ORIGINAL RESEARCH

Microbial Evaluation of Root Canals after Biomechanical Preparation with Manual K-files, Manual H-files, and Kedo-SG Blue Rotary Files: An *In Vivo* Study

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Abstract

Aim: The purpose of the present study was to comparatively evaluate the efficacy of Kedo-SG blue rotary files, manual K-files, and manual H-files in eliminating the root canal microflora of primary molars.

Materials and methods: Forty-five primary molars requiring pulpectomy were included in the study. Based on type of instrumentation, the teeth were randomly assigned to one of the three groups: group A: Kedo-SG blue rotary files, group B: manual H-files, and group C: manual K-files. Sterile absorbent paper points were used for sample collection and stored in sterile Eppendorf tubes containing saline as transport medium. Culturing was done on thioglycolate agar and blood agar media for the cultivation of anaerobic and aerobic microbes, respectively, and recorded as colony-forming units (CFU) using digital colony counter. Wilcoxon signed-rank test and one-way analysis of variance (ANOVA) test were performed for statistical analysis.

Results: Postinstrumentation, 93–96% reduction of aerobic and anaerobic microbial count was recorded in group A. Whereas, it was 87–91% reduction in group B and 90–91% reduction in group C. No statistically significant difference was noted between the three groups.

Conclusion: Kedo-SG blue rotary files showed a better reduction of microbes in root canals when compared to manual instrumentation. However, there was no significant difference between manual and rotary instrumentation in microbial reduction of primary root canals.

Keywords: Biomechanical preparation, Kedo files, Manual files, Microbial, Rotary files.

International Journal of Clinical Pediatric Dentistry (2022): 10.5005/jp-journals-10005-2457

Introduction

The fundamental objective of endodontic treatment is to eliminate the microorganisms from root canal system as the predominant role of microbes in pulpal pathosis was well-established.[1] Endodontic infection is the aftereffect of both the pathogenic impacts of microorganisms and response of the host system. The significant determinant associated with endodontic failure is the persistence of microbial infection in the root canal system.[2] The aim of the operator is to disrupt and obliterate the microbiological system associated with the disease process.[3]

Pulpectomy in primary teeth is carried out to mechanically remove the necrotic tissue from root canals followed by abundant cleaning with irrigants and filling with resorbable obturating material. When planning on cleaning and shaping the primary root canals, their morphology has to be considered as they have shorter and more curved roots with thinner dentinal walls.[4] The traditional manual instrumentation is still preferred in primary root preparation, but studies have illustrated the possibility of ledge formation, perforations, dentin compaction, and instrument fracture.[5] Whereas rotary instrumentation with nickel-titanium properties not only results in better quality preparation and lower risk of flare-up, but also significantly reduces the working time, which is an intriguing aspect to consider in pediatric patients.[6]

Utilization of protocols for permanent teeth to primary teeth may prompt in lateral perforations in root surfaces, specifically in curved molar roots.[5,6] With the introduction of pediatric rotary files, various studies were conducted to assess their quality of preparation and time consumption.[7–9] Only limited data are available on the efficacy of pediatric rotary instrumentation in eliminating microbial flora in the primary root canal system. Therefore, this study is undertaken to assess the antimicrobial efficacy of Kedo-SG blue pediatric rotary file and manual files in primary teeth.

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How to cite this article: Lakshmanan L, Jeevanandan G. Microbial Evaluation of Root Canals after Biomechanical Preparation with Manual K-files, Manual H-files, and Kedo-SG Blue Rotary Files: An *In Vivo* Study. Int J Clin Pediatr Dent 2022;15(6):687–690.

Source of support: Nil

Conflict of interest: None

Materials and Methods

The ethical approval for the research project was obtained from the Institutional Review Board of Saveetha Institute of Medical and Technical Sciences (SRB/SDC/PEDO-1803/20/03) and registered at clinical trials.gov (CTRI/2021/02/031399). Informed consent was obtained from the guardians, after explaining the details of the study.

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Study Population

The sample size for this trial was determined based on data from previously published study (10), with 95% power using G-power analysis. A total of 45 primary molars (maxillary and mandibular—first and second molars) with irreversible pulpitis requiring single-visit pulpectomy were selected from children aged between 4 and 9 years attending the department of pediatric and preventive dentistry between February and March 2021. Those teeth with abscess or sinus, internal and/or external root resorption, perforation in pulpal floor, inadequate crown structure and less than 2/3rd root structure, and children with systemic illness or under antibiotic coverage for the past 2 weeks were excluded from the study.

Procedure

After administration of local anesthesia (2% lignocaine in 1:200,000 adrenaline), the tooth included for the study was isolated with a rubber dam and the operative field was disinfected with 5% tincture iodine. Access cavity was performed by utilizing #6 round and nonending cutting sterile burs with water spray. Pulp tissue from the chamber was removed using sterile and sharp spoon excavator. Pulp tissue from root canals was extirpated using barbed broach. Working length was determined from radiographs using Ingle's method.

