ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 13, Issue, 01, pp.15637-15641, January, 2021

DOI: https://doi.org/10.24941/ijcr.40560.01.2021

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

ANATOMICAL VARIATIONS IN ROOT AND CANAL MORPHOLOGY OF PRIMARY MAXILLARY FIRST MOLARS: A CBCT STUDY

[1,*]Dr. Sharon Jose, [2]Dr. Navin Hadadi Krishnamurthy, [3]Dr. Umapathy, T. and [4]Dr. Balaji P

[1]Post Graduate Student, Department of Pediatric and Preventive Dentistry, Rajarajeswari dental college and hospital, Bangalore, India
[2]MDS, Professor, Department of Pediatric and Preventive Dentistry, Rajarajeswari Dental College and Hospital, Bangalore, India
[3]MDS, Professor, Department of Pediatric and Preventive Dentistry, Rajarajeswari Dental College and Hospital, Bangalore, India.
[4]MDS, Professor and HOD, Department of Oral Medicine and Radiology, Rajarajeswari Dental College and Hospital, Bangalore, India

ARTICLE INFO

Article History:
Received 28th October, 2020
Received in revised form
17th November, 2020
Accepted 04th December, 2020
Published online 30th January, 2021

Key Words:
Anatomical variations,
root canals, primary molars,
Cone beam computed tomography

ABSTRACT

Introduction: Premature loss of primary teeth can cause many problems including loss of arch perimeter, supraeruption of opposing teeth and changes in the patient's occlusion. Hence, maintaining the primary tooth is utmost important for maintaining the arch integrity. The successful endodontic treatment of primary teeth can be achieved only through a detailed knowledge of root and canal morphology. **Aim:** To evaluate the root and canal morphology of primary maxillary first molars using cone beam computed tomography (CBCT) in Pediatric Indian population. **Materials and Methods:** CBCT images of 25 children (50 images) in the age group of 4-10 years were obtained from the institutional data base and private diagnostic centers. The CBCT images were reconstructed with the help of Scanora software evaluated and analyzed the data using SPSS version for windows. **Results:** The majority of the primary maxillary first molar had three roots and three canals (Variant I) which account for 72% of teeth and Variant II had three roots and three canals with distobuccal and palatal root fused in 28% cases. **Conclusion:** Within the limitations of this study, we concluded that there was difference in the root canal configuration of primary maxillary first molars in the studied patients of an Indian population.

Citation: ***Dr. Sharon Jose, Dr. Navin Hadadi Krishnamurthy, Dr. Umapathy, T. and Dr. Balaji P.*** **2021.** "Anatomical variations in root and canal morphology of primary maxillary first molars: a cbct study", *International Journal of Current Research*, 13, (01), *15637-15641*.

INTRODUCTION

The primary dentition has numerous functions and is important in child's development[1]. They aid in maintaining the integrity of the dental arch, thereby preventing malocclusion, allowing proper speech and mastication, prevent aberrant tongue habits, providing esthetics and guiding the eruption of the permanent teeth. Therefore, preserving the vitality of deciduous teeth until their normal exfoliation is utmost important[3]. Primary teeth exhibit morphologic differences and have a thinner layer of mineralized tissue between the external and internal surfaces of teeth when compared with permanent teeth, which leads to rapid penetration of microorganisms into the pulp causes caries development[1]. Dental caries is the major etiological factor which leads to pulpal involvement that necessitates treatment to maintain the integrity of dental tissues[2]. The preservation of primary teeth in dental arch is an important concept as the major problems caused by its premature loss is changes in chronology and eruption sequence of permanent teeth[4]. The bizarre internal geometry of pulp cavity with features not commonly present in permanent teeth such as connections involving furcation, and horizontal anastomosis makes the root canal therapy as highly complicated procedure in primary teeth[3]. The detailed knowledge of the morphology and variation of the root canals of primary teeth are essential during endodontic therapy[5]. Besides, as root resorption initiates, dentin is deposited within the root canal system and may change the size, shape and number of root canals significantly[3]. The commonly used techniques in analyzing the root canal morphology are canal staining and tooth clearing methods, conventional radiographs, digital and contrast medium-enhanced radiographic techniques and radiographic assessment enhanced with contrast media[3].

