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CLINICAL ASSESSMENT OF ANTIMICROBIAL EFFECT **OF ROTARY VERSUS MANUAL FILING SYSTEM USING** DIFFERENT IRRIGANTS IN PRIMARY MOLARS

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ABSTRACT

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Background: Root canal treatment in primary teeth is essential for preserving oral health and function until natural exfoliation. Effective cleaning, shaping, and irrigation are critical for reducing microbial loads and ensuring successful outcomes. This study aims to assess the antimicrobial efficacy of a rotary and manual filing system in primary molar teeth when NaOCl 1%, NLE 100% and saline were employed.

Materials and methods: This randomised controlled clinical trial included 60 primary molars from 30 children aged 4-7 years, with two contralateral primary molars indicated for pulpectomy. The children were randomly selected from the Pediatric Dentistry Clinic at Mansoura University. The children were divided into groups: Group I (manual K-files) and Group II (rotary AF Baby Fanta files). Each group was further divided into three subgroups based on the irrigant used: Subgroup IA and IIA (normal saline), Subgroup IB and IIB (100% NLE), and Subgroup IC and IIC (1% NaOCI).

Results: The study demonstrated a highly statistically significant reduction in the mean preand post-preparation bacterial counts (CFU/mL) across all subgroups ($p \le 0.001$). Both rotary and manual systems significantly reduced bacterial counts, with rotary files achieving superior reductions without significant differences. Among irrigants, NaOCl showed the highest microbial reduction, followed by NLE, while saline was the least effective ($p \le 0.001$). For rotary files, NaOCl reduced CFU/mL from 15.31±6.03 to 0.91±0.34 and NLE from 17.27±6.11 to 1.38±0.59. Manual files showed similar trends with slightly lower reductions.

Conclusions: Both rotary and manual systems significantly reduced root canal flora, with AF Baby rotary files demonstrating superior microbial reduction. NaOCl and NLE were significantly more effective than saline.

KEYWORDS: Antimicrobial; Rotary; Manual Filing System; Primary Molars; AFbaby Fanta Files, Neem

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INTRODUCTION

Dental caries, if not correctly managed during its early stages, can lead to pulpal, periapical, and intraradicular infections, which are progressive conditions that may compromise the overall health of primary teeth^[1]. In cases where the pulp becomes necrotic or irreversibly inflamed, pulpectomy is considered the treatment of choice for primary teeth ^[2]. During the transition from primary to permanent dentition, the primary goal is to preserve arch length and restore masticatory function. This is achieved by ensuring that primary teeth remain symptomfree until their permanent counterparts naturally replace them ^[3, 4].

One of the most crucial factors in successful root canal treatment is effectively reducing or eradicating bacterial infection. The complex and resilient nature of these microorganisms presents a significant challenge in achieving complete disinfection ^[5]. Consequently, the success of root canal therapy largely depends on the critical stage of chemo-mechanical preparation, which removes both soft and hard tissues, establishes a pathway for irrigants to reach the apical third, and creates an optimal space for obturation. This process is vital for cleaning and shaping the root canal system, and the choice of instruments and irrigating solutions plays a significant role in the healing process ^[6].

ManualrootcanalpreparationusingK-files orH-files has traditionally been the first choice for primary teeth preparation. However, these instruments have certain limitations, such as a lack of flexibility, which can lead to issues like ledge formation or perforation during canal preparation, thus increasing procedure time ^[7]. To address these challenges, nickel-titanium rotary instruments have been introduced as an alternative. These rotary instruments are advantageous due to their speed, flexibility, and shape memory, leading to improved cleaning efficacy, reduced microbial flora, and shorter procedure times ^[7].

However, pediatric patients' restricted mouth openings can make the longer length of adult rotary files difficult to use. To overcome this limitation, specialised rotary NiTi files have been developed for primary teeth, designed with a reduced length for easier access. Examples include Pro AF Baby Gold, AF Baby rotary file, Kedo-S, Prime Pedo, and DXL-Pro Pedo, all of which cater to the needs of pediatric dentistry ^[8,9].

In addition to the choice of instruments, irrigation plays a key role in removing debris, dissolving tissue, and disinfecting the root canal system. Despite its widespread use, concerns remain regarding the potential toxicity of sodium hypochlorite (NaOCl), which is considered the gold standard in irrigation ^[10]. Over recent decades, natural plant-based alternatives have gained popularity as concerns about the cytotoxicity of commercial intracanal medicaments have emerged. These herbal alternatives offer benefits such as availability, cost-effectiveness, low toxicity, longer shelf life, and reduced microbial resistance, making them promising candidates for use as root canal irrigants ^[11, 12].

