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Age and Gender evaluation for prevalence of second mesiobuccal root canal in maxillary first molars in Gujarat population– a cone beam computed tomographic analysis - An in vitro prospective study

[1]Dr Kiran Vachhani, Professor, Department of Conservative Dentistry & Endodontics, NPDCH, SPU, Visnagar

[2]Dr Garg Thakar, Resident, Department of Conservative Dentistry & Endodontics, NPDCH, SPU, Visnagar

[3]Dr. Kamal Bagda, Head of department, Professor, Department of Conservative Dentistry & Endodontics, NPDCH, SPU, Visnagar

[4]Dr. Kailash Attur, Professor, Department of Conservative Dentistry & Endodontics, NPDCH, SPU, Visnagar

[5]Dr. Manjusha Rawtiya, Professor, Department of Conservative Dentistry & Endodontics, NPDCH, SPU, Visnagar

[6]Dr Sarang Soni, Resident, Department of Conservative Dentistry & Endodontics, NPDCH, SPU, Visnagar

Corresponding Author: Dr Garg Thakar, Resident, Department of Conservative Dentistry & Endodontics, NPDCH, SPU, Visnagar

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Abstract

Background: Presence of second mesiobuccal canal in maxillary 1st molar for evaluation of age and gender. Methods for detection includes increased magnification – cone beam computed tomography

Aim: The aim of the study is to evaluate the prevalence of second mesiobuccal root canals in maxillary first molars using CBCT in Gujarat population.

Materials and Method: Total 400 CBCT scans of patients were collected from the various dental collages and various CBCT center of the Gujarat. The study was done on the patient's records after taking the written consent.

Statistical Analysis: Pearson chi-square test

Results: After assessment in the present in-vitro CBCT study, it was shown that the prevalence of MB2 canals in permanent maxillary molar teeth is very high, in the first molar teeth. Based on gender and age evaluation, statistically significant difference was seen.

Conclusion: It can be concluded that CBCT enables the identification of root and canal configuration. The present retrospective study shows that the Indian subpopulation has a higher prevalence of 3-rooted first and second molars

Keywords: Cone Beam Computed Tomography, Prevalence, Vertucci Configurations

Introduction

Endodontic success is based on three factors - complete disinfection, debridement and obturation of the root canal system, and therefore intricate knowledge of canal anatomy holds imperative for accurate treatment.[1]

The long-term success of endodontic therapy depends on ability to locate and identify all canals present. knowledge of the external and internal anatomy of teeth is required. Extra root canals if not detected are the major reason for failure of root canal treatment. Hence CBCT imaging is considered as the best bet for endodontic treatment. CBCT is used to study complexities in root canal anatomy of maxillary first molars .[3]

Several techniques have been used to detect MB2 canals in maxillary molars in both in vitro and clinical studies, including operating microscopes, ultrasounds the use of a bur and explorer and conventional or advanced radiographic techniques. Such approaches are often employed to ease the detection of MB2 canals.

Frequency of second mesiobuccal (MB2) root canal of maxillary first molar may change among different populations. To understand its possible relation with sex, age and root configuration using in - vivo cone-beam computed tomographic (CBCT) assessment is important .[5]

The second canal of the mesiobuccal root of the maxillary first molars is difficult to detect in conventional radiographs and can be a major cause of failure in endodontic treatments. It is important to know the anatomy of the MB2 using high-resolution cone-beam computed tomography (CBCT).[2]

The percentage of visualization of the MB2 canal fluctuates according to the technique used in each study, including histological sections, diaphanization, magnifying loupes, endodontic surgical microscope, scanning electron microscope, microcomputed tomographic analysis, and cone beam computed tomography (CBCT).[24]

Maxillary molars are known to have the highest clinical failure rate in root canal treatment, likely because of their complex root anatomy and canal morphology. Most maxillary molars demonstrate three roots but four canals. The chances of finding a second mesiobuccal (MB2) canal in the mesiobuccal (MB) root is greater than 50%. Other anatomical variations that have been discovered include a third canal in the mesial root, more than one canals in the distobuccal and palatal roots, and C-shaped canals.

Subjects and Methods

Study Design: Total 400 CBCT scans of patients will be collected from the various dental collages and various CBCT center of the Gujarat. The study was done on the patient's records after taking the written consent.

