Original Article

COMPARATIVE EVALUATION OF INSTRUMENTATION TIME, OBTURATION TIME, AND RADIOGRAPHIC QUALITY OF OBTURATION USING ROTARY FILES SYSTEMS VERSUS HAND K FILES FOR PRIMARY MOLAR PULPECTOMY – IN VIVO STUDY

Dr. Dinesh kumar[1], Dr. Ganesh Jeevanandan[2]

[1]Saveetha Dental College and hospitals, Saveetha Institute of Medical and Technical sciences, Saveetha University, Chennai 600077.
Email – dineshdk7797@gmail.com
[2]Reader, Department of Pediatric and Preventive dentistry, Saveetha Dental College and hospitals, Saveetha Institute of Medical and Technical sciences, Saveetha University, Chennai 600077.

DOI: 10.47750/pnr.2023.14.02.356

Abstract

Background: For primary dentition, an ideal pulpectomy requires quick, straightforward procedures, short treatment times, and few appointments. Exclusive pediatric rotary files have recently become accessible for use on baby teeth. The clinical effectiveness of pediatric rotary files is not well covered in the literature. Therefore, it was intended for this study to assess and contrast pediatric rotary files and K-files.

AIM: The purpose of this study was to assess and compare the instrumentation time, obturation time, and radiographic quality of obturation in primary molar pulpectomies performed using rotary systems (Kedo-S Plus; Pro-AF Baby GOLD files) and manually (K-files).

MATERIALS AND METHODS: From 40 kids aged 5 to 9, 45 primary mandibular molars were chosen. After dividing the teeth into three equal groups, I K-files, (ii) Kedo-S Plus files, and (iii) Pro-AF Baby GOLD files, a single-visit pulpectomy was carried out. Instrumentation and obturation times were recorded during the procedure. Two impartial assessors blinded to the instrumentation method took immediate postoperative radiographs and later assessed quality of obturation.

RESULTS: Kedo-S Plus (Group II) files required the least instrumentation time followed by Pro-AF (Group III) and K-files (Group I). The superior quality of obturation in lesser time was achieved using Kedo S Plus files (Group II) followed by K Files (Group I) and AF baby Files (Group III).

CONCLUSION: When performing pulpotomies on primary teeth, pediatric rotary files are an effective substitute for hand instrumentation and can be regarded as the gold standard of care.

KEYWORDS: Kedo S plus files, AF baby files, Hand K files, Pulpectomy and obturation.

INTRODUCTION

The loss of primary molars that are necrotic and cause space loss is one of the most significant issues in pediatric dentistry. Primary teeth with extensive pulpal involvement should be investigated for pulpectomies, even though the anatomy of root canals in primary teeth makes endodontic therapy challenging. Bacteria are crucial to the development and maintenance of pulpal and periapical illness. The main goals of root canal cleaning and shaping are to eradicate bacteria containing soft and hard tissue, create a conduit for irrigation to the apical third, create space for instrumentation, perform future obturation, and maintain the integrity of radicular structures (1). Therefore, cleaning and contouring the root canals will remove the irrigation pathway, which will ensure the success of the pulpectomy. Reamers, files, burs, sonic tools, mechanical tools, and nickel-titanium (Ni-Ti) rotary file systems are used to prepare root canals.

Much emphasis has been paid to the root canal preparation methods using Ni-Ti rotary devices because most hand preparation techniques (such as ledging, zipping channel transfer, and apical blocking) take a long time and can result in iatrogenic problems (2). According to many experiments, they could efficiently construct predefined funnel shapes with little risk of ledging or transporting. Particularly in curved canals, the design and great flexibility of Ni-Ti files enable instruments to precisely maintain the original root canal course.