This investigation aimed to assess the antimicrobial efficacy of a rotary and manual filing system in primary molar teeth when NaOCl 1%, NLE 100%, and saline were employed.

MATERIALS AND METHODS

This split-mouth randomised controlled clinical trial study was carried out on 60 primary molars indicated for pulpectomy from 30 children aged between 4 and 7 years old, with two contralateral primary molars indicated for pulpectomy, who were randomly selected from the clinic of Pediatric Dentistry at Mansoura University.

The patients' parents provided informed written consent. The study was conducted after approval from the Ethics Committee of the Faculty of Dentistry, Mansoura University (Code No. M18060722). The present clinical trial was registered in ClinicalTrials. gov under the number NCT06418386. Inclusion criteria: The children were apparently healthy and free from any system disease, with no history of antibiotic coverage for the last two weeks, clinically asymptomatic teeth with necrotic pulp, and restorable tooth structure.

Exclusion criteria: Children were excluded from the study if their primary molars met any of the following conditions, as confirmed by clinical examination and preoperative periapical X-rays: the presence of significant loss of periodontal attachment, Detection of root perforations, Pathological or physiological root resorption exceeding one-third of the root length, and visible internal resorption on radiographs.

Sample size calculation:

By comparing the mean total bacterial count of pre- and post-treatment samples, the sample size was determined by previously published research by Kour et al.^[13]. The sample size was at least 30 in each group, as determined by the G power program version 3.1.9.7, which was used to calculate the sample size based on the expected effect size of 0.95 (76.87±28.46 & 116.53 ±52.5), a 2-tailed test, α error =0.05, beta value = 0.05 and power = 95.0%.

Group assignment and randomisation:

In this investigation, each child was exposed to one form of irrigant and both types of instrumentation. The 30 children were randomly separated into two equal main groups based on the type of file used in root canal preparation: Group I with manual file preparation and Group II with rotary file preparation.

Then, the children were randomly three equals subgrouped according to irrigant: subgroup I A, subgroup IB and Subgroup IC. Randomisation was achieved using a simple randomisation method to assign the type of irrigant. Thirty cards, 10 marked with either "C" (1% NaOCl), 10 marked with "N" (100% neem leaf extract), and 10 marked "S" (saline), were placed into an opaque bag. Before the intervention for each of the 30 children, the operator randomly selected one card from the bag to determine the assigned irrigant.

Preparation of 100% neem leave extract (NLE):

The NLE was prepared in the Faculty of Pharmacy at Mansoura University. According to Sundaram et al., ^[14] twenty-five grammes of mature neem leaves were collected and cleansed with sterile distilled water. The neem leaves were macerated for 1-2 minutes in 50 mL of unadulterated ethanol. The particulate residue was re-extracted with 25 mL of ethanol and filtered once more after filtering the extract through filter paper. Subsequently, the extract's alcohol phase was eliminated in a water immersion at 45-50°C temperature until the volume reached 25 mL. The extracts were combined and filtered through rapid filter paper. The liquid is currently being prepared for use as an irrigant.

Clinical part:

After administration of adequate local anaesthesia (Alexandria Co. for Pharmaceuticals, Egypt) according to the site of each primary molar, teeth were isolated with a rubber dam to ensure a dry and clean operating field. The initial caries removal and access opening were conducted using a round diamond bur (No. 330) and a high-speed handpiece (Sirona T3 Boost turbine Fiber-Optic, Germany) under a water coolant system. The pulp chamber was deroofed with a fissure diamond bur. The bacterial sampling procedure was conducted on the distal channel of the mandibular primary molars and the palatal channel of the maxillary primary molars. A sterile broach (mani, Japan) was inserted to extract the contents. The pre-preparation sample was obtained by sterile paper point (META BIOMED CO.Ltd, Chung Buk, Korea) inserted into the root canal to the approximate working length by diagnostic radiograph and was left for 1 min. The paper point was extracted using a sterilised tweezer and promptly transferred to a tube containing the transport medium (1ml nutrient broth medium, Oxoid, UK)^[15].

