



Comparative assessment of centralization ability and canal transportation of root canals prepared with three commercially available pediatric rotary files-An in-vitro study

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ABSTRACT

Background:The elimination of microorganisms through chemomechanical preparation is essential for the success of endodontic treatment. To perform an effective pulpectomy in primary teeth, it is essential to use rotary files with customized taper, length and tip size which is suitable for morphology of root canal for primary teeth. The present study was conducted to assess centralization ability and canal transportation of root canals prepared with three commercially available pediatric rotary files

Aim:To assess and compare the centralization ability and canal transportation of root canals prepared with three commercially available pediatric rotary files

Materials & Methods:45 extracted human primary teeth with a minimum 7 mm root length were randomly divided into three groups. Each group comprised of 15 teeth. Group I - Kedo-SG blue, group II - Kedo-S square, and group III - Pro AF baby gold. Biomechanical preparation was done according to the manufacturer's instructions. Pre- and post-instrumentation CBCT images were taken for each group to evaluate the remaining dentin thickness thereby assessing the centering ability and the canal transportation ability of different file systems.

Results: The canal transportation value at 3 mm was 0.90, 0.91 and 0.92, at 5 mm was 0.92, 0.93 and 0.94 and at 7 mm was 0.94, 0.95 and 0.96 in group I, II and III respectively. A non-significant difference was observed in all the groups ($P < 0.05$). The canal centering ratio at 3mm was 0.07, 0.04 and 0.03, at 5 mm was 0.06, 0.03 and 0.01 and at 7 mm was 0.05, 0.01 and 0.01 in group I, II and III respectively. The difference was significant for all the values ($P < 0.05$).

Conclusion: All three file systems tested in the study were effective in removing the radicular dentin. However, Kedo-SG Blue and Pro AF Baby Gold rotary file systems showed comparatively less canal transportation and more centering ability than Kedo-S Square rotary file system.

Key words: Kedo –S Square, Kedo-SG Blue, Pro AF Baby Gold rotary file

Introduction

The elimination of microorganisms through chemo-mechanical preparation is essential for the success of endodontic treatment.¹ Even with advanced instrumentation technology, effective cleaning of the entire root canal system remains a challenge.² The risk factors that may contribute to treatment failure are iatrogenic procedural errors in the preparation of curved root canals, such as instrument separation, ledge, zips, perforations, and apical transportation.³ Canal transportation is the removal of canal wall structure on the outside curve in the apical half of the canal due to the tendency of files to restore themselves to their original linear shape during canal preparation, leading to ledge formation and possible perforation. Canal centering is the capacity of the instrument to remain centered within the canal.⁴ This ability indicates whether the dentin removal over the prepared area is spread evenly by the instrument or no.⁵

Considering the clinical advantages of biomechanical preparation with rotary systems, it is necessary to investigate the shaping effectiveness of NiTi file systems and understand how the respective design features impact performance.⁶ Different methods can be used to evaluate the root canal shaping, though more recently, the use of computed tomography (CT) has been suggested for this purpose because it is a non-destructive and very precise method that even allows measuring the amount of root dentin removed by endodontic instruments.⁷ The present study was conducted to assess centralization ability and canal transportation of root canals prepared with three commercially available pediatric rotary files.

Materials & Methods

The present in-vitro study consisted of 45 extracted human primary teeth with a minimum 7 mm root length were taken and stored in Formalin solution until use. Ethical clearance was obtained from Institutional Ethical Review Board. Occupational Safety and Health Administration guidelines and regulations were used for storage and handling of teeth.

45 Teeth were randomly divided into three groups. Each group comprised of 15 teeth. Group I -Kedo-SG blue, group II - Kedo-S square, and group III - Pro AF baby gold. Biomechanical preparation was done according to the manufacturer's instructions. Pre- and post-instrumentation CBCT images were taken for each group to evaluate the remaining dentin thickness thereby assessing the centering ability and the canal transportation ability of different file systems. Data thus obtained were subjected to statistical analysis. The mean and standard deviation for canal transportation and canal centering ability were estimated by one-way analysis of variance (ANOVA). P value < 0.05 was considered significant.