The main difficulties in performing pulpectomy are navigating and carefully instrumenting strange and tortuous tubes enclosed in roots programmed for physiological resorption. Barr et al. performed the first manual preparations of primary teeth using Ni-Ti rotary files. They came to the conclusion that the use of Ni-Ti rotary files for primary tooth root canal preparation was time and money efficient, produced consistently homogeneous fillings, and was consistent. For both experienced and new operators, several research (3)hers have documented benefits of preparation using rotating Ni-Ti equipment over the manual method.

According to Silva et al Manual cleaning and shaping of the canals of extracted teeth took longer than Ni-Ti rotary preparation, and the canals were less clean (4). There are a variety of Ni-Ti rotary instruments available. Manufacturers emphasize the simplicity of their processes, cleaning effectiveness for root canal preparation, and shorter procedure times, which are crucial for youngsters. Different taper, blade, groove, and tip designs have been proposed (5). According to taper, shaft designs can be divided into two categories: advancing and consistent. According to some reports, instruments with increasing tapers can form canals more quickly than instruments with continuous tapers (6). The finishing files (F) in the progressive ProTaper system have a decreasing taper while the shaping files (S) have a growing taper in the coronal orientation. According to others, decreasing divergence instruments have a greater taper in the crucial apical region but stiffen the instruments whereas growing taper instruments have improved flexibility in the intermediate region and at the tip.

Traditionally, infected deciduous teeth's root canals were cleaned and prepared with hand K-files (5,7). Even though they are often used, hand instruments might cause iatrogenic mistakes because of the forceful and uncontrolled cutting action of stainless-steel files. The first mention of the use of rotary instruments for shaping and cleaning deciduous teeth dates back to 2000. It was discovered to be an effective approach that produced canals with a consistent shape and consistent obturation (8). Conical-shaped canals can be produced using it, and canal preparation takes less time overall. It is advised that pediatric patients have shorter appointments to encourage cooperation (9). For the preparation of permanent and baby teeth's root canals, various rotational systems are available and being researched (10). Permanent teeth are the main target audience for these systems. Utilizing current rotary methods in main teeth is restricted by their length and taper. Exclusive pediatric rotary files of 16 or 17 mm length have recently become available for use on baby teeth (11). The clinical effectiveness of these pediatric rotary files in attaining high quality obturation, a sign of long-term success in pulpectomized primary teeth, is poorly documented in the scientific literature (12). In order to assess and evaluate the Instrumentation Time, Obturation Time, and Radiographic Quality of Obturation Using Two Rotary Systems and Manual Technique for Primary Molar Pulpectomy

MATERIALS AND METHODS

The Paediatric and Preventive Dentistry Department of Saveetha Dental Hospital conducted the study following receipt of approval from the Scientific and Ethics committee. After meeting the eligibility requirements and providing written informed consent, 45 patients who consulted the hospital between the ages of 4 and 9 were chosen to take part in the controlled trials. Patient Selection was based on the following criteria.

Inclusion Criteria:

a) Primary molar teeth that have at least one necrotic, abscessed, or sinus-trained canal.

b) Patients who scored 3 and 4, or positively (+) and definitely (+++),

on the Frankl's Behavior Rating Scale.

c) Teeth in the primary molars with persistent, chronic irreversible pulpitis

d) Adequate crown structure for use with a rubber dam clamp

e) Two-thirds or more of the remaining root length Should be present.

f) Children between the ages of 4 and 9 were included

g) Presence of radiolucency in the peri-radicular or furcal region and patients with nocturnal pain.

Exclusion Criteria:

a) Patients with a systemic illness

b) Patients acting inappropriately throughout the procedures

c) Patients with clinically unrestorable teeth, perforated pulp floors, and extreme mobility

d) extra-oral edema or the existence of a dentoalveolar abscess (presence of purulence in the canals)

e) Patients that have pathologic root resorption in more than one-third of their roots

Study Design:

Selected teeth were subjectively assigned to one of the following three groups:

- Group 1 - K-files (n = 15)
- Group 2 - Kedo-S Plus files (n = 15)
- Group 3 - AF Baby Gold files (n = 15)

Treatment procedure:

One operator performed single-visit pulpectomies on all of the involved teeth. All individuals underwent pulpectomy under rubber dam isolation after receiving local anesthetic. After obturation, intraoral periapical radiographs of all the teeth were taken.

