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A Study of Root Canal Morphology of Human Deciduous Maxillary Molars using Cone Beam Computed Tomography (CBCT): An in Vivo Study

Asmita Das[1*], Sonal Gupta[2], Abhinandan Patra[3], Menia Gumro[3]

[1]MDS, Post Graduate Trainee, Department of Pediatric & Preventive Dentistry, K. D. Dental College & Hospital, Mathura, Uttar Pradesh, India
[2]Head of the department, Kanti Devi Dental College and Hospital, Mathura, Uttar Pradesh, India
[3]JR3, Kanti Devi Dental College and Hospital, Mathura, Uttar Pradesh, India

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***Corresponding author:** Asmita Das
MDS, Post Graduate Trainee, Department of Pediatric & Preventive Dentistry, K. D. Dental College & Hospital, Mathura, Uttar Pradesh, India

Abstract

Aim: The purpose of this study was to investigate the root canal morphology of the primary maxillary right first and second molars using CBCT according to Vertucci & New root canal classification system given by Ahmed HMA *et al*., ***Method*:** 60 Patients aged 3-9 years were taken in the study. The CBCT of maxillary right quadrants of study subjects were taken at imaging centre and evaluated on CBCT scans according to Vertucci & Ahmed HMA *et al*.,'s classification both. ***Result*:** The most common canal configuration for right primary maxillary 1st and 2nd molar was Vertucci Type I except mesio-buccal canal in right maxillary second molar was Vertucci Type IV. ***Conclusion*:** As deciduous molar teeth exhibit thin torturous canals and ribbon like roots a thorough knowledge of the root canals can improve the outcome of pulp treatment in pediatric patients.

Keywords: root canal morphology, primary maxillary, CBCT scans, teeth exhibit.

INTRODUCTION

In childhood, primary teeth have crucial roles such as chewing, speaking, and maintaining spaces for permanent teeth. Therefore, maintaining primary teeth in the dental arch is the first aim of a pediatric dentist. To improve the success of endodontics in primary molars, more detailed knowledge of root canal number and morphology is needed [1].

The external and internal morphology of primary teeth are different in many aspects from permanent successors. In primary molars, the complexity of this system may increase over time due to the formation of secondary dentine and narrowing of the canal system and eventually the resorption process [2]. The primary maxillary first and second molars are difficult to be treated endodontically due to the variation in a number of roots, canal configuration, direction and longitudinal depressions of the roots, and pulp cavity configurations.

Many techniques can be used to research root canal morphology of teeth, such as computerized tomography, clearing technique, radiographs, operating microscope and high-resolution X-ray micro-computed tomography (micro-CT) [3]. Recently, cone-beam computed tomography (CBCT) images have been found to be useful and accurate in evaluating root and canal morphology in permanent mandibular and maxillary molars [3]. As an emerging technology in endodontics, CBCT has a lower radiation dose and a higher resolution than traditional computed tomography scans. It has proved useful in detecting periapical lesions and root canal morphology in the maxillary region [3].

The Vertucci classification system is the most widely established and used classification system and categorises the root canal configurations into eight types, increasing in complexity, from Type I to Type VIII. While this is used primarily for classification of permanent teeth, the nomenclature has been adapted for use in primary dentition root canal morphology studies. Another classification which was given by Ahmed *et al*.,

that also has been adopted for use in primary dentition root canal configuration studies [4].

So, the aim of this study is to investigate the root canal morphology of the primary maxillary right first and second molars according to both Vertucci & Ahmed et al's new root canal classification system using CBCT.

MATERIALS & METHODOLOGY

60 Patients aged 3-9 years attending the OPD in the Department of Pediatric and Preventive Dentistry of K.D. Dental College and hospital, Mathura will be required in the study. After Ethical clearance taken from the Ethical Committee of K.D. Dental College, Mathura, the written consent will be obtained from all the subjects. Study subjects will comprise of patients having valid diagnostic reasons or treatment in anterior region of primary maxillary right quadrant. Intraoral periapical X-rays of maxillary right deciduous molars were taken to examine the pathogenesis and carious lesion. The CBCT of maxillary right quadrants of study subjects will be taken at CBCT imaging centre. Then the primary maxillary first molars (n=60) and second molars (n=60) of patients will be evaluated on CBCT scans.

Patients who have signed the consent form, patient with complete root completion, high quality CBCT image were included in this study. Primary tooth with incomplete root completion, tooth associated with pathologies, root with open apices, immature apex, resorption or any calcification, medically compromised patient, Poor quality of CBCT image were excluded from this study. The data was calculated, organized, tabulated in Microsoft excel, and statistically analysed with SPSS V.24 software. The variables are presented with frequency and percentage. Z test is used for the comparisons. The P value ≤ 0.05 is considered as statistically significant.