For the study sampling, the distal canal of mandibular molar and palatal canal of maxillary molar were selected. The orifices of mesial canals in mandibular molar and buccal canals in maxillary molars were temporarily sealed with Cavit (3M ESPE) to prevent inadvertent contamination. The initial sample (preinstrumentation) was obtained by placing #15 size sterile absorbent paper point inside the selected canal for 1 minute and stored in sterile Eppendorf tube containing 1 mL of thioglycolate broth. The canal patency was established with #15 K-file in all the teeth. Subsequently, the canal was prepared with different file systems according to the groups assigned. Based on computer-generated randomization and sequentially numbered, opaque, sealed envelope method, the teeth were randomly assigned to three groups of 15 teeth each.

- Group A: biomechanical preparation was carried out with Kedo-SG blue rotary files (Kedo Dental, India) in lateral brushing motion with an X-Smart endodontic motor (Dentsply Maillefer, OK, USA) at 250 rpm and 2.2 N cm torque. In mesiobuccal and mesiolingual canals, D1 file (red color coded) was used and in distal/palatal canal, D1 file followed by E1 file (blue color coded) was used for canal preparation.
- Group B: the canal preparation was done with manual H-file (Mani Inc., Tochigi, Japan) till #30 size file using quarter-turn-pull technique.
- Group C: the instrumentation was carried out with manual stainless steel K-file (Mani Inc., Tochigi, Japan) till #35 size file in pullback motion.

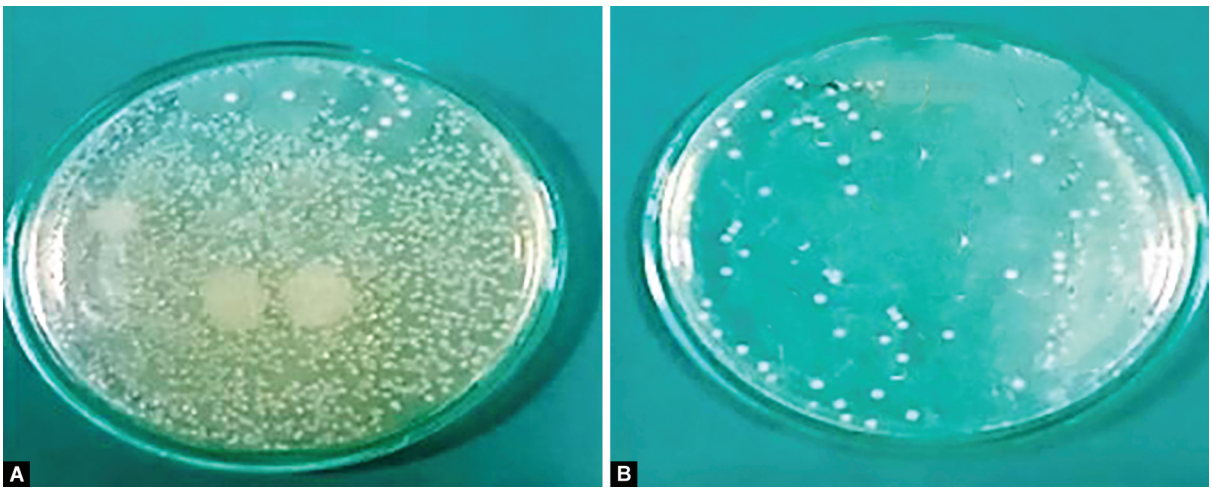
Seventeen percent ethylenediaminetetraacetic acid (Endoprep-RC) was employed for lubrication during instrumentation and intermittent irrigation was carried out manually using physiologic saline with a standard volume of 5 mL. The postinstrumentation sample was obtained using sterile absorbent paper points with a size appropriate to the prepared root canal diameter and stored in the manner as illustrated prior. Following this, the temporary seal over the remaining canals was removed and prepared in the same method. After thorough drying of canals using absorbent paper points, the tooth was obturated with Metapex (Meta Biomed Co., Ltd., Chungbuk, Korea). Restoration was carried out with type II glass ionomer cement (GC India) and stainless steel crown (3M ESPE).

Sample Processing

The samples were submitted to a microbiological laboratory within an hour for quantitative analysis of microbes. The samples were diluted with saline to obtain 10^{-4} dilution. 1 mL from each was inoculated onto blood agar plates and incubated aerobically at 37°C for 3 days. Similarly, the dilution was inoculated onto thioglycolate agar plates and incubated in an anaerobic jar with a gas pack at 37°C for 7 days. The total bacterial count expressed as CFU/mL was recorded by a reviewer who was blinded to the study groups using digital colony counter. Figure 1 depict the pre- and postinstrumentation samples collected from a tooth included in the study.

Statistical Analysis

The outcomes were analyzed by a statistician blinded to the instrumentation groups using SPSS software version 23.0 (SPSS Inc., Chicago, IL, USA). The analysis was complemented by the Wilcoxon test and by the one-way ANOVA test at a 5% significance level.