In manual file group I: the primary molar was prepared with manual k files (Mani, Japan) and root canal irrigant according to each subgroup irrigation with 1% NaOCl (JK Dental, EGYPT) in IC, 100% NLE in IB, and saline (ATECO PHARMA, EGYPT) in IA.

In rotary file group II, the primary molar was prepared with AF baby fanta files (Fanta, Shanghai, China) and root canal irrigant according to subgroup IIA, which contains saline, IIB, which contains 100% NLE, and IIC, which contains 1% NaOC1.

Root canal irrigation was performed for each subgroup using a side vented needle (Fanta, china) to produce less pressure at the apical foramen and the prepared canals after each file received 5 mL of the irrigant ^[15, 16]. The sterile paper point was inserted into the root canal and allowed to remain in position for one minute. The paper point was removed using a sterilised tweezer and transferred to a tube containing a transport medium. The pre-preparation sample and post-preparation sample were transmitted to the microbiological laboratory ^[15]. The cavity was sealed with a temporary restoration (Litark, Lascod, Italy).

During the second visit, NaOCl was employed to prepare and irrigate the canals between each file. Paper points were employed to dry the canals, and Metapex (META BIOMED CO. Ltd, Chung Buk, Korea) was employed to obturate them in accordance with the manufacturer's instructions. A Metapex syringe was inserted into the root canal space near the apex. The hypodermic was progressively withdrawn, and the paste was pressed into the canals. Moist cotton fibres were employed to apply pressure.

The property and optimal filling with Metapex were assessed through postoperative radiographic film. For the final restoration, A glass ionomer infill material (Kromoglass filling Lascod, Italy) was introduced to encapsulate an endodontically treated tooth coronally cavity. Stainless steel crowns (SSCs) (3M ESPE, USA) were ultimately used to restore all teeth. The tooth was prepared for the implantation of a crown.

Microbiological evaluation :

All samples were incubated for 24 hours aerobically, and for the anaerobic bacteria, the agar plate was incubated in the sealed anaerobic jar containing AnaeroPack-Anaero at 37°C for 72 hours. After incubation of the bacteria, colonies were observed growing on the plates. The colony counting was done under a colony counter, and the number of CFU was multiplied by (100) to get the number of colonies per 1ml ^[17].

Statistical analysis:

The data was analysed using the Statistical Package of Social Science (SPSS) program for Windows (Standard version 24). Shapiro's test was implemented initially to evaluate the data's normality. In the case of standard data, continuous variables were represented as the mean (SD). A paired t-test was employed to compare paired groups, while an independent t-test was employed to compare independent groups. The three groups were compared using the ANOVA test; the results were considered significant when the p-value was less than 0.05. The results are more significant when the p-value is lower.

RESULTS

Figure 1 shows the distribution and grouping of the studied children and samples.

At the investigation's outset, the groups had no statistically significant distinction. **Table 1**

There was a highly significant difference between the mean \pm SD of pre and post-preparation (CFU/ML) in various subgroups. In subgroup



Fig. (1): Schematic diagram showing study design and grouping.

IA (saline), the bacterial count decreased from 18.38 ± 4.08 to 5.51 ± 1.58 post-preparation. In the subgroup IB (NLE) group, the bacterial count decreased from 15.81 ± 4.1 to 1.58 ± 0.49 postpreparation. In subgroup IC (NaOCL), the total bacterial count decreased from 13.45 ± 3.79 to 1.08 ± 0.46 post-preparation. The highest percent change was observed in sub-group IC, followed by the Neem group, and the least in the Saline group (92.9%, 90.09%, and 70.36%, respectively. In subgroup IIA, the bacterial count decreased from 16.02 \pm 3.98 to 4.48 \pm 1.22 post-preparation. In subgroup IIB, the bacterial count decreased from 17.27 \pm 6.12 to 1.38 \pm 0.59 post-preparation. In Subgroup IIC, the bacterial count decreased from $15.31 \pm$ 6.03 to 0.917 ± 0.345 post-preparation. The highest percent change was observed in the NaCl group,

followed by the Neem group, with the least change in the Saline group (93.93%, 92..19%, and 72.15%, respectively). **Table 2**

There was no statistically significant difference between the mean±SD (CFU/ML) of postpreparation in the manual and rotary groups. **Table 3**

Neem and NaOCl are significantly different from saline but do not differ substantially from each other. Across both methods (manual and rotary), NaOCl consistently shows the highest effect, while saline shows the lowest impact and neem in between. **Table 4**

Figure 2 shows the aerobic and anaerobic culture plates with pre- and post-preparation colony-forming units.