Results

Table I -Assessment of canal transportation

Area	Group I	Group II	Group III	P value
3 mm	0.90	0.91	0.92	0.98

5 mm	0.92	0.93	0.94	0.87
7 mm	0.94	0.95	0.96	0.75

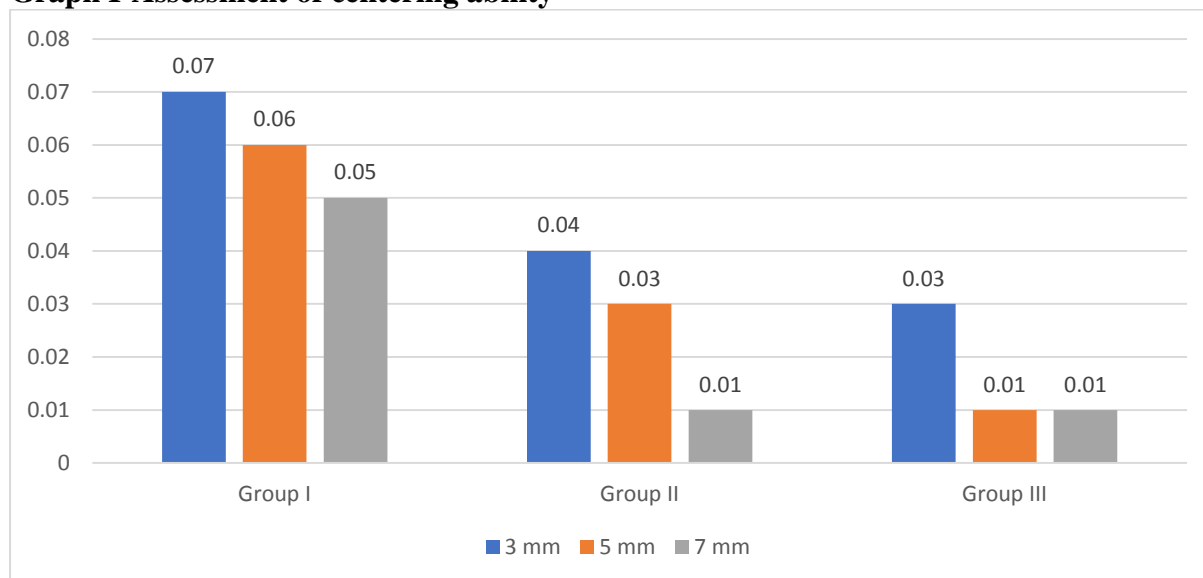
Table I shows that canal transportation value at 3 mm was 0.90, 0.91 and 0.92, at 5 mm was 0.92, 0.93 and 0.94 and at 7 mm was 0.94, 0.95 and 0.96 in group I, II and III respectively. A non- significant difference was observed ($P < 0.05$).

Table II-Assessment of centering ability

Canal centering ratio	Group I	Group II	Group III	P value
3 mm	0.07	0.04	0.03	0.02*
5 mm	0.06	0.03	0.01	0.05*
7 mm	0.05	0.01	0.01	0.04*

Table II, graph I shows that canal centering ratio at 3mm was 0.07, 0.04 and 0.03, at 5 mm was 0.06, 0.03 and 0.01 and at 7 mm was 0.05, 0.01 and 0.01 in group I, II and III respectively. The difference was significant ($P < 0.05$).

Graph I-Assessment of centering ability



Discussion

The aim of endodontic treatment is to clean and shape root canals adequately so that canal disinfection and filling are optimized.⁸ According to Schilder, root canal preparation should present a flare shape from apical to coronal, preserving the apical foramen and not alter the original canal curvature. However, endodontic preparation in curved and narrow root canals are more challenging, with a tendency for the prepared canal to deviate away from its natural axis.⁹ Cleaning and shaping is the most important stage in root canal treatment. Instrumentation of curved canals is still challenging with conventional stainless steel files leading to iatrogenic errors such as canal straightening, ledges, and transportation.¹⁰ NiTi files are found to decrease the canal transportation and are said to have the ability to shape the canal into a desired conical form because of its super elastic property, but file breakage was its major problem, especially in curved canals.¹¹ The root canal geometry is different in primary teeth and hence it is important to assess the canal preparation using different instruments.¹² The present study was conducted to assess centralization ability and canal transportation of root canals prepared with three commercially available pediatric rotary files.

We found that canal transportation value at 3 mm was 0.90, 0.91 and 0.92, at 5 mm was 0.92, 0.93 and 0.94 and at 7 mm was 0.94, 0.95 and 0.96 in group I, II and III respectively and it was not statistically significant. Similarly, Pagliosa et al¹³ evaluated the transportation and centering ability of curved mesiobuccal canals in maxillary molars after biomechanical preparation with different nickel-titanium (NiTi) rotary systems by cone-beam computed tomography.. The results demonstrated no significant difference ($p > 0.05$) in shaping ability among the rotary systems.

In present study,that canal centering ratio at 3mm was 0.07, 0.04 and 0.03, at 5 mm was 0.06, 0.03 and 0.01 and at 7 mm was 0.05, 0.01 and 0.01 in group I, II and III respectively and it was statistically significant. Similar to our study, Sunildath et al¹⁴ assessed the canal transportation and centering ability of Wave One Gold, Pro-Taper Gold, and NiTi Flex K-file systems with and without glide path preparation.Glide path creation reduced canal transportation and improved canal-centering ability.

Similarly, Reddy et al¹⁵ evaluated the efficacy of root canal instruments, various technologies have been used; one of the most reliable strategies was cone-beam computed tomography (CBCT).Significant difference was noticed in canal transportation and centering ability between the three tested groups.

The major challenging factors for canal transportation and centering ability includes complex radicular anatomy of tooth structure, the lack of direct accessibility, instrument design, incorrect sequences of the usage of instruments, torque of instrument rotation, improper irrigation, and using inadequate lubricant solutions.¹⁶ Among these, the instrument design and radicular canal morphology are important factors that are independent of the operators' expertise and skill. Among these two factors, the instrument design can be modified. So, in the present study we have used 3 different pediatric rotary files for centralization ability and canal transportation of root canals. It was finally assessed that Kedo-SG Blue and Pro AF Baby Gold rotary file systems showed comparatively significant changes in the canal transportation and centering ability.

Conclusion

The Present study evaluated that all the three file systems tested in the study were effective in removing the radicular dentin. However, Kedo-SG Blue and Pro AF Baby Gold rotary file systems showed comparatively less canal transportation and more centering ability than Kedo-S Square rotary file system.However, further studies are required to evaluate the performance of all these files in the uneven walls of primary teeth with larger sample size.

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