontic failure [3].

The introduction of the rotary system with Ni-Ti files for preparation of primary teeth is recent. The uniform taper, ability to rotate on its own axis, which maintains the original taper of the root canals lead to its increasing use in primary teeth [8]. A new rotary file system Kedo S plus has been recently introduced and used due to its variable taper leading to sufficient coronal enlargement, preserving the root canal dentine [9]. Earlier versions of this file included a 2 file system namely Kedo SG Blue whereas Kedo S plus is a single file system. Kedo S plus has a 0.30 tip diameter with a variably variable taper. Coronal 2/3rd of the file appears gold and is heat treated whereas the apical 1/3rd of the file appears blue. This is due to the titanium oxide layer coating after heat treatment which gives greater flexibility to the file to

work along the curvature of primary root canals.

A concern has been presented, however, regarding the ability of a single-file instrumentation system to disinfect the root canal, due to the shortening of preparation time of the canal, together with the lesser amount of antimicrobial agents and shorter contact time [10, 11].

It is well known that chemomechanical preparation reduces the maximum bacterial load. Large number of clinical studies have proven the efficiency of chemicals like EDTA, sodium hypochlorite, chlorhexidine etc in destroying the endodontic pathogens but studies on the ability of rotary instruments to reduce intra-canal flora in primary teeth are lacking. Therefore, the present study was undertaken to evaluate efficacy of rotary nickel-titanium files in reducing microflora in root canals of primary molars, in comparison to manual instrumentation.

Materials And Methods

This randomized clinical trial was conducted in children aged between 4 and 8 years with mandibular primary 1st and 2nd molars scheduled for pulpectomy and accompanying their parents to the department of pediatric and preventive dentistry.

Ethical approval

The study was registered with the Institutional Review Board of the Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu, India. Ethical approval was obtained from the Institutional Review Board of the SIMATS. Informed consent was obtained from all parents of the children before including them in the study prior to the treatment.

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Study design

The participants were selected following thorough clinical and radiographic examination and were randomly allocated to one of the two groups. 30 patients in the age group of 4 to 8 years having good systemic health, without history of antibiotic coverage for the past two weeks and radiographic evidence of carious pulp exposure in primary teeth with more than two third root structure and restorable teeth were included in the present study. Exclusion criteria includes children with systemic illness, grossly decayed teeth, presence of internal or external resorption.

Clinical Procedure

Local anaesthesia containing 2% lignocaine in 1:200,000 adrenaline was administered followed by isolation of the selected tooth using a rubber dam. Access opening was done with sterile high speed handpiece using no. 6 or no. 8 round bur and the roof of the pulp chamber was removed using a non end cutting bur. Pulp extirpation was done using No 15 H file and working length was determined. The distal canal was selected for sampling procedure. Before sample collection, Temporary restorative material was used to cover the remaining mesial canals in mandibular molars. The pre irrigation sample was collected by using 15 size sterile absorbent paper points till the predetermined working length for 1minute. The collected sample was transferred to an Eppendorf tube containing sterile saline as a transport media. Following the initial sample collection, cleaning and shaping was done randomly by using two endodontic files till the working length.

Group 1: Hand K-files in a reciprocal reaming and filing motion.
Group 2: Kedo-S Plus Rotary Ni-Ti endodontic file in a crown down sequence

The canals were irrigated with sterile saline solution and EDTA. The post irrigation sample was collected by using no 25 size sterile absorbent paper point from the canal, as described above. Then the remaining canals were prepared and dried out with appropriate size sterile absorbent paper points and obturation was carried

out using Metapex (Meta Biomed Co. Ltd. Chungbuk, Korea) followed by placement of stainless steel crown. Both the samples were then transported to the Microbiology lab for culture. The samples were inoculated in a culture plate containing blood agar. They were incubated for the period of 48 hours for aerobic culture and for 5 days for the anaerobic culture. The antibacterial effectiveness of both was assessed by the colony forming units. They were counted using the digital colony counter. Mean and standard deviation of the bacterial colony count were estimated for each study group. Mean values between pre and post instrumentation sample was compared by Paired t-test using SPSS version 21.0 and statistical significance was set at P< 0.05.

Results

Thirty children in the age group of 4 to 8 years were included in the study out of which 13 were males and 17 were females. The above table shows the aerobic and anaerobic colony forming units which was found pre and post instrumentation of the manual stainless steel k files and rotary kedo S PlusNiTi files in mandibular molars of primary teeth. The anaerobic colony count pre instrumentation was found to be high in all the groups. Paired t test was done for all the groups and was found to be statistically significant (p<0.05). There is a significant reduction in mean difference in aerobic (0.271 x 10⁵) and anaerobic (1.846 x 10⁵) bacterial count while using rotary instrumentation. There was a 95% decrease in the anaerobic microbial load in while using rotary instruments as compared to the 80% decrease when using k files. This was seen even in aerobic bacterial colony count where there was an increased reduction of about 7% when using Kedo S Plus files. Instrumentation using Ni-Ti rotary file system appears to show higher potential in decreasing the microbial load as compared to the Hand K file group.