Subgroup	GI (CFU/ML) (10*4) (n=10)	GII (CFU/ML) (10*4) (n=10)	t- test	P value
Subgroub A	18.38±4.07	16.02±3.98	t=1.309	0.207
Subgroup B	15.80±4.07	17.27±6.11	t=0.634	0.534
Subgroub c	13.45±3.79	15.31±6.03	t=0.822	0.422
ANOVA test	F=3.81	F=0.332	-	-
P value	P value 0.055		-	-

TABLE (1) CMF/ml in prepreparation samples.

Data is presented as mean \pm SD, CFUs: colony-forming units, GI: glass ionomer, GII: genomic inflammatory index and ANOVA: Analysis of variance.

TABLE (2) Comparison between CFU/ml (10*4) pre and post preparation of different subgroup and percentage of bacterial reduction

Subgroup		Pre CFU/ml (10*4)	Post CFU/ml (10*4)	Paired t- test	P value	% of reduction
Manual group I	Subgroup I A	18.38±4.07	5.51±1.58	t= 15.56	≤0.001*	70.36%
	Subgroup IB	15.80±4.07	1.58±0.48	t= 12.46	≤0.001*	90.09%
	SubgroupIC	13.45±3.79	1.07±0.46	t=11.43	≤0.001*	92.9%
Rotary group I	SubgroupIIA	16.02±3.98	4.48±1.22	t=13.16	≤0.001*	72.15%
	SubgroupIIB	17.27±6.11	1.38±0.59	t= 9.06	≤0.001*	92.190%
	SubgroupIIC	15.31±6.03	0.91±0.34	t= 7.98	≤0.001*	93.93%

Data is presented as mean \pm SD or frequency (%),

* significant as P-value ≤ 0.05 and CFUs: colony-forming units.

TABLE (3) Comparison between CFU/ml (10*4) post preparation between rotary and manual, in respect of irrigants

Subgroups	Manual group (CFU/ML)(n=10)	Rotary group (CFU/M) (n=10)	Independent t- test	P value
Saline	5.51±1.58	4.48±1.22	t=1.623	0.122
Neem	1.58±0.48	1.38±0.59	t=0.820	0.423
NaOCl	1.07±0.46	0.91±0.34	t=0.879	0.391

Data is presented as mean ± SD, CFUs:colony-forming units and NaOCl: Sodium hypochloride.

TABLE (4) Comparison between (CMF/ml) (10*4) post preparation of subgroups irrigant in respect of manual and rotary filling system

		Saline	Neem	Sodium hypochlorite	ANOVA test	P value
Post	Manual	5.51±1.58 ab	1.58±0.48 ª	1.07±0.46 ^b	F=59.82	≤0.001*
	Rotary	4.48±1.22 ^{ab}	1.38±0.59 ^a	0.91±0.34 ^b	F=57.19	≤0.001*

Data is presented as mean \pm SD, ab: similar letters indicate significant difference between groups within the same row. * significant as P-value ≤ 0.05 , ANOVA: Analysis of variance.



Fig. (2) (A) Anaerobic culture-plates showing prepreparation and post preparation colony forming unit. A1 saline pre, A2 saline post. B1 Neem pre, B2 neem post. C1 Naocl pre ,C2 Naocl post. (B) aerobic culture plate showing pre and post preparation .colony forming unit . A1 saline pre, A2 saline post. B1 Neem pre ,B2neem post .C1 Naocl pre ,C2 Naocl post.

DISCUSSION

Pulpectomy procedures aim to completely disrupt and destroy the bacteria involved in the root canal infection. Therefore, chemical and mechanical preparation is required to effectively sanitise the root canal system. Conventional manual instrumentation has been employed for years in the performance of paediatric endodontics, which is considered the gold standard technique. However, manual procedures are time-consuming, which leads to fatigue in both the operator and the paediatric patients. This has a substantial impact on the administration of behaviour ^[18].

The biofilm may remain undisturbed following mechanical debridement in anatomically challenging areas such as lateral or furcal canals, apical deltas, and isthmi. To guarantee that the canal system is entirely pure, it is imperative to employ irrigant solutions to augment the mechanical instruments' effectiveness ^[19].