Patient Selection Criteria

Inclusion Criteria

- Images of good qualities
- CBCT with voxel size less than 0.2.
- Age 20 - 60 years, both sexes.
- Minimum of one molar in the scan.
- Maxillary first molars with fully formed apices; and no root canal fillings, posts, crown restorations.

Exclusion Criteria

- Images with voxel size more than 0.2.
- Images with missing all maxillary molars.
- Open apices.
- Root resorption.
- Calcifications or extensive coronal restoration.
- Osteoradionecrosis
- Pregnant women
- Endodontic restorations
- Images with distortion

Selected Radiographic Scans for the Study

CBCT scans were included in our study collected from OROSCAN and SCANMAX CBCT Centres of Gujarat.

The CBCT images will be scanned with the following parameters:

Oroscan

No.	OROSCAN	SCANMAX
CBCT machine	NEWTOM GIANO	CS 9300 P
Viewer software	NNT	CS 3D IMAGING
kvp	90 kVp	90 kVp
mA	10 - 12 mA	6 – 10 Ma
FOV	5 * 5 cm	5 * 5 cm
Resolution	75 microns	90 microns
Exposure time	15 seconds	15 seconds

Scanmax

No.	Centers	No of CBCT Scans
1	Naranpura, Ahmedabad	50
2	Gandhinagar	45
3	Satellite, Ahmedabad	35

Detection of Mb2 of the Maxillary First Molars

- The sagittal plane will aligned with the nasal septum and the axial plane with hard palate.
- The axial plane will aligned with the hard palate and the sagittal plane with nasal septum.
- The slice thickness of the axial images as well as the inter-slice thickness will be adjusted to 0.15 mm.
- The axial images will be scrolled along the whole length of the root for detection of presence of MB2, type of MB root canal, number of root canals and roots of the maxillary first molars.
- The axial images will scrolled along the whole length of the root for detection of presence of MB2.

Results

Table 1: Distribution of study subjects based on gender and age groups.

Gender	20-30 Years		31-40 Years		41-50 Years		51-60 Years		Total	
	n	%	n	%	n	%	n	%	n	%
Male	64	46.72	47	42.34	48	48.48	32	60.38	191	47.75
Female	73	53.28	64	57.66	51	51.51	21	39.62	209	52.25
Total	137	100	111	100	99	100	53	100	400	100

Table 1 : shows distribution of study subjects based on gender and age groups. Out of total 400 study subjects, 137 belonged to 20-30 years age group. Among them 64 (46.72%) were males and 73 (53.28%) were females. 111 study subjects belonged to 31-40 years age group. Among them 47 (42.34%) were males and 64 (57.66%) were females. 99 study subjects belonged to 41-50 years age group. Among them 48 (48.48%) were males and 51 (51.51%) were females. 53 study subjects belonged to above 51-60 years age group. Among them 32 (60.38%) were males and 21 (39.62%) were females.

Table 2: Distribution of study subjects based on gender and presence of second Mesiobuccal root canal on right quadrant.

Gender	Present N (%)	Absent N (%)	Total N (%)	p value
Male	118 (61.8%)	73 (38.2%)	191 (100%)	≤0.05*
Female	74 (35.4%)	135 (64.6%)	209 (100%)	
Total	192 (48%)	208 (52%)	400 (100%)	

Pearson chi-square value= 27.810, Level of significance ≤ 0.05, * Significant Result, ** Non-Significant Result

Table 2: shows distribution of study subjects based on gender and presence of second mesiobuccal root canal on right quadrant. Out of the total study population, 191 study subjects were males. Among them 118 (61.8%) study subjects had 2nd mesiobuccal root canal on right

quadrant. Whereas 209 study subjects were females. Among them, 74 (35.4%) study subjects had 2nd mesiobuccal root canal on right quadrant and statistically significant result was observed among genders in relation to presence of 2nd mesiobuccal root canal on right quadrant. ($p \leq 0.05$)

Table 3: Distribution of study subjects based on gender and presence of second Mesiobuccal root canal on left quadrant.

