



## Comparison Of Quality of Obturation and Instrumentation Time Using Manual Hand-K Files and Rotary Kedo-S Square Files for Pulpectomy in Primary Molars: A Double Blinded Randomised Controlled Trial

Dinesh kumar<sup>1</sup>, Vignesh Ravindran<sup>2\*</sup>

<sup>1</sup>Saveetha Dental College and hospitals, Saveetha Institute of Medical and Technical sciences, Saveetha University, Chennai 600077.

<sup>2</sup>Reader, Department of Pediatric and Preventive dentistry, Saveetha Dental College and hospitals, Saveetha Institute of Medical and Technical sciences, Saveetha University, Chennai 600077.

\***Corresponding author:** Vignesh Ravindran, Reader, Department of Pediatric and Preventive dentistry, Saveetha Dental College and hospitals, Saveetha Institute of Medical and Technical sciences, Saveetha University, Chennai 600077, Email: vigneshr.sdc@saveetha.com

**Submitted: 27 March 2023; Accepted: 16 April 2023; Published: 08 May 2023**

### ABSTRACT

**Aim:** To compare and evaluate the instrumentation time and quality of obturation between paediatric rotary files and manual hand k-files

**Materials and Methods:** Sixty mandibular molars were randomly assigned to two experimental groups (n=30). Group I was instrumented using Kedo-S Square paediatric rotary files and Group II with manual hand K-files. Standardised digital radiographs were taken before and after root canal instrumentation. Root canal preparation time was also recorded. Statistical analysis of the obtained data was done using SPSS software version 17.0. The quality of obturation was done using ANOVA and Chi square test with the level of significance set at 5%.

**Results:** Mean instrumentation time with paediatric rotary Kedo S Square files (72.6s) was significantly less than manual k-files (92.4s) ( $p < 0.001$ ). There was a significant improvement in the quality of obturation ( $p < 0.015$ ) with paediatric rotary files (kedo-S Square). (Kedo-S) and manual instrumentation techniques in primary molars. ( $p < 0.05$ ). There was a significant improvement in the quality of obturation ( $p < 0.05$ ) with paediatric rotary files (Kedo-S).

**Conclusion:** Kedo-S Square rotary system provides better quality of root canal filling in minimum instrumentation time.

**Keywords:** *Hand files, Primary molars, Paediatric rotary files, Innovative Technique*

### INTRODUCTION

Retaining primary teeth in the oral cavity until its physiological exfoliation to preserve arch integrity is the ultimate goal in Paediatric Dentistry (1) Literature suggests that reasons to preserve the primary teeth is to gain during mastication, serve a pulpally involved primary tooth in the absence of a permanent tooth,

prevent aberrant tongue habits, prevent possible speech problems, manage aesthetics, prevent the psychological effects associated with early tooth loss, and maintain normal eruption time of the succedaneous teeth (2) The only viable option in paediatric dentistry to re-establish the dentition to a functional state is through endodontic intervention (3)

Pulpectomy is the treatment of choice for symptomatic decayed deciduous teeth and is a demanding and tedious procedure in paediatric dentistry (4) The success of endodontic procedure lies in an efficient chemo mechanical preparation (5) The universal method for debridement and shaping of primary root canals is hand instrumentation, but can result in iatrogenic errors such as perforation, ledge formation. It's Also generally time consuming for cleaning and shaping of the deciduous root canals with hand files (6) The length of the procedure in paediatric practice is firmly connected with the child's behaviour and his/her ultimate acceptance of the dental treatment (7)

Barr et al was the first to use Nickel Titanium (Ni-Ti) rotary files in deciduous teeth (8) Ever since, use of rotary instrumentation for pulpectomy has grown in paediatric dentistry. Various Ni-Ti instruments which were recommended for use in permanent teeth were integrated for use in deciduous teeth. Protaper, M2 and K3 files were used for canal preparation with modified sequence to promote its use in deciduous teeth (9) Use of these files, although outstanding, had limitations such as increased file length and taper, which made it problematic for the practitioners to use it in children. There appeared the need for an unique paediatric rotary file with altered length and taper (10)

Jeevanandan G in the year 2017 popularised an unique paediatric rotary file which served the goal, reducing the instrumentation time and resulting in a better quality of obturation, promoting its use in paediatric endodontics (10) The Kedo paediatric rotary files are individualised files which are used solely for root canal preparation of deciduous teeth. To attain successful cleaning and shaping, these files have a variably variable taper (VV) yielding the flexibility and efficiency. Continuous progression of this version is the launch of Kedo S, Kedo-SG and Kedo-SH.