For this reason, this investigation aimed to illuminate the antibacterial properties of the paediatric rotary system and natural irritants that can rival the intracanal efficacy of chemical irrigants against microorganisms while exhibiting fewer adverse effects.

In the present study, Verma et al. selected children aged 4-7 for both genders ^[20]. This age meets the criteria of having at least two-thirds to one-half of the root structure developed. Children younger than

4 are often uncooperative, making it challenging to achieve proper isolation, which could impact the results. Additionally, the roots of primary molars in younger children may not be fully formed.

No antibiotics were used for at least two weeks before treatment of the selected children. This requirement helps ensure that the microbiota profile in the necrotic pulp canal remains consistent and prevents alterations in the growth of microorganisms. Also, asymptomatic restorable teeth with necrotic pulp are essential not to affect the isolated bacteria. This was consistent with Ahmadi et al., ^[21] and Lakshmanan et al., ^[15].

Samples were collected from the distal canal of mandibular primary molars and the palatal canal of maxillary primary molars, as these canals are more expansive than others, facilitating the use of paper points for collection. The samples were subsequently preserved in a sterilised broth medium and transported to the laboratory for analysis. Verma et al. supported this result ^[20] and Kour et al., ^[13].

The current study compared AF baby rotary files, manual k files, saline, 1% Nacl and Neem extract irrigation solutions. According to AAPD, the choice of irrigants NaOCL one to five had no impact on pulpectomy success, so 1% NaCl was used in this study. The neem leaf extract was prepared as suggested by Ghonmode et al, ^[11] And Sundaram et al, ^[14].

In the current investigation, NLE was used. Few studies have discussed the antibacterial effects of NLE as an endodontic irrigant in primary teeth. The broad spectrum of therapeutic and antimicrobial effects of the isoprenoid group (nimbin, nimbinin, nimbidinin, nimbolide, and nimbidic acid) as an endodontic irrigant suggests its potential. Using neem as an endodontic irrigant may be advantageous due to its exceptional biocompatibility and antioxidant properties ^[11, 22, 23]. Consequently, using this substance does not pose a danger of tissue toxicity.

The human periodontal ligament fibrobroblasts' biocompatibility with neem has been established

by Botelho et al., ^[24]. This is a critical factor that encourages its clinical implementation in endodontics. Nevertheless, The characteristic bitter flavour of this wonder drug is a significant factor that significantly influences its antibacterial activity. Nimbidin is also accountable for the antiinflammatory properties of neem. This constraint can be overcome by incorporating sweeteners into the neem extract ^[22, 25].

In this study, microorganisms can be cultured or extracted directly from root canals or the oral cavity. The sample was collected directly from the oral cavity using sterilised paper points rested in the canal for 1 minute, in line with Podar et al., ^[26] and Dutta and Kundabala ^[22].

Detection and quantification of the bacteria can be done using different methods, such as chemical sensors-based detection strategies, enzyme-linked immunosorbent assay (ELISA), plate cultivation, and polymerase chain reaction (PCR). The plate cultivation method, the gold standard, was employed in the current study. It is fast, cheap, and easily detectable ^[20]. This is also in line with Podar et al., ^[26] and Dutta and Kundabala ^[22].

Regarding the results of this study, The microbial reduction was considerably lower in all of the post-instrumentation samples. The findings of the current investigation were comparable to those of the inquiry conducted by Lakshmanan et al., ^[15] Who exhibited significant microbial reduction with each instrument technique they implemented.

This study's results indicate no significant difference between the preparation of manual K files and AF Fanta baby files. However, the preparation of AF Fanta baby files is associated with the highest bacterial reduction.

This outcome was by Abdulhaligov et al., ^[27] Who demonstrated no statistically significant difference in detritus extrusion between (Hand files, Endoart Pedo Gold, Easyinsmile Baby Rotary, and AF Baby Rotary). Regarding the irrigant result, NaOCl 1% has a higher percentage reduction in microbial load, but there is no significant difference between NaOCl 1% and NLE 100%.

This was consistent with Kaur et al., ^[28] Who concluded that neem is as effective as NaOCl against endodontic microflora ^[29]. Also, the antimicrobial activity of neem was equal to NaOCl.The possible reason might be that the neem extract has. These active constituents include nimbidin, nimbin, nimbolide, gedunin, azadirachtin, mahmoodin, margolone, and cyclic disulfide.