***Corresponding author: Dr. Sharon Jose,**
Post graduate student, Department of Pediatric and Preventive Dentistry, Rajarajeswari dental college and hospital, Bangalore, India.

Among this, intraoral periapical radiographs are routinely used for diagnostic and endodontic assessment that provides only two dimensional images of a three dimensional structure which might create errors in proper treatment plan[5]. Cone beam computed tomography (CBCT) is a non-invasive tool with a lower radiation dose than medical CT, and higher resolution than conventional radiographic technique. It provides the clinician with detailed images of the dentoalveolar regions for disease diagnosis and even useful in different fields of dentistry[2]. It is also possible to obtain sections from multiple planes that have no projection errors associated with superimposition and magnification thereby creating three dimensional images of the teeth more accurately[5]. Currently it is represented as the "GOLD standard" in identifying root canal anatomy when used with an appropriate small field of view (FOV) and small voxel size[5,7].
The studies carried out to analyze the various root canal configuration and its classifications for permanent teeth have been proposed, and well documented in the literature. However, the studies done to determine root canal morphology of primary teeth using CBCT in Indian pediatric population is relatively rare[2]. Hence, the present study was undertaken to assess the variation in number and morphology of the root canals of primary maxillary first molars and to study applicability of CBCT in assessing the root canal morphology.

MATERIALS AND METHODS

This current retrospective study was carried out on fifty CBCT images of primary maxillary first molars of children aged between 4 to 10 years obtained from the institutional database and other private diagnostic centers. This particular age group was chosen in order to ensure the integrity of the original morphology of the root canals of primary maxillary molars and also the amount of root resorption is minimal at this age. The CBCT images that were taken for various valid diagnostic reasons such as developmental or congenital anomaly, pathological and traumatic lesions were collected and analyzed. The teeth which require Endodontic treatment with or without periapical lesions, minimal root resorption were included in the study and teeth involving multi-surface carious lesion, resorbed root > ½ root length, restored or fractured teeth and teeth with bone loss were excluded. The sample size was estimated using the formula N= Z2 (1-α) X PQ where Z (1-α) =1.96, P=0.50, Q=1-P, δ (Margin of Error) =0.15. δ2. The study data was analyzed using SPSS [Statistical Package for Social Science] v.22 [IBM, Corp.,] for Windows. The level of significance was set at P<0.05. The ethical clearance was obtained from the institutional ethical and research committee prior to the commencement of the study.

RADIOGRAPHIC TECHNIQUES

The CBCT images were taken by a SCANORA® 3D machine at 90 kV and 12.5 mA, with a field of view of 60 mm and a voxel size of 0.1 mm. The slice thickness was 1 mm and the exposure time was 15 seconds. Scans were made according to the manufacturer's recommended protocol and all of the images were taken by a licensed radiologist, with the minimum exposure necessary for adequate image quality. The lowest radiation dose and field were guaranteed.

EVALUATION OF THE IMAGE: The 50 CBCT image were reconstructed in coronal section and analyzed with the help of ON DEMAND 3D and Scanora software. (CBCT MACHINE: SCANORA 3D, SOREDEX, FINLAND).The contrast and brightness of images were adjusted using the image processing tool of the software to ensure optimal visualization. The images were evaluated for number of root, number of canals per root and root canal variations. The evaluation criteria of images were based on that given by Gozde Ozcan in the year 2015 [Figure: 1]

The two variants which were analyzed in this study:

VARIANT I: Three separate roots with each root having one canal.

VARIANT II: Three roots with three canals where distobuccal and palatal roots fused [Figure: 2]

The variant I, II corresponds to class I, class III in Gozde Ozcan's root canal variations.