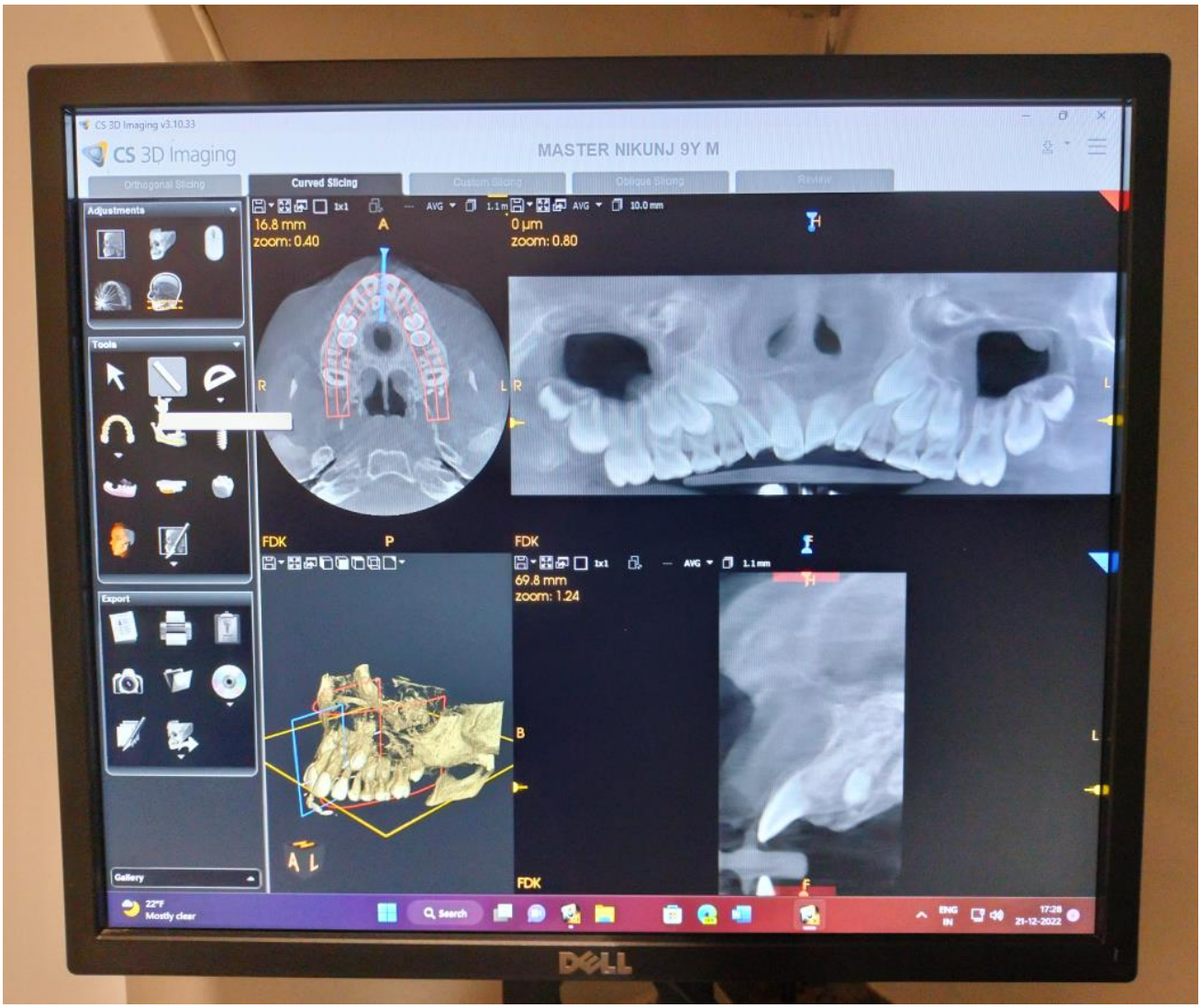

Fig 1: CBCT images viewed by CS-3D imaging software viewer

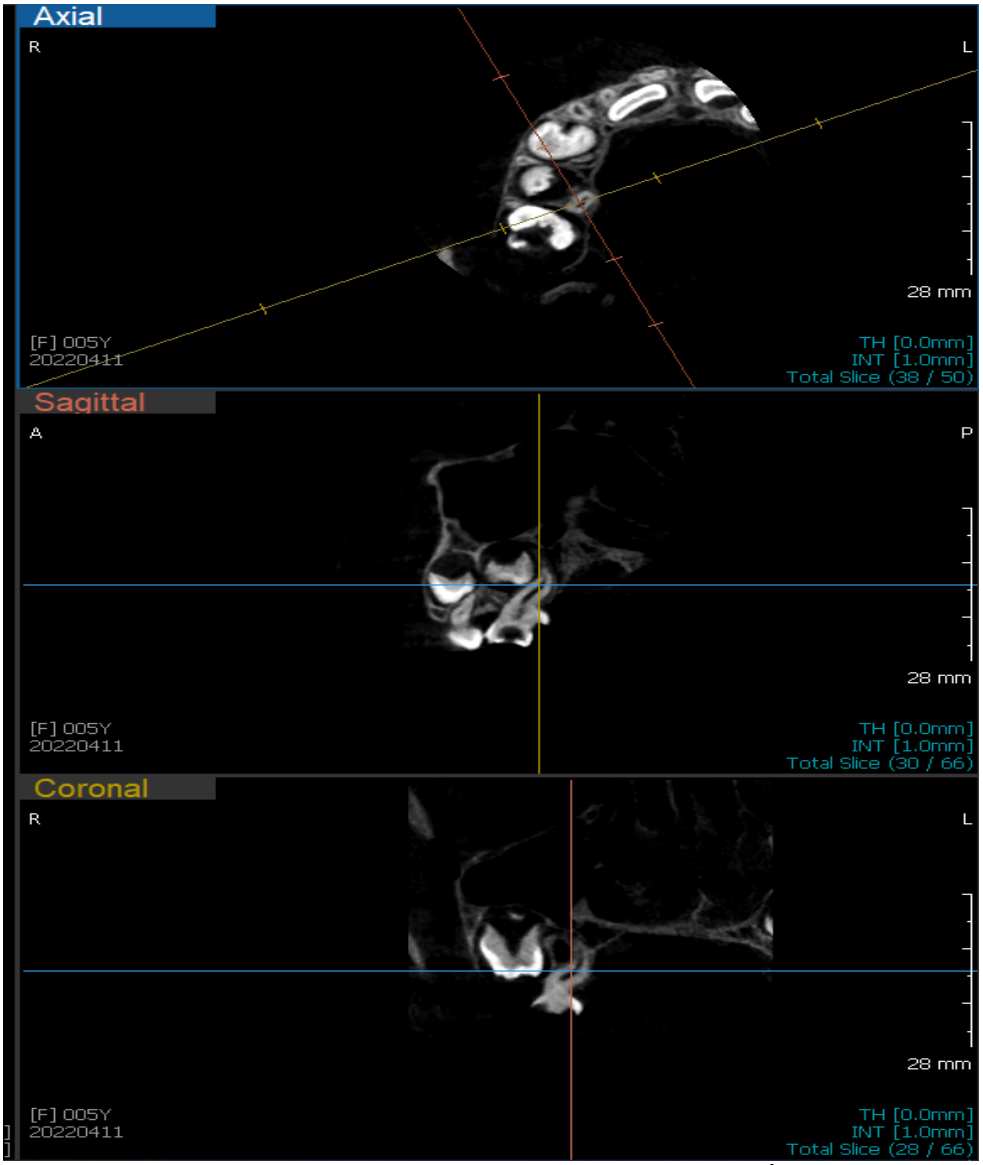

Fig 2: Axial, Sagittal and Coronal View of Palatal root of Maxillary Primary 2nd molar in right quadrant

Fig 3: View of Root Canal Morphology according to classification by sectional view of Maxillary primary 2nd molar in right quadrant