Conversely, Sundaram et al., ^[14] NaOCl 5% was more efficacious as a root canal irrigant than 100% neem leaf extract. NaOCl exhibited the highest antimicrobial efficacy against C. albicans, followed by the A. indica (Neem) group. This may be due to the high concentration of NaOCl 5% used in his vitro study and his research on C. albicans. Additionally, the present analysis employed a low concentration of 1%.

In the current investigation, a saline subgroup showed a significant reduction of bacterial count post-irrigation compared with pre-irrigation. However, a statistically significant difference was observed when saline was compared to neem leaf extract and NaOCl, which exhibited the lowest microbial reduction. This could be attributed to saline's lack of inherent antibacterial properties, primarily as a flushing agent rather than an antimicrobial agent, aligning with Walia et al., ^[17] And Tanvir et al., ^[30].

This clinical study has some limitations. There was no follow-up, which was insufficient to test the procedure's sequelae on periapical and furcation bone healing. Achieving an environment that preserves the samples at zero percent oxygen within minutes was difficult in the clinical study.

CONCLUSION

Both rotary and manual files significantly decreased the root canal flora. However, compared

to manual instrumentation, the AF baby Fanta rotary files demonstrated a more effective reduction of microorganisms in root canals but without significant differences. A diluted formula of NaOCl (1%) and Neem leaf extract showed antibacterial efficacy as a root canal irrigant in primary teeth, but NaOCl (1%) had a better reduction of microbes.

The results of this investigation recommend utilising neem leaf extract and herbal irrigant. The impact of neem leaf extract on eradicating stain layers necessitates further investigation due to the limited availability of data. Follow-up periods are needed to detect the healing of periapical and furcation bone healing.

REFERENCES

- Ohara P, Torabinejad M, Kettering JD. Antibacterial effects of various endodontic irrigants on selected anaerobic bacteria. Endod Dent Traumatol. 1993;9:95-100.
- Ramezanali F, Afkhami F, Soleimani A, Kharrazifard MJ, Rafiee F. Comparison of cleaning efficacy and instrumentation time in primary molars: Mtwo rotary instruments vs. Hand k-files. Iran Endod J. 2015;10:240-3.
- Chen X, Liu X, Zhong J. Clinical and radiographic evaluation of pulpectomy in primary teeth: a 18-months clinical randomized controlled trial. Head Face Med. 2017;13:12.
- Gamal B, Hamdy D. Effect of diode laser versus chlorhexidine on bacterial reduction in pulpectomy of primary molars: An in-vitro-study. Ain Shams Dent J. 2024;35:433-40.
- Kayaoglu G, Ørstavik D. Virulence factors of Enterococcus faecalis: relationship to endodontic disease. Crit Rev Oral Biol Med. 2004;15:308-20.
- Tyagi SP, Sinha DJ, Garg P, Singh UP, Mishra CC, Nagpal R. Comparison of antimicrobial efficacy of propolis, Morinda citrifolia, Azadirachta indica (Neem) and 5% sodium hypochlorite on Candida albicans biofilm formed on tooth substrate: An in-vitro study. J Conserv Dent. 2013;16:532-5.
- Barr ES, Kleier DJ, Barr NV. Use of nickel-titanium rotary files for root canal preparation in primary teeth. Pediatr Dent. 2000;22:77-8.
- Chauhan A, Saini S, Dua P, Mangla R. Rotary endodontics in pediatric dentistry: Embracing the new alternative. Int J Clin Pediatr Dent. 2019;12:460-3.