Access cavity preparation:

The diseased tissue was removed. Round and straight fissure burs were used to open access points quickly. After coronal pulp amputation, the canal was located using the DG16 probe. Utilizing K-files, pulp was eradicated. A large amount of the pulp chamber was irrigated with 3% sodium hypochlorite and distilled water.

Working length determination:

After irrigating the pulp chamber, a no. 15 K-files were placed in the canal. According to the traditional Ingle's approach, the radiological working length was 1 mm below the radiographic apex.

Biomechanical preparation:

Group 1: From #15 to #30, a quarter-turn pull method and the standard step-back approach of preparing the root canal were used.

Group 2: After using a #15 K-file, root canal instrumentation was carried out using Kedo-S plus files (0.25 mm tip diameter)

Group 3: After expanding the canals with K-files up to #15, the root canals were instrumented using AF baby files. After using the files in no more than three teeth, those that were defect-free were discarded.

Obturation:

Only after the canals could be cleansed with paper points were all of the canals obturated in one visit. All three groups underwent a final irrigation of the root canals with 3% sodium hypochlorite. The canals were then dried using absorbent, sterile paper points before being obturated with Metapex. After that, Type IX GIC was used to repair the tooth. For the purpose of evaluating the obturation quality, a postoperative digitized radiograph was acquired.

Assessment of teeth:

Instrumentation and obturation time

A stopwatch was used to record the instrumentation time from the beginning of instrumentation to the end of the biomechanical canal preparation. From the start of the canals' drying process until the obturation was complete, the obturation time was correspondingly tracked.

Immediate radiographic assessment

After evaluating the existence of voids and the extent of fill based on the immediate postoperative radiograph, two reviewers who were blinded to rotary files which had been used, evaluated the quality and length of the root canal obturation using Coll and Sadrian criteria.

Figure 1: Hand K Files (observation of underfilled canals and over obturation)

Figure 2: Kedo S Plus Files (Optimal obturation)

Figure 3: AF Baby Gold Files (Presence of voids and under obturation of the root canals)

- Score 0 – Complete absence of voids
- Score 1 – Presence of one void
- Score 2 – Presence of two voids
- Score 3 – Presence of three voids
- Score 4 – Presence of four voids
- Score 5 – Presence of five voids.

The extent of fill was scored from grade A to D based on the following criteria:

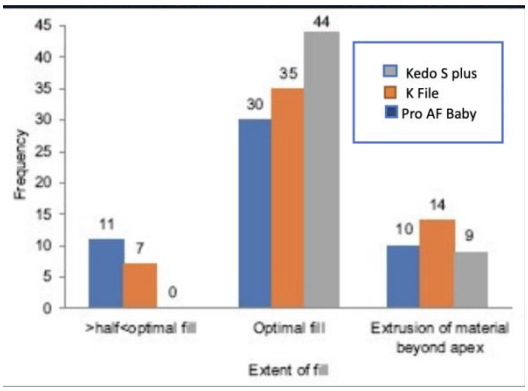
- Grade A – Less than one-half of the canal obturated
- Grade B – Greater than one-half but less than optimal fill
- Grade C – Optimal fill
- Grade D – Extrusion of material beyond apex.

Results:

The collected data was tallied, organized, and statistically analyzed. Kappa statistics were used to evaluate the evaluators' consistency and dependability. Quality of obturation was evaluated using Coll and sadrian methods, Canals were optimally filled without any voids using Kedo S Plus Files followed by Hand files. And the Canals which were obturated using AF Baby Files were under-obturated and presented with more voids. With a P value

of 0.05, the post hoc test showed a significant difference between the K-file group (Group 1) and the rotary systems Kedo-S Plus (Group 2) and Pro-AF (Group 3). This showed that rotary file systems are faster at finishing the obturation process than manual K-files. There were no discernible differences between the two rotary file systems. The following instrumentation, which used a Pro-AF rotary system instead of a Kedo-S Plus rotary system, required the least amount of time for obturation.