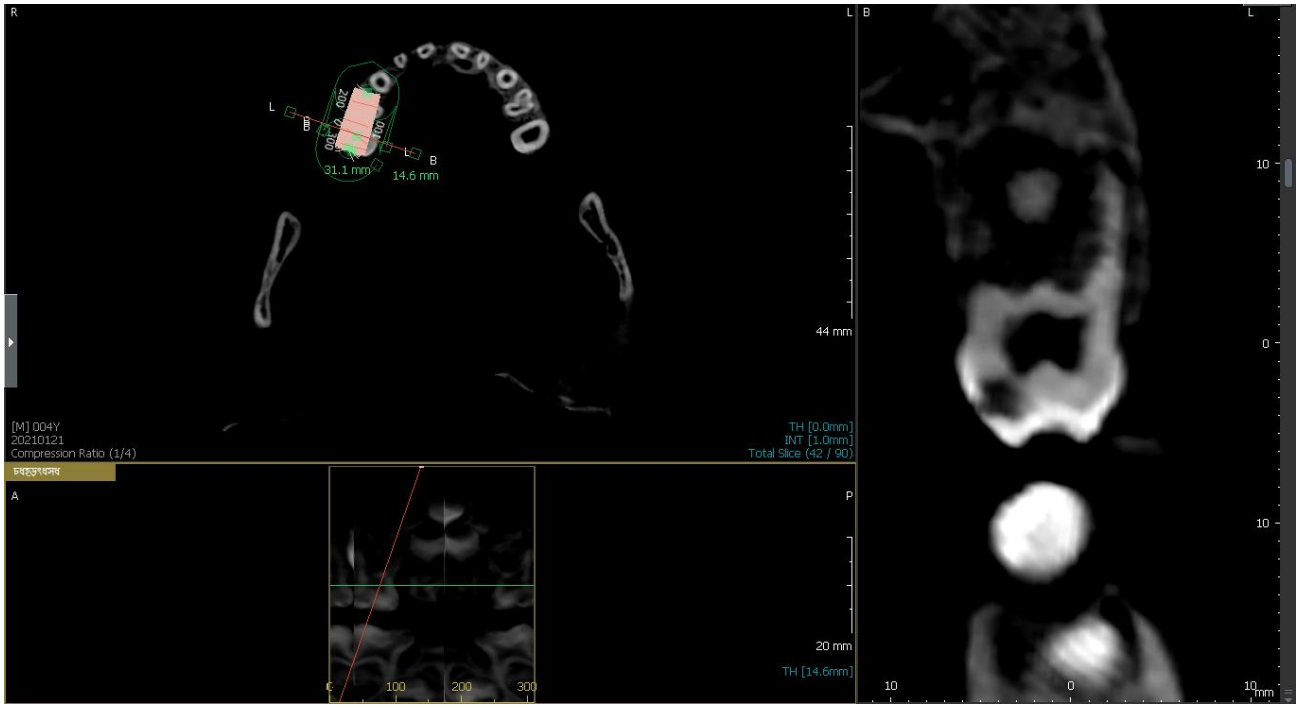

Fig 4: Vertucci Type 2 Root Canal Morphology in both Mesio-buccal & Disto-buccal root of of Primary maxillary first molar in right quadrant

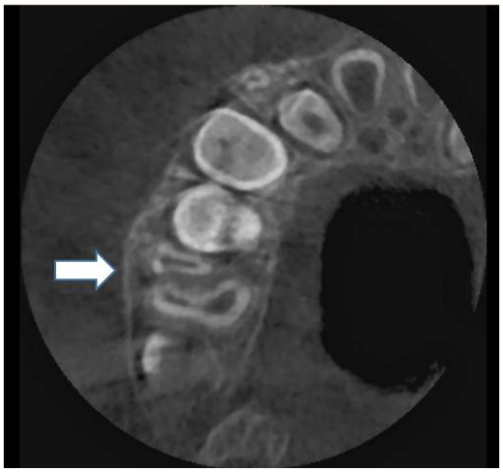

Fig 5: 1 Mesio-buccal canals, 1 Disto-buccal canal & 1 Palatal canal of Primary maxillary first molar in right quadrant

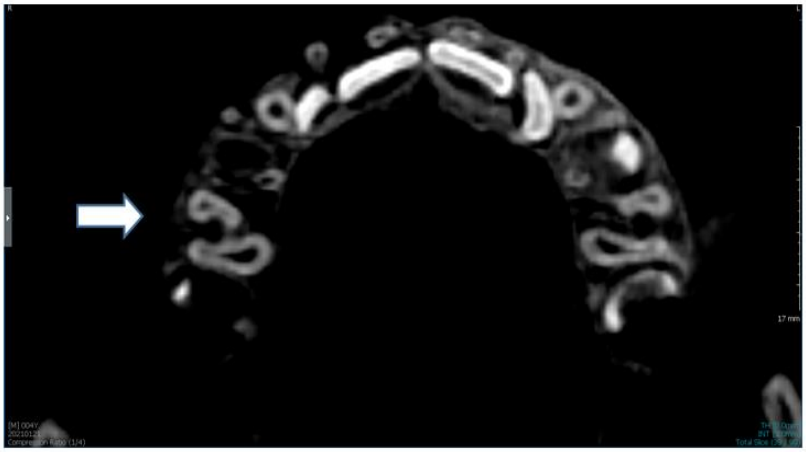

Fig 6: 1 Mesio-buccal canals, 1 Disto-buccal canal & 1 Palatal canal of Primary maxillary second molar in right quadrant

RESULT

In present study, 60 primary right maxillary 1st molars (tooth no. 54) and 60 primary right maxillary 2nd molars (tooth no. 55) & their number of canals in the mesio-buccal, disto-buccal & palatal canal were evaluated by using CBCT. Among 60 Right Maxillary 1st primary molars evaluated, mesio buccal root had one canal in 80% cases and 2 canals in 20% cases. In disto-buccal roots, 86.66% had single canal and 13.33% had 2 canals. In Palatal root, 100% had single canal. In maxillary right primary 1st molar, Mesio-buccal root, Disto-buccal root & Palatal root has high frequency of single canal. Among 60 Right Maxillary 2nd primary molars evaluated, mesio-buccal root had one canal in 40% cases and 2 canals in 60% cases. In disto-buccal roots, 90% had single canal and 10% had 2 canals. In Palatal root, 100% had single canal. In maxillary right primary second molar, Mesio-buccal root has high frequency of two distinct canals and Disto-buccal root & Palatal root has high frequency of single canal.