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- Hadwa SM, Ghouraba RF, Kabbash IA, El-Desouky SS. Assessment of clinical and radiographic efficiency of manual and pediatric rotary file systems in primary root canal preparation: a randomized controlled clinical trial. BMC Oral Health. 2023;23:687.
- El-Tayeb MMN, Nabeel M. Effect of two laser systems on root canal disinfection: An in vitro study. Ain Shams Dent J. 2021;21:72-9.
- Ghonmode WN, Balsaraf OD, Tambe VH, Saujanya KP, Patil AK, Kakde DD. Comparison of the antibacterial efficiency of neem leaf extracts, grape seed extracts and 3% sodium hypochlorite against E. feacalis - An in vitro study. J Int Oral Health. 2013;5:61-6.
- Sinha DJ, Sinha AA. Natural medicaments in dentistry. Ayu J. 2014;35:113-8.
- Kour G, Masih U, Dhindsa A, Gojanur S, Gupta SK, Singh B. Comparative clinical and microbial evaluation of two endodontic file systems and irrigating solutions in pediatric patients. Contemp Clin Dent. 2018;9:637-43.
- Sundaram D, Narayanan RK, Vadakkepurayil K. A Comparative Evaluation on Antimicrobial Effect of Honey, Neem Leaf Extract and Sodium Hypochlorite as Intracanal Irrigant: An Ex-Vivo Study. J Clin Med. 2016;10:Zc88-91.
- 15. 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;15:687-90.
- 16. Hosny NS, El Khodary SA, El Boghdadi RM, Shaker OG. Effect of Neem (Azadirachta indica) versus 2.5% sodium hypochlorite as root canal irrigants on the intensity of postoperative pain and the amount of endotoxins in mandibular molars with necrotic pulps: a randomized controlled trial. Int Endod J. 2021;54:1434-47.
- 17. Walia V, Goswami M, Mishra S, Walia N, Sahay D. Comparative evaluation of the efficacy of chlorhexidine, sodium hypochlorite, the diode laser and saline in reducing the microbial count in primary teeth root canals - an in vivo study. J Lasers Med Sci. 2019;10:268-74.
- Azar MR, Mokhtare M. Rotary Mtwo system versus manual K-file instruments: efficacy in preparing primary and permanent molar root canals. Indian J Dent Res. 2011;22: 363-9.
- N A, Idris M, i B G, J N, Sahu G, Arul P, et al. Root canal irrigants and irrigation techniques: A review. J of Evolution of Med and Dent Sci. 2015;4:4694-700.

- Verma MK, Pandey RK, Khanna R, Agarwal J. The antimicrobial effectiveness of 25% propolis extract in root canal irrigation of primary teeth. J Indian Soc Pedod Prev Dent. 2014;32:120-4.
- Ahmadi M, Govil S. Conventional to endovac: A comparative evaluation of two irrigation systems in microbial reduction of primary root canals using chemical irrigants: An in vivo study. Int J Clin Pediatr Dent. 2023;16:113-7.
- Dutta A, Kundabala M. Comparative anti-microbial efficacy of Azadirachta indica irrigant with standard endodontic irrigants: A preliminary study. J Conserv Dent. 2014;17:133-7.
- 23. Ravishankar P, Thangavelu L, Kumar Subramanian A. Ethno-botanical approach for root canal treatment An update. J Pharm Sci Res. 2011;3:1511-9.
- Botelho M, Santos RAD, da Costa JG, Carvalho CO, Paz M, Azenha C. Efficacy of a mouthrinse based on leaves of neem in the treatment of patients with chronic gingivitis. J Med Plant Res. 2008;2:341-6.
- 25. Prasad S, Goda P, Reddy K, Kumar C, Hemadri M, Reddy D. Evaluation of antimicrobial efficacy of neem and Aloe vera leaf extracts in comparison with 3% sodium hypochlorite and 2% chlorhexidine against E. faecalis and C. albicans. J Dr NTR Univ Health Sci. 2016;5:104-9.
- Podar R, Kulkarni GP, Dadu SS, Singh S, Singh SH. In vivo antimicrobial efficacy of 6% Morinda citrifolia, Azadirachta indica, and 3% sodium hypochlorite as root canal irrigants. Eur J Dent. 2015;9:529-34.
- Yılmaz N, Abdulhaligov M, Tüzüner T, Baygın O, Emeksiz C. The effect of three different primary teeth rotary instrument systems on the amount of apically extruded debris in pulpectomy of primary teeth. Eur Oral Res. 2024;58:58-63.
- Kaur K, Kumar T, Mittal S, Bansal R. Phytomedicine: Herbal venture in green endodontics. J Endod. 2018;30:98-102.
- 29. Varghese SA. Comparative Evaluation Of Antimicrobial Activity Of Propolis, Neem Leaves, Green Tea, Sodium Hypochlorite and Saline as Root Canal Irrigants By Microbial Culturing And Quantification In Chronically Exposed Anterior Primary Teeth: Rajiv Gandhi University of Health Sciences (India); 2018.
- 30. Tanvir Z, Jabin Z, Agarwal N, Anand A, Waikhom N. Comparative evaluation of antimicrobial efficacy of nanosilver solution, Azadirachta indica, sodium hypochlorite, and normal saline as root canal irrigants in primary teeth. J Indian Soc Pedod Prev Dent. 2023;41:76-82.