STATISTICAL ANALYSIS:

The study data was analyzed using SPSS version 22.0 [IBM, Corp.,] for Windows. The experimental data obtained in this paper were presented as categorical variables. The frequency of the numbers of root and canals were determined and were compared by the Chi-square test, with a significance level of $p<0.05$.

RESULTS

Fifty primary maxillary first molars CBCT images were examined. The mean age of the subjects included in the study was 6.9 years for the males (n=15) and 7.6 years for the females (n=10). Majority of the primary maxillary first molar had three roots separately with each root having one canals (Variant I) which account for 72% of teeth. Remaining teeth had three roots and three canals with distobuccal and palatal root fused (Variant II) were analyzed in 28% teeth which is statistically insignificant [Table: 1].There was no significant difference in the root and canal morphology of maxillary first molar teeth with respect to gender. The genderwise distribution of primary maxillary first molar revealed that 88.9% of Variant I were seen in males whereas only 75% were seen in females. Variant II were noted in 11.1% of males while 25% of females had distobuccal and palatal canal fused. [Table: 2]. The two variants found in the root canal morphology of primary maxillary first molars [Figure: 3 & 4]

DISCUSSION

The main aim of pulp therapy for primary teeth is to avoid premature loss of teeth due to carious exposure[4]. It is imperative for maintaining the primary teeth in dental arch in order to avoid undesirable consequences for ensuring correct spacing between tooth, mastication, phonation, esthetics, and also for the prevention of psychological effects due to tooth loss[8]. Endodontic treatment in deciduous teeth is a great challenge for pediatric dentist. Therefore, a detailed knowledge on the root and canal morphology of primary teeth is essential which greatly enhance the effectiveness of pulpal treatment[9]. In the present study, we used CBCT to evaluate the number of root and canal morphology in 50 primary maxillary first molars of 25 individuals. The primary maxillary first molar is unique in that it looks somewhat like a molar but also like a premolar[13].

Table I. Genderwise distribution of total number of primary maxillary first molar teeth observed for different Root & canal variants using Chi Square test

Gender	Variant I		Variant II	
	n	%	N	%
Males	22	61.1%	8	57.1%
Females	14	38.9%	6	42.9%
Total	36	72.0%	14	28.0%
c^2 Value	0.702		1.637	
P-Value	0.40		0.20	

Table 2. Genderwise comparison of bilaterally symmetrical different Root & canal variants for primary maxillary First Molars using Chi Square test

Teeth	Variants	Males		Females		c^2 Value	P-Value
		n	%	n	%		
Primary Maxillary first Molars	Variant I	8	88.9%	6	75.0%	0.562	0.45
	Variant II	1	11.1%	2	25.0%		