Graph 1: Demonstrates the Quality of Obturation of Different files



Graph 2: Represents the number of voids present

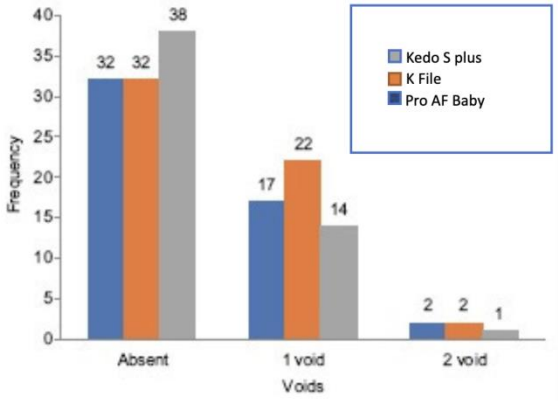


Table 1: Descriptive data regarding mean timings taken for instrumentation for different file systems [minutes]

File system	No of teeth	Minimum	Maximum	Mean	SD
K Files	**15**	**25.87**	**30.30**	**27.87**	**1.35**
Kedo S Plus	**15**	**16.05**	**25.55**	**19.25**	**2.98**
AF Baby Gold	**15**	**18.75**	**25.05**	**21.89**	**2.43**

Table 2: Descriptive data regarding mean timings taken for obturation for different file systems [minutes

Files System	No of teeth	Minimum	Maximum	Mean	SD
K Files	**15**	**4.80**	**5.78**	**5.44**	**0.319**
Kedo files	**15**	**3.30**	**5.67**	**4.71**	**0.743**
AF Baby Gold	**15**	**3.83**	**5.20**	**4.62**	**0.427**

Discussion:

Due to variables such as the duration of primary dentition, overall durability of the coronal structures, root canal architecture and morphology, as well as physiological resorption, the diagnosis and management of deciduous teeth varies greatly (13). These issues make endodontic therapy for baby teeth difficult. The main etiologic causes of pulpal and periapical disease are microorganisms (11). The reduction of microbial load following chemico-mechanical preparation, elimination of debris and residual pulp, and preservation of original canal form during instrumentation are the factors that lead to the most ideal endodontic treatment outcome for primary teeth. In situations of apical periodontitis, there is still some dispute about whether this reduction in microbial load can be achieved in a single visit (12). Regardless of the number of visits, it is challenging to completely disinfect the canals in deciduous molars because of their complicated architecture. Additionally, research has revealed that kids under 4 are more sensitive to painful stimuli and that younger kids behave negatively more often than older kids (14).

Therefore, the age range that was covered was 5 to 9. Additionally, this met the requirement for completely grown, mildly resorbed, or unresorbed roots needed to perform pulpectomy. The super-elasticity, shape memory, and strength of nickel-titanium (NiTi) rotary files help them preserve the original geometry of curved canals while also reducing errors. Numerous systems have been built on the market since its introduction