So maximum roots in right primary maxillary molars, tend to have 1 canal except mesiobuccal root of maxillary primary 2nd molar. Vertucci type I canal configuration are most commonly found in mesiobuccal, distobuccal and palatal root of maxillary 1st and 2nd molars, except mesiobuccal root of maxillary primary 2nd molar where Vertucci Type I and Type IV both are most common.

Table 1: Incidence of different types in Mesio buccal root of primary maxillary 1st molar

TYPE (Vertucci / New System Classification)	**NUMBER OF TEETH**	**PERCENTAGE**
TYPE I / $^{3}54\ MB^{1}$	35	58.33%
TYPE II / $^{3}54\ MB^{2-1}$	3	5%
TYPE III / $^{3}54\ MB^{1-2-1}$	3	5%
TYPE IV / $^{3}54\ MB^{2}$	9	15%
TYPE V / $^{3}54\ MB^{1-2}$	10	16.66%

Table 2: Incidence of different types in Disto buccal root of primary maxillary 1st molar

TYPE (Vertucci / New System Classification)	**NUMBER OF TEETH**	**PERCENTAGE**
TYPE I / $^{3}54\ DB^{1}$	47	78.33%
TYPE IV / $^{3}54\ DB^{2}$	8	13.33%
TYPE V / $^{3}54\ DB^{1-2}$	5	8.33%

Table 3: Incidence of different types in Palatal root of primary maxillary 1st molar

TYPE (Vertucci / New System Classification)	**NUMBER OF TEETH**	**PERCENTAGE**
TYPE I / $^{3}54\ P^{1}$	60	100%

Table 4: Incidence of different types in Mesio buccal root of primary maxillary 2nd molar

TYPE (Vertucci / New System Classification)	**NUMBER OF TEETH**	**PERCENTAGE**
Type I / $^{3}55\ MB^{1}$	18	30%
Type II / $^{3}55\ MB^{2-1}$	14	23.33%
Type III / $^{3}55\ MB^{1-2-1}$	1	1.66%
Type IV / $^{3}55\ MB^{2}$	22	36.66%
Type V / $^{3}55\ MB^{1-2}$	5	8.33%

Table 5: Incidence of different types in Disto buccal root of primary maxillary 2nd Molar

TYPE (Vertucci / New System Classification)	**NUMBER OF TEETH**	**PERCENTAGE**
Type I / $^{3}55\ DB^{1}$	54	90%
Type II / $^{3}55\ DB^{2-1}$	1	1.66%
Type IV / $^{3}55\ DB^{2}$	5	8.33%

Table 6: Incidence of different types in Palatal root of Primary maxillary 2nd molar

TYPE (Vertucci / New System Classification)	**NUMBER OF TEETH**	**PERCENTAGE**
Type I / $^{3}55\ P^{1}$	60	100%

DISCUSSION

A thorough knowledge of anatomy of the tooth is essential before beginning the endodontic treatment. It is generally accepted that the major cause of failure of root canal treatment is an inability to recognize the number of canal and therefore treatment of all the canals of the root canal system is important (Gaurav V 2021) [5]. The purpose of this study was to investigate the root canal morphology of maxillary primary first and second molars in pediatric patients through CBCT scan. Bagherian A *et al*., 2010 [6] conducted a study on root canal morphology of human deciduous molars in an Iranian population and Katge F *et al*., 's 2018 [7] study

was on root canal morphology of primary molars by clearing technique, an *in vitro* study. Ariffin S *et al*., 2020 [8] conducted a study on root canal morphology of primary maxillary second molars using a micro-computed tomography analysis. No study was done on specific right side primary 1st and 2nd maxillary molar with a significant sample size. Most of these studies seem to lack in defining morphologic variations in a systematic classification in which only the prevalence of one or two root canals were reported and connecting branches, lateral fibrils were evaluated separately and above all these studies had taken very less sample size, that's why no single study reported statistically significant result. Also major studies done on root canal morphology of primary mandibular molars than primary maxillary molars. So, the present study has aimed to analyze the detailed images of the root canal morphology and determine the frequency of complex morphologies of primary maxillary right first and second molars an in vivo study.