Latest to join in the bandwagon of paediatric rotary files is the Kedo-S Square file system (Reeganz Dental Care Pvt. Ltd, India). This is a single file system for anterior and posterior teeth separately with a total length of 16 mm. The working length of the file is 12 mm with a gradual

taper. A1 (Green and black coded) Kedo S Square rotary file is used in the anterior canal(s), whereas P1 (Red and blue coded) is used for posterior canals. Both these files are designed to cut dentin, in a crown down manner, with its controlled taper avoiding excess root dentin removal and are to be used in lateral brushing motion. These files result in momentous preparation in the coronal third and ample preparation at the middle and apical third of the primary root resulting in an easy flow of the obturating material and avoiding lateral perforation at the apical region. Our team has extensive knowledge and research experience that has translate into high quality publications (1-10) (11)(12) . There are no studies in the literature evaluating the application of rotary Kedo-S Square file and Hand k-files in primary teeth. Hence, for use in primary teeth, these two instruments were selected for evaluation in the current study.

Hence, the aim of the present study was to comparatively evaluate the instrumentation time and the quality of obturation using Kedo S-Square rotary files and Hand-K files in primary mandibular molars.

## MATERIALS AND METHODS

The present randomised clinical trial was carried out in the Department of Paediatric and Preventive Dentistry, Saveetha Dental College and Hospitals following the approval from the Institutional Review Board from September 2019- January 2020. The informed consent was obtained from the parents of the children who participated in the study. CONSORT guidelines (11) for planning and reporting clinical trials in paediatric endodontics was followed during the different stages of the study [Fig-1]

### *Sample size estimation and study participant's selection*

The sample size was calculated from a previous study with 95% power, alpha error at 5%, using G Power analysis and arrived at a total sample of 60 (12). Children between 4 and 8 years of age requiring pulpectomy in any one of the primary mandibular molars were selected and were

randomly allotted to the groups according to the computer generated randomization sequence, where the instrumentation was done using rotary Kedo S-Square in Group 1 and Manual Hand K-files in Group 2.

Children with systemic diseases, lacking cooperative ability were excluded from the study. Also, teeth with sinus opening, pathological root resorption and inadequate coronal tooth structure to receive stainless steel crown were excluded.

### ***Clinical Procedure***

A full mouth inspection with Intra Oral Periapical Radiograph of the teeth designated for pulpectomy was taken before the start of the clinical procedure. The working length was evaluated using the pre-operative radiograph. Local anaesthesia was delivered using lignocaine (LOX\* 2% adrenaline, Neon Laboratories Limited, India). The tooth designated for pulpectomy was isolated using a rubber dam (GDC Marketing, India) for better visibility and to enhance the efficiency of the operator. Superficial caries were removed using No. 6 round bur and de-roofing of the pulp chamber was done using No.330 pear shaped bur (Mani, Inc, Tochigi, Japan). Patency of the canals were checked using No. 10 size Manual hand K-files in both the groups. The canal preparation was done using:

Group 1:(n=30) Kedo-S Square rotary files (KEDO DENTAL). P1 file was used for canal