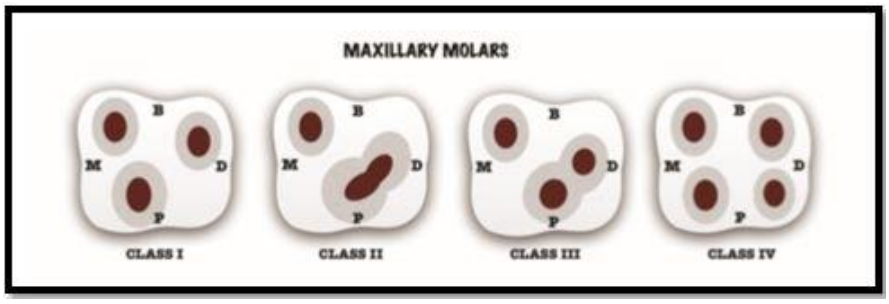

Figure 1. Image for evaluation

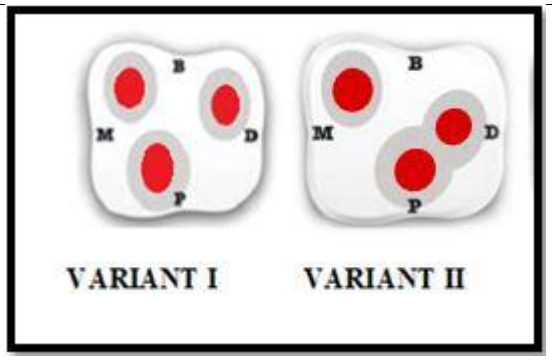

Figure 2: Variants in Root Canal Morphology of Primary Maxillary First Molar

Figure 3: VARIANT I- Three separate roots with each root having one canal

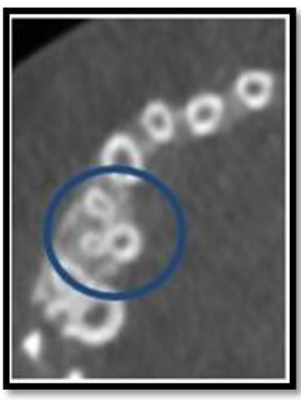

Figure 4.VARIANT II- Three root with three canals but distobuccal and palatal root fused

An in-vitro study by Yin-Lin et al. which were conducted on extracted primary molars (29 teeth), including eight maxillary first molars, 10 maxillary second molars, two mandibular first molar and nine mandibular second molars showed that in primary molars, the variation in the numbers of roots and root canals were two to three and three to four, respectively. Maxillary molars exhibited mostly one canal than two-canal roots, yet there were equal numbers in mandibular molars. Fusion between distobuccal and palatal roots in maxillary molar was common with a greater prevalence in maxillary molars[10]. Apart from this, an in-vitro study was conducted by Zoremchhingi et al. to evaluate the root canal morphology of 60 primary molars by computerized tomography showed that out of 15 of primary maxillary first molar, seven of the samples had three roots with three canals, which were separated. In eight samples, both the distobuccal and palatal roots were fused and in all the samples two canals were seen, i.e. 1 distobuccal and 1 palatal canal which is also in accordance to this present study[11].

An in-vitro study conducted by Rajendran et al. on 30 extracted primary maxillary molars using spiral computed tomography scan showed that in primary maxillary first molars, two of the samples had 2 canals both distobuccal and palatal root canals were fused and in 13 samples had 3 canals (mesiobuccal, distobuccal, palatal) [9] whereas in this present study no samples presented with two canals. A study was carried out by Gozde Ozcan et.al, to investigate the variation in number and morphology of the root canals of the primary molars, to study the applicability of cone beam computerized tomography (CBCT) in assessing the root canal variarions. It was concluded that in maxillary primary first molars, one canal was seen in the mesiobuccal root in most of the samples. All the distobuccal and palatal roots of maxillary molars were single canal roots. Out of 81 samples, 48 samples presented with three roots with three canals , 25 of them showed three roots with 4 canals, 6 samples showed two roots with 3 canals and one tooth with two roots with 4 canals which was not in accordance to our study[1] .

However, in this present CBCT study, only two types of root canal variations were determined. The Variant I was three separate roots with one canal each which was most commonly observed and account for 72%, whereas Variant II was three roots with 3 canals where the distobuccal and palatal root fused were seen in 28% of teeth which was statistically insignificant. In this present study, CBCT was found to be an effective and efficient diagnostic tool for investigating root canal anatomy than conventional radiographs. It allows the visualization of fine details of structures in three-dimensional imaging without visual noise, even ensuring the radiation exposure as low as possible in patients[5, 6]. It uses isotropic voxels, empowering exact linear geometric and three dimensional measurements of acquired data in axial, coronal and saggital cross sections[7]. The majority of primary maxillary first molar shows three root with three canal which did not have any gender predilection. Hence, this study indicates that CBCT is helpful in evaluating the root and canal system of primary teeth. CBCT cannot be used routinely and can be considered only when it has been determined that conventional radiographic techniques are yielding limited details for proper diagnosis and treatment planning.

Limitation: A limitation of this study was the sample size was less. Thus, further studies have to be conducted to identify more number of variants which could help pediatrics dentists in improving their diagnostic and endodontic treatment skills.