In present study, for primary maxillary 1st molar 58.3% of mesiobuccal canal had Vertucci Type I, 15% was Vertucci Type IV, 16.66% was Vertucci Type V and Type III & II root canal configurations was 5% each. Bagherian *et al*., [6] found that, in mesial buccal root maxillary first molar, 92.6% of the samples had Vertucci's Type I root canal configuration and rest 7.4% of the samples were vertucci Type IV. Katge *et al*., [7] found that 91.10% of the samples had Vertucci Type I, 6.9% had Vertucci Type II and 6.9% had Type IV. In the distobuccal root, Type I was found in 78.33% of the specimens and 13.33% of the specimens had Type IV and 8.3% had type V root canal configuration. According to the study conducted by Bagherian *et al*., [6] disto buccal root had Type I root canal configuration in 96.3% and Type IV root canal configuration in 3.7% of sample specimens. According to the study conducted by Katge *et al*., 2016 [7], disto buccal root had Type I root canal configuration in 95.65% and Type IV root canal configuration in 4.35% of sample specimens. 100% Palatal root of maxillary primary 1st molar had Vertucci Type I canal configuration which was similar with previous study done by Bagherian *et al*., [6] and Katge *et al*., [7].

In present study, for primary maxillary 2nd molar, 30% of mesiobuccal canal had Vertucci Type I, 36.7% had Vertucci Type IV, 23.3% had Vertucci Type II and 8.33% had Vertucci Type V & 1.7% had Vertucci type III. Ali Bagherian *et al*., [9] found that, in mesial buccal root maxillary second molar, 100% of the samples had Vertucci's Type I root canal configuration. Katge *et al*., [7] found that 90% of the samples had Vertucci Type I, 10% had Vertucci Type II. Ariffin S *et al*., [4] found that 36.4% of the samples had Vertucci Type V, followed by 27.2% had Vertucci Type I, 9.1% had Vertucci Type IV, 9.1% had Vertucci Type VII, 6.8% had Vertucci Type III, 2.3% had Vertucci Type II & 2.3% had Vertucci Type VI & 6.8% were unclassified. According to current study, for mesio buccal root of primary maxillary 2nd molar, Vertucci Type IV was more common root canal configuration followed by Vertucci Type I, where other roots of primary maxillary first and second molars had Vertucci Type I root canal configuration more commonly. In the distobuccal root of maxillary 2nd molar, Type I was found in 90% of the specimens and 8.3% of the specimens had Type IV and 1.7% had type II root canal configuration. According to the study conducted by Bagherian *et al*., [6] disto buccal root of primary maxillary second molar had Type I root canal configuration in 100% of sample specimens. According to the study conducted by Katge *et al*., [7] 2016, disto buccal root of maxillary 2nd molar also had Type I root canal configuration in 100% of sample specimens. Ariffin S *et al*., [4] found that 77.3% of the samples had Vertucci Type I, followed by 11.3% had Vertucci Type V, 6.8% had Vertucci Type III, 2.3% had Vertucci Type II & 2.3% had Vertucci Type VII. 100% Palatal root of maxillary primary 2nd molar had Vertucci Type I canal configuration which was similar with previous study done by Bagherian *et al*., [6] and Ariffin *et al*., [4] But Katge *et al*., [7] found 96.3% Vertucci Type I and 3.7% Vertucci Type III root canal configuration in palatal root of maxillary 2nd primary molar.

Thus in our study , the root canal configuration of primary maxillary 1st and 2nd molar showed almost similar to previous study result except mesio-buccal canal of primary maxillary second molar having Vertucci Type IV configuration majorly whereas, maximum number of Vertucci Type I found in the previous literature. Also in present study, Mesiobuccal root canal configuration of primary maxillary 2nd molars had given statistically non-significant result where other roots of primary maxillary 1st and 2nd molars had given statistically significant result.

This variation in result compare to previously mentioned studies, may be due to variation in different technique, different method, in-vivo & in-vitro study on different population, also because of one or both quadrant of maxillary arch involvement.

Future Recommendation

1. Large sample size.
2. Different ethnicity and different population should be included.
3. Different geographic area should be included.
4. Most advanced technology should be used.

CONCLUSION

From the results of the present study, regarding the morphology of first and second maxillary primary molars, the following conclusions can be withdrawn:

1) There is a wide range of anatomical variations of the shape and number of all the root canals.

2) All the roots present complexity and variability of the canal system with additional interconnecting isthmuses.
3) The above findings may contribute to favourable clinical outcomes after endodontic treatment.

Why this study is important in pediatric dentistry?

1) Importance of knowledge about root canal morphology in pediatric dentistry to perform successful endodontic treatment.
2) This study prove that there are various types of root canal variations in primary maxillary 1st and 2nd molar.