Endodontic broaches, hand files, reamers, and nickel-titanium (Ni-Ti) rotary files can all be used for mechanical cleaning. However, the traditional method still uses manual instrumentation with stainless steel files (15). Time-consuming and frequently exhausting for both the operator and the youngster. On the other hand, rotary file systems are effective at producing predefined conical shapes with the least level of risk (16). The stainless-steel (SS) files have an intrinsic stiffness that causes the different aberrations that may be noticed during canal preparation. Thus, it is challenging to employ these SS files in small, curved canals. This restricts apical expansion and prevents high-quality obturation (17). The possibility of lateral perforations on the inner aspect of the curved root canals in deciduous molar teeth is a serious issue when using files made for permanent teeth in primary tooth endodontic treatment . Due to these drawbacks and the fact that deciduous root canals have a ribbon-shaped morphology, Kuo et al. (2006) claimed that new NiTi rotary files made specifically for primary teeth would be more beneficial (18). Additionally, when using the available rotational devices, increased instrument separation has been observed in deciduous teeth. A pediatric-specific rotary file was required by 66% of dentists, according to a 2017 survey, for easier accessibility and quicker preparation(19). Because of these requirements, rotary files have been created specifically for baby teeth. These files are made to be more favorable for usage on primary teeth due to their length and taper (20). The second generation of NiTi rotary files includes the 2017-introduced Kedo-S rotary files.

The development of third-generation NiTi file Pro-AF Baby Gold files followed after that (21). Three 16 mm long NiTi rotary files are included with the Kedo-S plus. 12 mm is the active length. D1, E1, and U1 are the files that have a taper that varies considerably. The optimal speed range is 150-300 rpm, while the torque range

is 2.2-2.4 N. To avoid the instrument deforming and separating, it is advised to use these files in a "in and out" motion in well-lubricated canals.

Additionally, after the working length has been reached, the files should be removed. Pro-AF Baby Gold has five files constructed of NiTi-CM wire, which makes it more flexible and cyclic strain resistant. It continuously tapers between 4% and 6%. These files are 17 mm long whereas the active length is just 13 mm. It is advised to utilize Pro-AF files in well-lubricated canals at 250–300 rpm and 2.0–2.2 N torque. Use these files once or twice in a brushing stroke for the duration of the working length. In-vitro research conducted by Mittal et al. in 2015 found that metallurgy and taper had an impact on the cleaning and shape of root canals. The metallurgy and taper of the two rotary systems, Kedo-S Plus and Pro-AF, are different. In order to determine if these modifications to the metallurgy and taper of rotary files had an impact on the clinical result of pulpectomy, these two rotary systems were examined in our study together with the manual system. Consequently, three groups were examined in the study.

In the current investigation, the maximum number of canals instrumented with Kedo S plus files demonstrated the ideal length of obturation, while K-files and AF infant files demonstrated the greatest number of underfilled canals. Ochoa-Romero et al. (2011) reported similar substantial results, even though the investigation found no differences between the lengths of obturation performed using rotary and manual preparation. The existence or absence of voids is another crucial factor that affects the quality of obturation (22). Void formation could create channels for the leakage and retention of bacteria and poisons, which could result in treatment failures afterward(23). Procedure errors undermine the cleaning and shape of the canals, which leads to partial or poor-quality filling of the canals and may jeopardize the outcome of the therapy.

The presence of moisture in the canals is another factor contributing to the development of voids. As a result, post obturation radiographs were used to evaluate voids with the greatest canal visibility feasible (24). When compared to AF infant files and K-files in the current study, rotary instrumentation employing the Kedo S Plus produced a generally lower number of voids. In this investigation, the presence of voids in obturation following the preparation of canals using rotary and manual procedures was not significantly different (25). Therefore, it can be said that using rotary files as an instrumentation method produced improved obturations in a short amount of chair-side time. Utilizing digital radiography, which produced two-dimensional images of the three-dimensional structure, the quality of the obturation was evaluated (26). It might be the present study's limitation.

Additionally, the cases' success or failure during follow-up are not reported, which is a crucial component in determining the efficacy of endodontic therapy. Our team has extensive knowledge and research experience that has translated into high quality publications (27–36). Only mandibular molars were considered for the current investigation because maxillary molars present a unique set of problems for radiographic interpretation. Due to the operator's inability to be blindfolded to the various file systems, the current investigation is a single-blinded study.