Conclusion

Within the limitation, it was concluded that this in-vitro study provided the root canal variations in primary maxillary first molars, which is essential for the diagnosis and successful endodontic therapy of primary teeth. The majority of primary maxillary first molars have three roots with three separate canals and the diversity in root canal variants should be considered while performing pulp therapy. CBCT ensures as an accurate diagnostic tool for analyzing the root canal variations in a three dimensional view when compared to conventional radiographs. A good knowledge regarding the morphological variations in the root canals of primary maxillary first molar is quintessential requirement, thus allows an appropriate management strategies can be undertaken to overcome the problem faced during the endodontic therapy in primary maxillary first molars.

Acknowledgement: We are indebted to Dr. Nagarathna C, Professor and HOD, Department of pediatric and preventive dentistry, for her constant encouragement and support.

Conflict of Interest: The authors declare no conflicts of interest in preparing this article.

Funding Source: Self funded

Abbreviations

CBCT: Cone beam computed tomography
FOV: Field of view
SPSS: Statistical Package for Social Science

REFERENCES

1. Ozcan G, Sekerci AE, Cantekin K, Aydinbelge M, Dogan S. Evaluation of root canal morphology of human primary molars by using CBCT and comprehensive review of the literature. Acta Odontologica Scandinavica. 2016; 74(4):250-8.
2. Yang R, Yang C, Liu Y, Hu Y, Zou J. Evaluate root and canal morphology of primary mandibular second molars in Chinese individuals by using cone-beam computed tomography. J Formos Med Assoc 2013; 112:390-5.
3. Reddy NV, Daneswari V, Patil R, Meghana B, Reddy A, Niharika P. Three – dimensional assessment of root canal morphology of human deciduous molars using cone beam computed tomography: An In vitro study. Ind J Pedod Rehabil 2018:3:36-41.
4. Fumes AC, Sousa-Neto MD, Leoni GB, Versiani MA, da Silva RA, Consolaro A. Root canal morphology of primary molars: a micro-computed tomography study. Eur Arch Paediatr Dent 2014; 15(5):317-26.
5. Acar B, Kamburoğlu K, Tatar İ, Arıkan V, Çelik HH, Yüksel S, Özen T. Comparison of micro-computerized tomography and cone-beam computerized tomography in the detection of accessory canals in primary molars. Imag Sci Dent 2015; 45(4):205-11.
6. Rouhani A, Bagherpour A, Akbari M, Azizi M, Nejat A, Naghavi N. Cone-beam computed tomography evaluation

of maxillary first and second molars in Iranian population: a morphological study. Iran Endod J. 2014; 9(3):190.
7. Przesmycka A, Tomczyk J. Differentiation of root canal morphology–a review of the literature. Anthropol review 2016; 79(3):221-39.
8. Bagherian A, Kalhori KA, Sadeghi M, Mirhosseini F, Parisay I. An in vitro study of root and canal morphology of human deciduous molars in an Iranian population. J Oral Sci 2010; 52(3):397-403.
9. Vijayakumar R, Selvakumar H, Swaminathan K, Thomas E, Ganesh R, Palanimuthu S. Root canal morphology of human primary maxillary molars in Indian population using spiral computed tomography scan: an in vitro study. SRM J Res in Dent Sci 2013; 4(4):139.
10. Wang YL, Chang HH, Kuo CI, Chen SK, Guo MK, Huang GF, Lin CP. A study on the root canal morphology of primary molars by high-resolution computed tomography. J Dent Sci 2013; 8(3):321-7.
11. Joseph T, Varma B, Mungara J. A study of root canal morphology of human primary molars using computerised tomography: an in vitro study. J Indian Soc Pedod Prev Dent 2005; 23(1):7.
12. Salama S, Hanes Carole, Myers Davis. Anatomy of primary incisor and molar root canal. Pediatric dentistry 1992; 14.
13. Richard J. Mathewson, Robert E. Primosch. Fundamentals of pediatric dentistry, 3rd ed. Quintessence publishing Co, Inc, pp 197-205

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