REFERENCES

1. Demiriz, L., Bodrumlu, E. H., & Icen, M. (2018). Evaluation of root canal morphology of human primary mandibular second molars by using cone beam computed tomography. *Nigerian journal of clinical practice*, *21*(4), 462-467.
2. Fumes, A. C., Sousa-Neto, M. D. D., Leoni, G. B., Versiani, M. A., Da Silva, L. A. B., Da Silva, R. A. B., & Consolaro, A. (2014). Root canal morphology of primary molars: a micro-computed tomography study. *European Archives of Paediatric Dentistry*, *15*, 317-326.
3. Dinakar, C., Shetty, U. A., Salian, V. V., & Shetty, P. (2018). Root canal morphology of maxillary first premolars using the clearing technique in a south Indian population: An in vitro study. *International Journal of Applied and Basic Medical Research*, *8*(3), 143-147.
4. Mohd Ariffin, S., Dalzell, O., Hardiman, R., Manton, D. J., Parashos, P., & Rajan, S. (2020). Root canal morphology of primary maxillary second molars: a micro-computed tomography analysis. *European Archives of Paediatric Dentistry*, *21*, 519-525.
5. Gaurav, V., Srivastava, N., Rana, V., & Adlakha, V. K. (2013). A study of root canal morphology of human primary incisors and molars using cone beam computerized tomography: An: in vitro: study. *Journal of Indian Society of Pedodontics and Preventive Dentistry*, *31*(4), 254-259.
6. Bagherian, A., Kalhori, K. A., Sadeghi, M., Mirhosseini, F., & Parisay, I. (2010). An in vitro study of root and canal morphology of human deciduous molars in an Iranian population. *Journal of oral science*, *52*(3), 397-403.
7. Katge, F., & Wakpanjar, M. M. (2018). Root canal morphology of primary molars by clearing technique: An: in vitro: study. *Journal of Indian Society of Pedodontics and Preventive Dentistry*, *36*(2), 151-157.
8. Mohd Ariffin, S., Dalzell, O., Hardiman, R., Manton, D. J., Parashos, P., & Rajan, S. (2020). Root canal morphology of primary maxillary second molars: a micro-computed tomography analysis. *European Archives of Paediatric Dentistry*, *21*, 519-525.
9. Yang, R., Yang, C., Liu, Y., Hu, Y., & Zou, J. (2013). Evaluate root and canal morphology of primary mandibular second molars in Chinese individuals by using cone-beam computed tomography. *Journal of the Formosan Medical Association*, *112*(7), 390-395.
10. Ozcan, G., Sekerci, A. E., Cantekin, K., Aydinbelge, M., & Dogan, S. (2016). Evaluation of root canal morphology of human primary molars by using CBCT and comprehensive review of the literature. *Acta Odontologica Scandinavica*, *74*(4), 250-258.
11. Chawla, S., Goswami, M., Sachdeva, P., & Walia, V. (2016). Primary molars with extra root canals-a case series. *Journal of Dental Specialities*, *4*(1), 55-60.
12. Reuben, J., Velmurugan, N., & Kandaswamy, D. (2008). The evaluation of root canal morphology of the mandibular first molar in an Indian population using spiral computed tomography scan: an in vitro study. *Journal of Endodontics*, *34*(2), 212-215.
13. Neelakantan, P., Subbarao, C., Ahuja, R., Subbarao, C. V., & Gutmann, J. L. (2010). Cone-beam computed tomography study of root and canal morphology of maxillary first and second molars in an Indian population. *Journal of endodontics*, *36*(10), 1622-1627.
14. Zhang, R., Wang, H., Tian, Y. Y., Yu, X., Hu, T., & Dummer, P. M. H. (2011). Use of cone-beam computed tomography to evaluate root and canal morphology of mandibular molars in Chinese individuals. *International endodontic journal*, *44*(11), 990-999.
15. Chourasia, H. R., Meshram, G. K., Warhadpande, M., & Dakshindas, D. (2012). Root canal morphology of mandibular first permanent molars in an Indian population. *International journal of dentistry*, 7(4), 51-52.
16. Liu, N., Li, X., Liu, N., Ye, L., An, J., Nie, X., ... & Deng, M. (2013). A micro-computed tomography study of the root canal morphology of the mandibular first premolar in a population from southwestern China. *Clinical oral investigations*, *17*, 999-1007.
17. Vijayakumar, R., Selvakumar, H., Swaminathan, K., Thomas, E., Ganesh, R., & Palanimuthu, S. (2013). Root canal morphology of human primary maxillary molars in Indian population using spiral computed tomography scan: an in vitro study. *SRM Journal of Research in Dental Sciences*, *4*(4), 139-142.
18. Wang, Y. L., Chang, H. H., Kuo, C. I., Chen, S. K., Guo, M. K., Huang, G. F., & Lin, C. P. (2013). A study on the root canal morphology of primary molars by high-resolution computed tomography. *Journal of Dental Sciences*, *8*(3), 321-327.
19. Mukhaimer, R. H. (2014). Evaluation of root canal configuration of mandibular first molars in a Palestinian population by using cone-beam computed tomography: an ex vivo