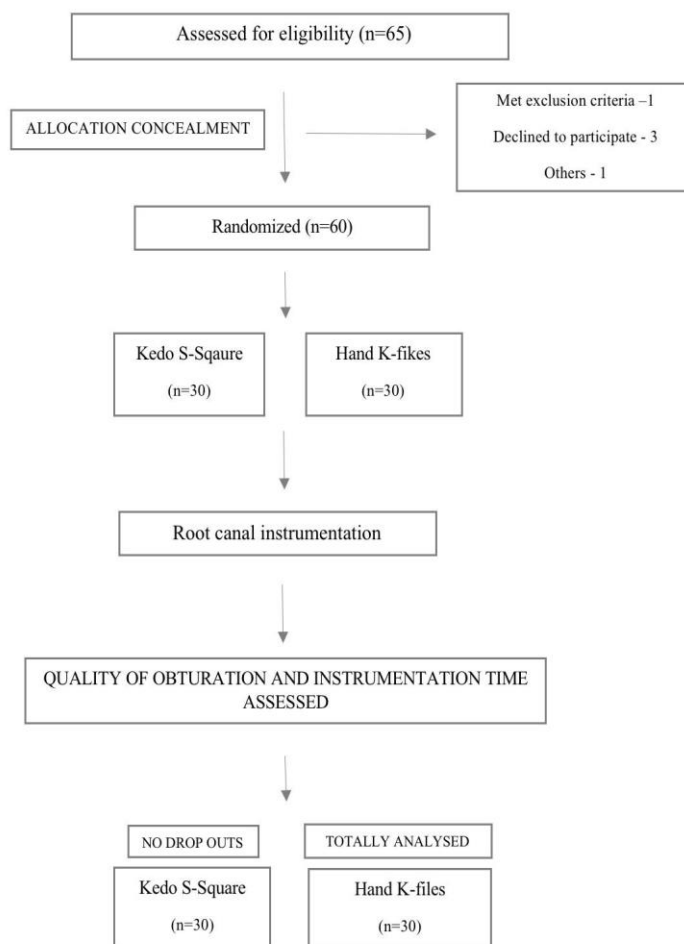
preparation in molars as per the manufacturer's recommendation

Group 2:(n=30) Manual Hand K-files from size 15 to size 30 (Mani) in quarter pull turn method.

The files in both the groups were coated with 17% EDTA (RC help, Prime dental products, Pvt. Ltd. India) before instrumentation into the canals. The canals were irrigated with 1ml of 1% sodium hypochlorite and 15 ml of saline. The canals were then dried with sterile paper points (Adenta). Metapex (Meta Biomed Co. Ltd. Chungbuk, Korea) was used for obturation by gently pushing the material with moist cotton pellets. All the clinical procedures were done by a single operator to prevent operational bias.

The instrumentation time was calculated using a digital stop watch and was documented in seconds by a trained dental assistant. The quality of obturation was assessed with the post-operative radiograph using Coll and Sadrian criteria according to which the obturation is graded as under filled if all the canals were filled more than 2 mm short of the apex, optimally filled if one or more of the canals having ZOE ending at the radiographic apex or up to 2 mm short of the apex, over filled if any canal showing ZOE beyond the root (13).

Assessment was done by a pedodontist who was not a part of the study. All possible actions were taken to avert any sort of bias. The glass ionomer cement was used as the entrance filling and was restored with a stainless steel crown on the same appointment.



**[Figure- 1]:** Flow chart describing the randomization of the participants and the parameters evaluated during the clinical trial.

### Statistical Analysis

The statistical analysis was done using SPSS software version 17.0 (SPSS Inc., Chicago, IL, USA) with a statistical significance set at  $p < 0.05$ . Descriptive statistics were used for data summarization and presentation. Independent t-test was used to compare the instrumentation time. Chi square test was used to compare the quality of obturation in both the groups.

### RESULTS

The demographic detail of the present study is depicted in Table 1 and shows no statistical significant difference. The instrumentation time on using kedo-S Square paediatric rotary files group was significantly less when compared to manual hand K-files with a statistically significant difference ( $p < 0.005$ ) [Table-2]. However, there was a statistically significant difference noted on the quality of obturation between the two groups ( $P < 0.05$ , Chi square test) [Table-3]

Table 1: Demographic variables describing age and distribution of male and female participants in each group

Treatment groups	Sample size	Age (Years)	Gender (Female/Male)
Kedo S-Square files	30	5.10 + 1.185	16/14
Hand K files	30	5.80 + 1.324	18/12

Table 2: Comparison of instrumentation time between two groups

Treatment Group	n	Mean ± SD	Overall p-value
Kedo-S Square files	30	72.6 ± 9.8	<0.001 (sig)*
Hand k-files	30	92.4 ± 12.7	