Conclusion:

Efficacy in terms of chair-side time is essential in primary molar endodontics. Kedo-S plus and Pro-AF rotary files allowed chair-side instrumentation and obturation times to be dramatically reduced. A greater grade of obturation is promoted by the use of pediatric rotary files during complete isolation utilizing a rubber dam, which improves clinical success. Following AF infant rotary files, Kedo S Plus files demonstrated the greatest number of optimum obturations and the fewest voids. Thus, pediatric rotary files like the Pro-AF Baby Gold and Kedo-S plus files are safer and more effective options than traditional manual instrumentation. Pediatric rotary files are a crucial component of a pediatric dentist's toolkit and are generally used for primary molar pulpectomies.

REFERENCES

1. Priyadarshini P, Jeevanandan G, Govindaraju L, Subramanian EMG. Clinical evaluation of instrumentation time and quality of obturation using paediatric hand and rotary file systems with conventional hand K-files for pulpectomy in primary mandibular molars: a double-blinded randomized controlled trial. Eur Arch Paediatr Dent. 2020 Dec;21(6):693–701.

2. Jain N, Garg S, Dhindsa A, Joshi S, Khatria H. Impact of 6% citric acid and endoactivator as irrigation adjuncts on obturation quality and pulpectomy outcome in primary teeth [Internet]. Vol. 29, Pediatric Dental Journal. 2019. p. 59–65. Available from: http://dx.doi.org/10.1016/j.pdj.2019.05.002

3. Shathviha PC, Lakshmanan L. Evaluation of quality of obturation in 6-9-year-old children. J Adv Pharm Technol Res. 2022 Nov;13(Suppl 1):S36–9.

4. Manchanda S, Sardana D, Yiu CKY. A systematic review and meta-analysis of randomized clinical trials comparing rotary canal instrumentation techniques with manual instrumentation techniques in primary teeth. Int Endod J. 2020 Mar;53(3):333–53.

5. Jeevanandan G, Govindaraju L, Subramanian EMG, Priyadarshini P. Comparative Evaluation of Quality of Obturation and Its Effect on Postoperative Pain between Pediatric Hand and Rotary Files: A Double-blinded Randomized Controlled Trial. Int J Clin Pediatr Dent. 2021 Jan-Feb;14(1):88–96.

6. Chen Y, Li H, Li M, Yang L, Sun Q, Chen K. Analysis of survival and factors associated with failure of primary tooth pulpectomies performed under general anaesthesia in children from South China. Int J Paediatr Dent. 2020 Mar;30(2):225–33.

7. Shah HS, Patil VM, Kamath AP, Mathur AA. Comparative Evaluation of Instrumentation Time, Obturation Time, and Radiographic Quality of Obturation Using Two Rotary Systems and Manual Technique for Primary Molar Pulpectomies - Study. Contemp Clin Dent. 2021 Mar 20;12(1):55–62.

8. Ellana Jermiah J, Rao A, Srikant N, Rao A, Suprabha BS. Comparative Evaluation of Three Obturating Techniques in Primary Molars: An Study. J Clin Pediatr Dent. 2019;43(6):372–5.

9. Divya S, Jeevanandan G, Sujatha S, Subramanian EMG, Ravindran V. Comparison of quality of obturation and post-operative pain using manual vs rotary files in primary teeth - A randomised clinical trial. Indian J Dent Res. 2019 Nov-Dec;30(6):904–8.