study. *International Scholarly Research Notices*, 58(3), 6-21.
20. Ok, E., Altunsoy, M., Nur, B. G., Aglarci, O. S., Çolak, M., & Güngör, E. (2014). A cone-beam computed tomography study of root canal morphology of maxillary and mandibular premolars in a Turkish population. *Acta Odontologica Scandinavica*, *72*(8), 701-706.
21. Bulut, D. G., Kose, E., Ozcan, G., Sekerci, A. E., Canger, E. M., & Sisman, Y. (2015). Evaluation of root morphology and root canal configuration of premolars in the Turkish individuals using cone beam computed tomography. *European Journal of Dentistry*, *9*(04), 551-557.
22. Mokhtari, H., Niknami, M., Zonouzi, H. R. M., Sohrabi, A., Ghasemi, N., & Golzar, A. A. (2016). Accuracy of cone-beam computed tomography in determining the root canal morphology of mandibular first molars. *Iranian Endodontic Journal*, *11*(2), 101-105.
23. Ghoncheh, Z., Zade, B. M., & Kharazifard, M. J. (2017). Root morphology of the maxillary first and second molars in an Iranian population using cone beam computed tomography. *Journal of Dentistry (Tehran, Iran)*, *14*(3), 115-122.
24. Martins, J. N., Marques, D., Mata, A., & Caramês, J. (2017). Root and root canal morphology of the permanent dentition in a Caucasian population: a cone-beam computed tomography study. *International Endodontic Journal*, *50*(11), 1013-1026.
25. Boel, T., & Kartika, D. (2018, February). Root Canal Configuration of Permanent Mandibular First and Second Molars Using Radiographic Tube Shift Technique in Dental Hospital Patients at Faculty of Dentistry Universitas Sumatera Utara. In *International Dental Conference of Sumatera Utara 2017 (IDCSU 2017)* (pp. 301-303). Atlantis Press.
26. Katge, F., & Wakpanjar, M. M. (2018). Root canal morphology of primary molars by clearing technique: An: in vitro: study. *Journal of Indian Society of Pedodontics and Preventive Dentistry*, *36*(2), 151-157.
27. Kurumboor, K., Tarun, G., Chandra, R. V., Vasundhara, V., & Aruna, C. (2018). Root Canal Morphology of Human Permanent Mandibular Anterior Teeth in an Indian Population using CBCT. *Int J Oral Care Res*, *6*(1), 67-71.
28. Ni, N., Cao, S., Han, L., Zhang, L., Ye, J., & Zhang, C. (2018). Cone-beam computed tomography analysis of root canal morphology in mandibular first molars in a Chinese population: a clinical study. *Evidence-Based Endodontics*, *3*(1), 1-6.
29. Reddy, N. V., Daneswari, V., Patil, R., Meghana, B., Reddy, A., & Niharika, P. (2018). Three-dimensional assessment of root canal morphology of human deciduous molars using cone beam computed tomography: An In vitro Study. *International Journal of Pedodontic Rehabilitation*, *3*(1), 36-41.
30. Rezaeian, M., Tonekaboni, M. R., & Iranmanesh, F. (2018). Evaluating the root canal morphology of permanent maxillary first molars in Iranian population. *Iranian endodontic journal*, *13*(1), 78-82.
31. Roy, C., Pagare, S., Vahanwala, S., & Waghmare, M. (2018). Root canal morphology variation in mandibular posteriors: A cone beam computed tomography study. *Journal of Indian Academy of Oral Medicine and Radiology*, *30*(4), 342-348.
32. Senan, E. M., Alhadainy, H. A., Genaid, T. M., & Madfa, A. A. (2018). Root form and canal morphology of maxillary first premolars of a Yemeni population. *BMC Oral Health*, *18*(1), 1-10.
33. Algarni, Y. A. (2019). Analysis of Root Canal Anatomy and Variation in Morphology of Maxillary First Molar Using Various Methods: An In Vitro Study. *World*, *10*(4), 292-294.
34. Sim, D., & Mah, Y. (2019). A study of root canals morphology in primary molars using computerized tomography. *Journal of the Korean Academy of Pediatric Dentistry*, *46*(4), 400-408.
35. Maghfuri, S., Keylani, H., Chohan, H., Dakkam, S., Atiah, A., & Mashyakhy, M. (2019). Evaluation of root canal morphology of maxillary first premolars by cone beam computed tomography in Saudi Arabian southern region subpopulation: An in vitro study. *International journal of dentistry*, 20(6), 39-43.
36. Mashyakhy, M. (2019). Anatomical analysis of permanent mandibular incisors in a Saudi Arabian population: An in Vivo cone-beam computed tomography study. *Nigerian journal of clinical practice*, *22*(11), 1611-1616.
37. Meryem, Z. İ. Y. A., YÜKSEL, B. N., & Şaziye, S. A. R. I. (2019). Root canal morphology of mandibular primary molars: a micro-CT study. *Cumhuriyet Dental Journal*, *22*(4), 382-389.