Table 3: Comparison of obturation quality between the two groups

Obturation quality	Group, n(%)		Overall p value
	Kedo-S Square files	Hand K file	
			< 0.015 (sig)*
Under fill	4(13%)	10(33.3%)	
Optimal fill	23(76.7%)	12(40%)	
Over fill	3(10%)	8(26.7%)	

## DISCUSSION

Dentistry has witnessed tremendous advances over the past decades and many more extensive approaches are yet to appear ultimately in the future. Managing the behaviour and understanding an apprehensive, fearful and disobliging child is the most challenging facet in paediatric dentistry. As the trend continues, the time and attempt required in cleaning of root canals is deteriorating as new instrumentation methods have been established. Manual hand instruments are substituted by rotary instruments in the current endodontic use. The benefit of rotary files in primary teeth for pulpectomy was first advanced during the mid-90's. Barr et al. was the first to represent rotary files in deciduous teeth using the Profile system (6,8,14). The primary goal of attaining pulpectomy in children is to perpetuate the pulpectomy tooth as a natural space maintainer till its natural exfoliation (15). Success of endodontic treatment relies on efficient chemo-mechanical preparation for effective canal disinfection.

In-vitro and in-vivo researches have used Ni-Ti files devised for permanent teeth and analysed the instrumentation technique such as cleaning efficacy, instrumentation time and obturation quality in primary teeth (16,17,18,19). The complex design of the primary teeth vary notably from that of the permanent teeth as the roots of the primary teeth are short, thin, curved and have softer and less dense root dentine with unnoticeable root resorption (20). Besides, the ribbon-shaped morphology of the root canal entails the call for an absolute rotary file for cleaning and shaping of the primary root canals (21). The essential properties to be examined while devising rotary files in primary teeth are alteration in length, taper, appropriate flexibility in rotary files to attain even the narrowest canals in root canal system of the primary teeth (11,22,23,24). In paediatric dentistry, brief treatment period reduces the anxiety, thus providing optimal treatment protocol (12). Hence, the present study evaluates the instrumentation time and obturation quality to



measure treatment outcome with the two different methods of chemo mechanical preparation.

Makarem et al. has observed reduced chair side time with rotary instrumentation compared with hand instrumentation (25). The present study shows a similar result with statistically significant decreased instrumentation time as compared to hand instrumentation. Similar findings have also been reported by other studies both in vitro and in vivo (9,12,26,27,28). The present study shows a higher number of optimal obturation with rotary instrumentation, as compared to more under obturation with manual instrumentation. The under obturation was higher in manual hand K-file group than that of the Kedo S-Square group. Similar findings have been reported by Tania Ochoa-Romero et al. who reported 80% of teeth showing optimal obturation and L. Govindaraju et al. reported higher number of optimal filling with rotary files as compared to hand files (12, 23). Rotary instrumentation reduces human dexterity, thereby increasing the efficiency of the operator (29). Bergmans et al has reported higher cervical enlargement and restricted apical preparation with progressive taper than constantly fixed taper (30). This can be the reason for better obturation quality as rotary Kedo S-Square files have variable taper as compared to manual hand k-files. Another reason for better obturation quality with rotary Kedo-S Square files as compared to hand files can be due to the use of NiTi material used, which increases the flexibility of files (10). This aids in the adaptation of files to the primary canal curvature, rather than increased zipping and transportation as in hand instrumentation (31).

Use of two-dimensional imaging modality, employed to assess the quality of obturation could be considered as a potential limitation of the present study. Clinically, the reduced instrumentation time improves patient cooperation and lessens innervation of the operator. However, long term follow-up is needed to appraise the clinical and radiographic success of the pulpectomy achieved using different instrumentation techniques.

## CONCLUSIONS

Kedo-S Square rotary file system showed a marked reduction in instrumentation time with superior quality of obturation in primary mandibular molars compared to conventional hand K-files. It can be used as an appropriate and advanced alternative to the existing Kedo files and permanent rotary file system in rendering effective and faster dental treatment in children.

