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Evaluation of centralization ability and canal transportation of root canals prepared with three commercially available pediatric rotary files.

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ABSTRACT

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

Materials and Methods:A total of 45(15 per group) freshly extracted human primary teeth, each with a root length of at least 7 mm, were collected from the Department of Pediatric Dentistry. These teeth were divided into three groups: Group 1 received the Pro AF Baby Gold Rotary file the Kedo-SG Blue Rotary file system, Group 2 the Kedo-S Square Rotary file system, and Group 3 the Kedo-SG Blue Rotary file system. A CT value of 0 indicated no transportation. Negative values represented transportation toward the distal/lingual direction, while positive values indicated transportation toward the mesial/buccal direction.The centering ability ratio was calculated as follows: Mesiodistally: (M1 − M2)/(D1 − D2) , Buccolingually: (B1 − B2)/(L1 − L2). A ratio of 1.0 suggested perfect centralization, whereas values closer to zero indicated lesser ability to maintain central axis alignment.

Results: At all three levels—cervical, middle, and apical third—significant variations in canal transportation values in the mesiodistal direction were found by intergroup comparison. Comparing the apical third of canal transportation values to the cervical and middle thirds, a significant difference was seen in all groups in the buccolingual direction. On the other hand, group 2's canal transportation values are larger than those of the other two groups with mean values, according to the mean values.

Conclusion: All three file systems effectively removed radicular dentin. However, the cutting ability of the files correlated with increased dentin removal, potentially leading to canal transportation and compromised centering ability.

Keywords: Centralization, Root canal, Pediatric rotary files

INTRODUCTION

The premature loss of primary teeth, whether caused by cavities or trauma, can profoundly impact various aspects of a child's oral health, including occlusion, chewing function, speech, and the arrangement of permanent teeth. Consequently, special attention is required to maintain the affected tooth's normal function in the dental arch until its natural shedding. To accomplish this, dental procedures such as pulp therapies are performed to address any infection or damage to the pulp tissue in the affected primary tooth. Pediatric endodontics plays a crucial role in managing pulp-related issues in children, aiming to restore and maintain the health and function of primary teeth[1].

Ideally, the process of pulpectomy should involve thorough removal of debris from the root canal while preserving the structural integrity of the tooth and safeguarding the development of the underlying permanent teeth[2]. Various factors contribute to the complexity of this procedure, including the irregular shape of root canals with unpredictable constrictions, the curvature of primary tooth roots, potential connections between the pulp and periodontal tissues, and the risk of harm to developing successor tooth buds. These considerations pose significant challenges when conducting endodontic treatment in primary teeth[3].

Initially, aside from traditional hand instruments, permanent rotary files were employed for preparing root canals in primary teeth. However, the pre-designed taper of these files posed a risk of lateral perforation. Consequently, pediatric rotary files with adjustable taper and length were exclusively introduced to mitigate this issue[4]. The selection of suitable instruments is crucial for effectively removing organic debris and the smear layer from the root canal during chemical and mechanical preparation, as well as for preventing canal transportation and maintaining canal centrality.

In the past, invasive methods like radiography, serial sectioning, and scanning electron microscopy were used for assessing root canal treatments, but they posed challenges in accuracy and repositioning of specimens. To overcome this, noninvasive 3D digital imaging via CBCT has emerged, offering superior accuracy[5]. However, there's limited research on pediatric rotary files. Addressing this gap, this in vitro study aimed to compare three such file systems' centralization ability and canal transportation at different root canal levels using CBCT imaging, potentially shedding light on their efficacy in pediatric dentistry.

MATERIALS AND METHODS

A total of 45(15 per group) freshly extracted human primary teeth, each with a root length of at least 7 mm, were collected from the Department of Pediatric Dentistry. These teeth were divided into three groups: Group 1 received the Pro AF Baby Gold Rotary file the Kedo-SG Blue Rotary file system, Group 2 the Kedo-S Square Rotary file system, and Group 3 the Kedo-SG Blue Rotary file system.

The collected teeth were cleaned and stored in a thymol solution. Using a carbide disc, the crowns were removed, and multirooted teeth were sectioned into single roots. Each root was assessed for length, resorption, and external fractures. An intraoral periapical radiograph was taken to detect internal anomalies like resorption. Root canal patency, curvature, and working length were determined using#10K-file. The root apices were sealed with wax to prevent resin penetration, and all specimens were arranged parallel to the acrylic mold's long axis for standardized tomographic imaging.