10. Shalan HM. Comparative Evaluation of Different Obturation Techniques in Primary Molars Pulpectomy: A Clinical Study [Internet]. Vol. 6, Acta Scientific Dental Scienecs. 2022. p. 03–9. Available from: http://dx.doi.org/10.31080/asds.2022.06.1313

11. Menon A, Mathew M, Vadivel J. Preference of Root Canal Obturation Materials for Pulpectomy Procedures by Students in A Private Dental Institution - A Retrospective Study [Internet]. Vol. 11, Journal of Complementary Medicine Research. 2020. p. 125. Available from: http://dx.doi.org/10.5455/jcmr.2020.11.04.16

12. NANOSILVER GEL VERSUS ZINC OXIDE-ALLIUM SATIVUM OIL PASTE AS OBTURATION MATERIALS FOLLOWING PARTIAL PULPECTOMY OF PRIMARY MOLARS: AN IN VIVO STUDY [Internet]. Vol. 18, Ain Shams Dental Journal. 2020. p. 177–87. Available from: http://dx.doi.org/10.21608/asdj.2020.164470

13. Alshehri M, Alamri HM, Alshwaimi E, Kujan O. Micro-computed tomographic assessment of quality of obturation in the apical third with continuous wave vertical compaction and single match taper sized cone obturation techniques [Internet]. Vol. 38, Scanning. 2016. p. 352–6. Available from: http://dx.doi.org/10.1002/sca.21277

14. El-Shereif S, Rabie M. CLINICAL EVALUATION OF ROOT CANAL OBTURATION QUALITY USING TWO DIFFERENT SEALERS AND OBTURATION TECHNIQUES BY CONE BEAM COMPUTERIZED TOMOGRAPHY (IN-VIVO STUDY) [Internet]. Vol. 64, Egyptian Dental Journal. 2018. p. 4039–48. Available from: http://dx.doi.org/10.21608/edj.2018.79521

15. Orhan AI, Tatli EC. Evaluation of Root Canal Obturation Quality in Deciduous Molars with Different Obturation Materials: An In Vitro Micro-Computed Tomography Study [Internet]. Vol. 2021, BioMed Research International. 2021. p. 1–6. Available from: http://dx.doi.org/10.1155/2021/6567161

16. Amoroso-Silva PA, Guimarães BM, Marciano MA, Duarte MAH, Cavenago BC, Ordinola-Zapata R, et al. Microscopic analysis of the quality of obturation and physical properties of MTAFillapex [Internet]. Vol. 77, Microscopy Research and Technique. 2014. p. 1031–6. Available from: http://dx.doi.org/10.1002/jemt.22432

17. Applegarth R. The Influence of Apical Seat Diameter On The Quality Of Obturation In Curved Canals [Internet]. Vol. 20, Australian Endodontic Newsletter. 2010. p. 29–30. Available from: http://dx.doi.org/10.1111/j.1747-4477.1994.tb00435.x

18. Nezam S, Mukherjee CG, Shukla JN, Jha A, Khan SA, Tanwar AS. Comparative Evaluation of Efficacy of Obturation Techniques in Deciduous Teeth Using Cone-beam Computed Tomography: An Study. Int J Clin Pediatr Dent. 2021 Jan-Feb;14(1):75–80.

19. Rajasekhar S, Mallineni SK, Nuvvula S. Comparative evaluation of three obturation systems in primary molars - A randomized clinical trial. J Indian Soc Pedod Prev Dent. 2019 Jul-Sep;37(3):297–302.

20. Vishwanathan S, Nagarathna C, Krishnamurthy N, Bhat P. Primary molar pulpectomy using two different obturation techniques: A

clinical study [Internet]. Vol. 9, Contemporary Clinical Dentistry. 2018. p. 231. Available from: http://dx.doi.org/10.4103/ccd.ccd_826_17

21. Boonchoo K, Leelataweewud P, Yanpiset K, Jirarattanasopha V. Simplify pulpectomy in primary molars with a single-file reciprocating system: a randomized controlled clinical trial. Clin Oral Investig. 2020 Aug;24(8):2683–9.