## REFERENCES

1. Ranly DM, Garcia-Godoy. Current and potential pulp therapies for primary and young permanent teeth. *J Dent.* 2000;28: 153-61
2. Goerig AC, Camp JH. Root canal treatment in primary teeth: A review. *Pediatr Dent* 1983; 5:33-7.
3. Garcia-Godoy F. Evaluation of an iodoform paste in root canal therapy for infected primary teeth. *J Dent Child.* 1987; 54:30-4
4. Bowen JL, Mathu-Muju KR, Nash DA, Chance KB, Bush HM, Li HF. Paediatric and general dentists' attitudes toward pulp therapy for primary teeth. *Pediatr Dent* 2012; 34:210-5
5. Endo MS, Ferraz CC, Zaia AA, Almeida JF, Gomes BP. Quantitative and qualitative analysis of micro-organisms in root filled teeth with persistent infection: Monitoring of endodontic retreatment. *Eur J Dent* 2013; 7:302-9
6. Silva LA, Leonardo MR, Nelson-Filho P, Tanomaru JM. Comparison of rotary and manual instrumentation techniques on cleaning capacity and instrumentation time in deciduous molars. *J Dent Child (Chic).* 2004; 71:45-7
7. Rosa FM, Modesto A, Faraco-Junior IM. Manual and rotary instrumentation techniques for root canal preparation in primary molar. *Dentistry.* 2014; 2:1-5
8. 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
9. Govindaraju L, Jeevanandan G, Subramanian EM (2017) Comparison of quality of
10. obturation and instrumentation time using hand files and two rotary file systems in primary molars: A single-blinded randomized controlled trial. *Eur J Dent* 11:376-9
11. Jeevanandan G. Kedo-S paediatric rotary files for root canal preparation in primary teeth – Case report. *J ClinDiagn Res* 2017;11: ZR03-5
12. 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.
13. 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.
  14. 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.
  15. 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.
  16. 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.
  17. 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>
  18. 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.
  19. 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.
  20. 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.
  21. Subashri A, Maheshwari TNU. Knowledge and attitude of oral hygiene practice among dental students. *J Adv Pharm Technol Res.* 2016;9(11):1840.
  22. Ezhilarasan D, Apoorva VS, Ashok Vardhan N. *Syzygium cumini* extract induced reactive oxygen species-mediated apoptosis in human oral squamous carcinoma cells. *J Oral Pathol Med.* 2019 Feb;48(2):115–21.
  23. Patil SR, Maragathavalli G, Araki K, Al-Zoubi IA, Sghaireen MG, Gudipani RK, et al. Three-rooted mandibular first molars in a Saudi Arabian population: A CBCT study. *Pesqui Bras Odontopediatria Clin Integr.* 2018;18(1):e4133.
  24. Altman D, Schulz K, Moher D, et al. The revised CONSORT statement for reporting randomized trials: explanation and elaboration. *Ann Intern Med.* 2001; 134:663–94
  25. Ochoa-Romero T, Mendez-Gonzalez V, Flores-Reyes H, Pozos-Guillen AJ. Comparison between rotary and manual techniques on duration of instrumentation and obturation times in primary teeth. *J ClinPediatr Dent.* 2011; 35:359–63
  26. Coll JA, Sadrian R. Predicting pulpectomy success and its relationship to exfoliation and succedaneous dentition. *Pediatr Dent.* 1996; 18:57–63
  27. Barr ES, Kleier DJ, Barr NV. Use of nickel-titanium rotary files for root canal preparation in primary teeth. *Pediatr Dent.* 1999; 21:453–4
  28. Mohamed HAA. Pulpectomy procedures in primary molar teeth. *Eur J Gen Dent.* 2014;3(1):3–10
  29. Azar MR, Saf L, Nikaein A. Comparison of the cleaning capacity of Mtwo and Pro Taper rotary systems and manual instruments in primary teeth. *Dent Res J (Isfahan).* 2012; 9:146–51
  30. Ochoa-Romero T, Mendez-Gonzalez V, Flores-Reyes H, Pozos-Guillen AJ. Comparison between rotary and manual techniques on duration of instrumentation and obturation times in primary teeth. *J ClinPediatr Dent.* 2011; 35:359–63
  31. Ramezanali F, Afkhami F, Soleimani A, Kharrazifard MJ, Rafee 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
  32. Vieyra JP, Enriquez FJJ. Instrumentation time efficiency of rotary and hand instrumentation performed on vital and necrotic human primary teeth: a randomized clinical trial. *Dentistry.* 2014; 4:1–5
  33. Fuks AB, Papagiannoulis L. Pulpotomy in primary teeth: review of the literature according to standardized criteria. *Eur Arch Paediatr Dent.* 2006; 7:64–71
  34. Kuo C, Wang Y, Chang H, et al. Application of Ni–Ti rotary files for pulpectomy in primary molars. *J Dent Sci* 2006; 1:10–5.
  35. Kuo C, Wang Y, Chang H, Huang G, Lin C, Li U, et al. Application of Ni-Ti rotary files for pulpectomy in primary molars. *J Dent Sci.* 2006; 1: 10–5.