Discussion

While various chemical and physical irritants can cause irritation and even necrosis of the pulp, the most common causes for pulpal inflammation (pulpitis) are bacteria and/or their products

Figure 1.



Table 1.

Groups	Microflora	Sample	Mean(Cf U/ml)	Std. deviation	Mean difference (Cf U/ml)	Microbial reduction (%)	P value
K -files	Aerobic	Pre-Instrumentation	0.623 x 10 ⁵	0.23.3 x 10 ⁵	0.579 x 10 ⁵	84	0.007
		Post-instrumentation	0.19 x 10 ⁵	0.102 x 10 ⁵			
	Anaerobic	Pre-Instrumentation	1.499 x 10 ⁵	0.518x 10 ⁵	0.822 x 10 ⁵	80	0.002
		Post-Instrumentation	0.264 x 10 ⁵	0.037 x 10 ⁵			
KedoS Plus	Aerobic	Pre-Instrumentation	0.591 x 10 ⁵	0.401 x 10 ⁵	0.271 x 10 ⁵	91	0.002
		Post-Instrumentation	0.072 x 10 ⁵	0.22 x 10 ⁵			
	Anaerobic	Pre-Instrumentation	1.146 x 10 ⁵	0.510 x 10 ⁵	1.846 x 10 ⁵	95	0.001
		Post-Instrumentation	0.081 x 10 ⁵	0.031 x 10 ⁵			

entering the pulp through a deep caries lesion or a leaking filling [12]. Several studies have indicated that the prognosis of apical periodontitis caused due to the said conditions after root canal treatment is poorer if viable microorganisms are present in the canal at the time of the root canal obturation [13, 14]. Thereby we can widely accept the view that cleaning and shaping of the root canal system is the most important step toward sterility of the canal.

In this study we have used saline as primary root canal irrigant rather than sodium hypochlorite during root canal preparation to analyse the efficiency of these systems so as to maintain a strategic distance from antimicrobial activity of irrigant [15, 16].

One study by Subramanyam et al compared the cleaning effectiveness (microbial reduction) of both manual and rotary techniques and found similar results [17]. It can be stated that mechanical instrumentation is the core method for bacterial reduction in the infected root canal. Dalton et al. [10] compared the ability of stainless steel K-type files and NiTi rotary instruments to remove bacteria from infected root canals using saline as the irrigating solution and found that with larger apical preparation, a significant reduction in bacterial counts was achieved. Card et al. [18] also reported sterility in a majority of root canals instrumented by rotary NiTi instruments using large apical sizes and irrigation with 1% NaOCl. He also stated that teeth that had more anastomoses between canals had reduced proportion of sterility [19].

Thought rotary instrumentation are nowadays being considered superior to manual instrumentation Byström & Sundqvist measured the reduction in bacterial counts cultured from infected canals by instrumentation with hand stainless-steel instruments under irrigation with physiological saline solution which was done in 5 sequential sittings with no antibacterial dressing in between appointment and there appeared to be a substantial reduction in bacterial numbers, about 100–1000-fold [20]. Siqueira et al. [21] study showed that increasing the size of apical preparation resulted in a significant reduction in the numbers of cultivable bacteria.

Further Goldberg & Massone studied the effect of patency files on transportation of the apical foramen using files of sizes #10–#25. The authors reported transportation in 18 of the 30 specimens studied, and concluded that if a patency file is used, one should use the smallest file size possible. No difference was observed between steel and NiTi files [22]. This could negatively affect the treatment as overinstrumentation, with the possible exception of the smallest hand files of size #06–#10 for apical patency can cause direct physical trauma to periapical tissues, cause extrusion of necrotic canal contents including dead and living microorganisms into the periapical area that could cause a flare-up, bacteremia.

Various studies have also reported that crown down techniques used by rotary instrumentation produce less apically extruded debris than stepback preparation used for manual instruments [23, 24].

It can also be noted that Pataky et al. [25] studied on the antimicrobial efficacy of various root canal hand preparation techniques and instruments in 40 human first maxillary premolars and found that though a considerable reduction in bacterial counts was measured after each type of preparation; none of the teeth

was sterile at the end of the preparation and saline irrigation.

Conclusion

Instrumentation using Ni-Ti rotary file system appears to show higher potential in decreasing the microbial load as compared to the Hand K file group and this was statistically significant. It is also imperative to combine the use of irrigating solutions with strong antibacterial activity as the necessary supplement to mechanical preparation for effective disinfection of root canals.

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