22. Pawar BA, Pawar AM, Bhardwaj A, Wahjuningrum DA, Rahardjo AK, Luke AM, et al. Effect of Adaptive, Rotary, and Manual Root Canal Instrumentation in Primary Molars: A Triple-Armed, Randomized Controlled Clinical Trial. Biology [Internet]. 2021 Jan 10;10(1). Available from: http://dx.doi.org/10.3390/biology10010042

23. Chugh VK, Patnana AK, Chugh A, Kumar P, Wadhwa P, Singh S. Clinical differences of hand and rotary instrumentations during biomechanical preparation in primary teeth-A systematic review and meta-analysis. Int J Paediatr Dent. 2021 Jan;31(1):131–42.

24. Agarwal SR, Bendgude VD, Kakodkar P. Evaluation of Success Rate of Lesion Sterilization and Tissue Repair Compared to Vitapex in Pulpally Involved Primary Teeth: A Systematic Review. J Conserv Dent. 2019 Nov-Dec;22(6):510–5.

25. Coll JA, Dhar V, Vargas K, Chen CY, Crystal YO, AlShamali S, et al. Use of Non-Vital Pulp Therapies in Primary Teeth. Pediatr Dent. 2020 Sep 15;42(5):337–49.

26. Coll JA, Vargas K, Marghalani AA, Chen CY, AlShamali S, Dhar V, et al. A Systematic Review and Meta-Analysis of Nonvital Pulp Therapy for Primary Teeth. Pediatr Dent. 2020 Jul 15;42(4):256–461.

27. Malli Sureshbabu N, Selvarasu K, V JK, Nandakumar M, Selvam D. Concentrated Growth Factors as an Ingenious Biomaterial in Regeneration of Bony Defects after Periapical Surgery: A Report of Two Cases. Case Rep Dent. 2019 Jan 22;2019:7046203.

28. Ahad M, Gheena S. Awareness, attitude and knowledge about evidence based dentistry among the dental practitioner in Chennai city. J Adv Pharm Technol Res. 2016;9(11):1863.

29. PradeepKumar AR, Shemesh H, Jothilatha S, Vijayabharathi R, Jayalakshmi S, Kishen A. Diagnosis of Vertical Root Fractures in Restored Endodontically Treated Teeth: A Time-dependent Retrospective Cohort Study. J Endod. 2016 Aug;42(8):1175–80.

30. Jangid K, Alexander AJ, Jayakumar ND, Varghese S, Ramani P. Ankyloglossia with cleft lip: A rare case report. J Indian Soc Periodontol. 2015 Nov;19(6):690–3.

31. Kumar A, Sherlin HJ, Ramani P, Natesan A, Premkumar P. Expression of CD 68, CD 45 and human leukocyte antigen-DR in central and peripheral giant cell granuloma, giant cell tumor of long bones, and tuberculous granuloma: An immunohistochemical study. Indian J Dent Res. 2015 May;26(3):295–303.

32. Manohar J, Abilasha R. A Study on the Knowledge of Causes and Prevalance of Pigmentation of Gingiva among Dental Students [Internet]. Vol. 10, Indian Journal of Public Health Research & Development. 2019. p. 95. Available from: http://dx.doi.org/10.5958/0976-5506.2019.01859.x

33. Sekar D, Mani P, Biruntha M, Sivagurunathan P, Karthigeyan M. Dissecting the functional role of microRNA 21 in osteosarcoma. Cancer Gene Ther. 2019 Jul;26(7-8):179–82.

34. Girija SA, Jayaseelan VP, Arumugam P. Prevalence of VIM- and GIM-producing Acinetobacter baumannii from patients with severe urinary tract infection. Acta Microbiol Immunol Hung. 2018 Dec 1;65(4):539–50.

35. Maheswari TNU, Venugopal A, Sureshbabu NM, Ramani P. Salivary micro RNA as a potential biomarker in oral potentially malignant disorders: A systematic review. Ci Ji Yi Xue Za Zhi. 2018 Apr;30(2):55–60.

36. Subashri A, Maheshwari TNU. Knowledge and attitude of oral hygiene practice among dental students. J Adv Pharm Technol Res. 2016;9(11):1840.