36. Govindaraju L, Jeevanandan G, Subramanian EMG. Clinical evaluation of quality of obturation and instrumentation time using two modified rotary file systems with manual instrumentation in primary teeth. *J ClinDiagn Res.* 2017;11(9): ZC55–ZC58.
37. Govindaraju L, Jeevanandan G, Subramanian E. Knowledge and practice of rotary instrumentation in primary teeth among Indian dentists: a questionnaire survey. *J Int Oral Health.* 2017;9:45–8. Govindaraju L, Jeevanandan G, Subramanian EM.
38. Makarem A, Ravandeh N, Ebrahimi M. Radiographic assessment and chair time of rotary instruments in the pulpectomy of primary second molar teeth: A randomized controlled clinical trial. *J Dent Res Dent Clin Dent Prospects* 2014; 8:84-9
39. Nagaratna PJ, Shashikiran ND, Subbareddy VV. In vitro comparison of Ni-Ti rotary instruments and stainless steel hand instruments in root canal preparations of primary and permanent molar. *J Indian Soc Pedod Prev Dent* 2006;24:186-91
40. Pinheiro SL, Araujo G, Bincelli I, Cunha R, Bueno C. Evaluation of cleaning capacity and instrumentation time of manual, hybrid and rotary instrumentation techniques in primary molars. *IntEndod J* 2012;45:379-85
41. Kummer TR, Calvo MC, Cordeiro MM, de Sousa Vieira R, de Carvalho Rocha MJ. Ex vivo study of manual and rotary instrumentation techniques in human primary teeth. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2008;105:e84-92
42. George S, Anandaraj S, Issac JS, John SA, Harris A. Rotary endodontics in primary teeth – A review. *Saudi Dent J* 2016;28:12-7.
43. Bergmans L, Van Cleynenbreugel J, Beullens M, Wevers M, Van Meerbeek B, Lambrechts P, et al. Progressive versus constant tapered shaft design using Ni-Ti rotary instruments. *IntEndod J* 2003;36:288-95
44. Tan BT, Messer HH. The quality of apical canal preparation using hand and rotary instruments with specific criteria for enlargement based on initial apical file size. *J Endod* 2002;28:658-64
45. Malli Suresh Babu 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.
46. Ahad M, Gheena S. Awareness, attitude and knowledge about evidence based dentistry among the dental practitioners in Chennai city. *J Adv Pharm Technol Res.* 2016;9(11):1863.
47. PradeepKumar AR, Shemesh H, Jothilatha S, Vijayabharathi R, Jayalakshmi S, Kishen A. Diagnosis of Vertical Root
48. Fractures in Restored Endodontically Treated Teeth: A Time-dependent Retrospective Cohort Study. *J Endod.* 2016 Aug;42(8):1175–80.
49. 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.
50. 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.
51. 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>
52. 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.
53. 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.
54. 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.
55. Subashri A, Maheshwari TNU. Knowledge and attitude of oral hygiene practice among dental students. *J Adv Pharm Technol Res.* 2016;9(11):1840.
56. Ezhilarasan D, Apoorva VS, Ashok Vardhan N. Syzygium cumini extract induced reactive oxygen species-mediated apoptosis in human oral squamous carcinoma cells. *J Oral Pathol Med.* 2019 Feb;48(2):115–21.
57. Patil SR, Maragathavalli G, Araki K, Al-Zoubi IA, Sghaireen MG, Gudipaneni RK, et al. Three-rooted mandibular first molars in a Saudi Arabian population: A CBCT study. *Pesqui Bras Odontopediatria Clin Integr.* 2018;18(1):e4133.