Figs 1A and B: (A) Culture media prior to instrumentation; (B) Culture media postinstrumentation

Table 1: Mean reduction of microbial count in all the groups

Groups	*Microflora*	*Sample*	*Mean (CFU/mL)*	*Standard deviation*	*Mean difference (CFU/mL)*	*Microbial reduction (%)*	*p-value*
Kedo-SG blue files	Aerobic	Preinstrumentation	0.722×10^5	0.227×10^5	0.697×10^5	96	0.001*
		Postinstrumentation	0.024×10^5	0.020×10^5			
	Anaerobic	Preinstrumentation	1.923×10^5	1.154×10^5	1.798×10^5	93	0.001*
		Postinstrumentation	0.125×10^5	0.083×10^5			
H-files	Aerobic	Preinstrumentation	1.167×10^5	0.664×10^5	1.072×10^5	91	0.001*
		Postinstrumentation	0.094×10^5	0.073×10^5			
	Anaerobic	Preinstrumentation	2.142×10^5	1.148×10^5	1.858×10^5	87	0.001*
		Postinstrumentation	0.283×10^5	0.266×10^5			
K-files	Aerobic	Preinstrumentation	0.733×10^5	0.388×10^5	0.697×10^5	90	0.001*
		Postinstrumentation	0.070×10^5	0.055×10^5			
	Anaerobic	Preinstrumentation	1.685×10^5	0.438×10^5	1.798×10^5	91	0.001*
		Postinstrumentation	0.143×10^5	0.094×10^5			

*$p < 0.05$ statistically significant

Results

Following biomechanical preparation, a statistically significant reduction in the mean bacterial colony count in the canals of all the three groups was noted (Table 1). 96% reduction in aerobic and 93% reduction in anaerobic microbial count was noted in group A. Group B showed 91% reduction of aerobic and 87% reduction of anaerobic microbial count. In group C, the aerobic count was reduced by 90% and anaerobic count was reduced by 91%, postinstrumentation. However, there was no statistically significant difference between the three groups ($p > 0.05$).

Discussion

The intricate root canal microbial flora is a significant concern in the failure of endodontic therapy. The success of root canal treatment is related to the decrease in the number of microbes.[3] Based on the complex anatomy of the primary root canals, it is acknowledged that, with accessible instruments and techniques, reducing the microbial load to a status below that is necessary to initiate or persist the disease is adequate for the success of pulpectomy.[10,11]

Biomechanical preparation using endodontic files have established to be major contributors in eradicating bacteria and their by-products in infected root canals.[12–14] The present study was undertaken to assess the efficacy of Kedo-SG blue pediatric rotary file when compared to manual files in primary teeth.

D1 and E1 files of Kedo-SG blue rotary system are utilized for performing pulpectomy in primary molar teeth. The variably variable taper, varying tip diameter (D1: 0.25, E1: 0.30), and thermal coat adding supreme flexibility to reach the tortuous root canals are considered as their unique properties. Priyadarshini et al., in a clinical study, reported that Kedo-SG blue file provides superior quality of obturation in reduced duration.[15]

Irrigation in pulpectomy procedure is not only essential to flush away the debris created during instrumentation, but also to act as a lubricant for instruments and to eliminate the smear layer that forms on dentine surfaces following instrumentation.[10] As the objective of the study was to evaluate the efficacy of instruments in reducing the microflora, only saline was utilized for irrigation as it avoids any bias arising from the use of antimicrobial irrigants. Byström and Sundqvist demonstrated more reduction in the bacterial count by using saline as an irrigant in permanent root canals.[16] Pre- and postinstrumentation samples were obtained from the same canal in every tooth subsequent to covering the orifice of other canals using temporary restorative material to prohibit cross-contamination. Collection of samples using paper points is considered to be a reliable technique as they have the property of absorbing contents as well as the capacity of reaching the apical region of root canals.[17]

The result of the study is influenced by the type of culture medium employed. The factors such as nutritional demands of bacteria, protection of samples from oxygen exposure, and inoculation time play a critical role in culturing.[18,19] The current study utilized thioglycolate agar and blood agar media for the cultivation of anaerobic and aerobic microbes, respectively, and they were expressed as CFU.

Microbial reduction was significantly reduced in all the postinstrumentation samples, but none of the samples were rendered free of microbes. The results of the present study were similar to the study done by Dalton et al., who demonstrated significant microbial reduction with each type of instrument technique employed.[20] The rotary instrument reduced 93–96% of aerobic and anaerobic microbes, whereas manual K and H files reduced 87–91% of microbes. This was in accordance with the study conducted by Subramaniam et al., who reported 96–99% reduction in aerobic and anaerobic microbial count and 94–97% microbial reduction with manual files.[10]

Estimation of mean microbial count instead of identifying specific microorganisms responsible for reinfection and comparison with only one type of rotary instrumentation can be considered as limitations of the current study. Further studies investigating different irrigation protocols, instrumentation techniques, and identifying specific microbes in primary root canals can be carried out.

Conclusion

Within the parameters of this study, it can be concluded that both rotary and manual files are effective in significantly reducing root canal flora. However, Kedo-SG blue rotary files showed a better reduction of microbes in root canals when compared to manual instrumentation. Efficient cleaning of primary root canals in a short span of time is a considerable factor in children.

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