Canals scouted with #10 K-file for patency and glide path establishment before instrumentation. Preparation was done with Kedo-SG Blue, Kedo-S Square, and Pro AF Baby Gold rotary files using X-smart plus endodontic motor, with Normal Saline as irrigants.

Teeth underwent CBCT scanning before and after mechanical preparation, with sections taken at coronal, middle, and apical levels. Pre- and post-dentin thicknesses were measured for all root canals. M1 represented dentin thickness from the external surface of the mesial root portion to the mesial wall of the non-instrumented canal, while M2 indicated thickness after instrumentation. Similarly, D1 and D2 represented dentin thickness for the distal portion, while B1/B2 and L1/L2 represented thickness buccally and lingually, respectively, before and after instrumentation.

Canal transportation was determined using the equation by Gambill et al.:

- Mesiodistally: $(M1 - M2) - (D1 - D2)$
- Buccolingually: $(B1 - B2) - (L1 - L2)$

Regarding transportation direction, a CT value of 0 indicated no transportation. Negative values represented transportation toward the distal/lingual direction, while positive values indicated transportation toward the mesial/buccal direction.

The centering ability ratio was calculated as follows:

Mesiodistally: $(M1 - M2)/(D1 - D2)$

Buccolingually: $(B1 - B2)/(L1 - L2)$

A ratio of 1.0 suggested perfect centralization, whereas values closer to zero indicated lesser ability to maintain central axis alignment.

RESULTS

At all three levels—cervical, middle, and apical third—significant variations in canal transportation values in the mesiodistal direction were found by intergroup comparison. Comparing the apical third of canal transportation values to the cervical and middle thirds, a significant difference was seen in all groups in the buccolingual direction. On the other hand, group 2's canal transportation values are larger than those of the other two groups with mean values, according to the mean values.

Table 1: Intergroupcomparison of canal transportation in mesiodistal direction at all three levels

Level	Group	n	Mean ± SD	p-value
Coronal	1	15	0.6 ±0.9	0.000 (Significant)
Coronal	2	15	0.25±0.20	
Coronal	3	15	0.11± 0.17	
Middle	1	15	0.9 ±0.3	0.002 (Significant)
Middle	2	15	0.30 ±0.10	
Middle	3	15	0.7 ±0.12	
Apical	1	15	0.6 ±0.12	0.003 (Significant)
Apical	2	15	0.24±0.3	
Apical	3	15	0.7± 0.16	

Table 2: Intergroupcomparison of canal transportation in buccolingual direction at all three levels

Level	Group	n	Mean ± SD	p-value
Coronal	1	15	-0.02±0.9	0.1212
Coronal	2	15	0.05±0.20	
Coronal	3	15	0.04± 0.17	
Middle	1	15	-0.04±0.3	0.3338
Middle	2	15	0.05±0.10	
Middle	3	15	0.03±0.12	
Apical	1	15	-0.03±0.12	0.000 (Significant)
Apical	2	15	0.09±0.3	
Apical	3	15	0.03± 0.16	

DISCUSSION

Effective endodontic treatment aims to eradicate microorganisms, eliminate remaining vital tissue, and remove necrotic remnants, infected dentin, and debris. This creates optimal conditions for tissue repair and prevents reinfection, ensuring the success of the procedure[6]. The intricate anatomy of primary teeth poses challenges in adequately shaping, cleaning, and filling the root canal system, unlike permanent teeth[7]. However, with the introduction of new instrumentation techniques, such as Ni-Ti alloy instruments, the time and effort required for cleaning root canals have decreased. These rotary files enable preservation of the original root canal anatomy, especially in curved canals, and reduce procedural errors, particularly in primary teeth. Additionally, they enhance patient cooperation by shortening treatment time, which is particularly beneficial in pediatric dentistry, reducing fatigue for both patients and dental professionals[8].

At all three levels—cervical, middle, and apical third—significant variations in canal transportation values in the mesiodistal direction were found by intergroup comparison. Comparing the apical third of canal transportation values to the cervical and middle thirds, a significant difference was seen in all groups in the buccolingual direction. On the other hand, group 2's canal transportation values are larger than those of the other two groups with mean values, according to the mean values.Kuo et al.[2] suggested that for pulpectomy in primary teeth, a rotary file with modified length, variable taper, and tip size would be more effective. Additionally, a study by Jeevanandan and Govindaraju found that the clinical use of pediatric rotary files, specifically Kedo-S, was effective in root canal preparation of primary teeth. This approach resulted in reduced instrumentation time and improved quality of obturation[10].

Vaudt et al. (2007)[11] conducted an examination of various rotary root canal instruments in laboratory settings and noted that the effectiveness of Ni–Ti rotary instruments was influenced by specific design characteristics. Presently, numerous pediatric rotary systems are available on the market, each featuring distinct instrument designs such as non-cutting tips, radial lands, diverse cross-sections, and varying tapers, all aimed at enhancing operational efficacy. For their study, three specific files—Kedo-SG Blue, Kedo-S Square, and Pro AF Baby Gold—were chosen. These files are exclusively designed for pediatric use, exhibiting different cross-sectional configurations and cutting efficiencies, yet they are all crafted from the same material (Ni–Ti).Waly AS et al compared two rotary file systems and hand instrumentation for root canal preparation in regard to canal

transportation, centering ability ratio, and dentin thickness using cone-beam computed tomography (CBCT).A total of 72 canals from 24 freshly extracted mandibular deciduous second molars were divided into a set of 8 teeth, then prepared using 2 rotary files systems: the Kedo-S pediatric file system (Group A) and Pro AF Baby Gold file system (Group B) were compared to hand instrumentation (Group C). CBCT scans before and after root canal preparation were used to evaluate tested parameters. Instrumentation time for all three techniques was also measured using a chronometer.Although rotary file systems have shown superior results in root canal preparation as compared to hand instrumentation, no significant differences were observed between all the groups for canal transportation and dentin thickness at all three levels of prepared canals. A comparison of centering ability ratio between all the groups was found to be statistically significant only at the cervical level. A significant difference was observed between hand instrumentation using K-files (117.3 s) and both rotary systems (Kedo-S (81 s) and Pro AF Baby Gold (81.5 s)) in terms of canal preparation time ($P < 0.001$).Both tested rotary systems and hand instrumentation demonstrated comparable canal preparation results, with differences that were statistically non-significant in most tested parameters, without shaping errors.[13]

CONCLUSION

All three file systems effectively removed radicular dentin. However, the cutting ability of the files correlated with increased dentin removal, potentially leading to canal transportation and compromised centering ability.

REFERENCES

1. Panchal V, Jeevanandan G, Subramanian E. Comparison of instrumentation time and obturation quality between hand K-file, H-files, and rotary kedo-S in root canal treatment of primary teeth:A randomized controlled trial. J Indian Soc Pedod Prev Dent 2019;37:75–9.
2. Kuo CI, Wang YL, Chang HH, Huang GF, Lin CP, Li UM, et al. Application of Ni-Tirotary files for pulpectomy in primary molars. J Dent Sci 2006;1:10–5.
3. Selvakumar H, Kavitha S, Thomas E, Anadhan V, Vijayakumar R. Computed tomographic evaluation of K3 rotary and stainless steel K File instrumentation in primary teeth. J Clin Diagn Res 2016;10:C05–8.
4. Musale PK, Jain KR, Kothare SS. Comparative assessment of dentin removal following hand and rotary instrumentation in primary molars using cone-beam computed tomography. J Indian Soc Pedod Prev Dent 2019;37:80–6.
5. Reddy KS, Prasad SD, Kumar CS, Reddy VR, Hemadri M, Karteek BS. Comparison of remaining root dentinethickness after three rotary instrumentation techniques by cone beam computerisedtomography –An *in vitro* study. J Res Adv Dent 2014;3:32–9
6. Nazari Moghaddam K, Mehran M, Farajian Zadeh H. Root canal cleaning efficacy of rotary and hand files instrumentation in primary molars. Iran Endod J 2009;4:53–7.
7. Goerig AC, Camp JH. Root canal treatment in primary teeth:A review. Pediatr Dent 1983;5:33–7.
8. Crespo S, Cortes O, Garcia C, Perez L. Comparison between rotary and manual instrumentation in primary teeth. J Clin Pediatr Dent 2008;32:295–8.
9. Thompson SA. An overview of Nickel-Titanium alloys used in dentistry. Int Endod J 2000;33:297–310.
10. Jeevanandan G, Govindaraju L. Clinical comparison of Kedo-S paediatric rotary files versus manual instrumentation for root canal preparation in primary molars:A double blinded randomised clinical trial. Eur Arch Paediatr Dent 2018;19:273–8.
11. Vaudt J, Bitter K, Kielbassa A. Evaluation of rotary root canal instruments in vitro:A review. Endodontic practice 2007;1:189–203.
12. Waly AS, Yamany I, Abbas HM, et al. Comparison of two pediatric rotary file systems and hand instrumentation in primary molar: An ex vivo cone-beam computed tomographic study. Niger J Clin Pract. 2021;24(10):1492-1498. doi:10.4103/njcp.njcp_563_20