Gender	Present N (%)	Absent N (%)	Total N (%)	p value
Male	63 (33%)	128 (67%)	191 (100%)	≤0.05*
Female	121 (57.9%)	88 (42.1%)	209 (100%)	
Total	184 (46%)	216 (54%)	400 (100%)	

Pearson chi-square value= 24.931, Level of significance ≤ 0.05, * Significant Result, ** Non-Significant Result

Table 3: Shows distribution of study subjects based on gender and presence of second mesiobuccal root canal on left quadrant. Out of the total study population, 191 study subjects were males. Among them 63 (33%) study subjects had 2nd mesiobuccal root canal on left quadrant. Whereas 209 study subjects were females. Among them, 121 (57.9%) study subjects had 2nd mesiobuccal root canal on left quadrant and statistically significant result was observed among genders in relation to presence of 2nd mesiobuccal root canal on left quadrant. ($p \leq 0.05$)

Table 4: Distribution of study subjects based on age groups and presence of second Mesiobuccal root canal on right quadrant.

Age groups	Present N (%)	Absent N (%)	Total N(%)	p value
20-30	93 (67.9%)	44 (32.1%)	137 (100%)	≤0.05*
31-40	52 (46.8%)	59 (53.2%)	111 (100%)	
41-50	41 (41.4%)	58 (58.6%)	99 (100%)	
51-60	6 (11.3%)	47 (88.7%)	53 (100%)	
Total	192 (48%)	208 (52%)	400 (100%)	

Pearson chi-square value= 52.046, Level of significance ≤ 0.05, * Significant Result, ** Non-Significant Result

Table 4: shows distribution of study subjects based on age groups and presence of second mesiobuccal root canal on right quadrant. Out of the total study population, 137 study subjects blonged to 20-30 years old age group. Among them 93 (67.9%) study subjects had 2nd mesiobuccal root canal on right quadrant. 111 study subjects blonged to 31-40 years old age group. Among them 52 (46.8%) study subjects had 2nd mesiobuccal root canal on right quadrant. 99 study subjects blonged to 41-50 years old age group. Among them 41 (41.4%) study subjects had 2nd mesiobuccal root canal on right quadrant. 53 study subjects blonged to 51-60 years old age group. Among them 6 (11.3%) study subjects had 2nd mesiobuccal root canal on right quadrant and statistically significant result was observed among age groups in relationto presence of 2nd mesiobuccal root canal on right quadrant. ($p \leq 0.05$)

Table 5: Distribution of study subjects based on age groups and presence of second Mesiobuccal root canal on left quadrant.

Age groups	Present N (%)	Absent N (%)	Total N (%)	p value
20-30	73 (53.3%)	64 (46.7%)	137 (100%)	≤0.05*
31-40	49 (44.1%)	62 (55.9%)	111 (100%)	
41-50	42 (42.4%)	57 (57.6%)	99 (100%)	
51-60	7 (13.2%)	46 (86.8%)	53 (100%)	
Total	184 (46%)	216 (54%)	400 (100%)	

Pearson chi-square value= 30.721, Level of significance ≤ 0.05, * Significant Result, ** Non-Significant Result

Table 5 : shows distribution of study subjects based on age groups and presence of second mesiobuccal root canal on left quadrant. Out of the total study population, 137 study subjects blonged to 20-30 years old age group. Among them 73 (53.3%) study subjects had 2nd mesiobuccal root canal on left quadrant. 111 study subjects blonged to 31-40 years old age group. Among them 49 (44.10%) study subjects had 2nd mesiobuccal root canal on left quadrant. 99 study subjects blonged to 41-50 years old age group. Among them 42 (42.4%) study subjects had 2nd mesiobuccal root canal on left quadrant. 53 study subjects blonged to 51-60 years oldage group. Among them 7 (13.2%) study subjects had 2nd mesiobuccal root canal on left quadrant and statistically significant result was observed among age groups in relation to presence of 2nd mesiobuccal root canal on left quadrant. ($p \leq 0.05$)

Discussion

A multitude of methods have been employed and documented for the determination of MB2 presence, both in-vitro and in-vivo. In-vitro studies require extraction of teeth often followed by destruction through sectioning, tooth clearing, root canal staining and microcomputed tomography (MCT) analysis. These methods have formed the main reference standards in the determination of the presence or absence of MB2 canals. Results from these in-vitro studies have revealed an MB2 prevalence of 90% (in MCT) and 93.5% (in tooth clearing and root canal staining). These results compare favorably with the present study (58-62%), which validates the findings and confirms that CBCT examination of teeth may be used for the detection of additional canals.

Studies have shown that CBCT has become more widely available, is more economical, and produces images at significantly lower levels of ionising radiation (compared to medical CT), it has become the method of choice for locating MB2 canals.1

Authors opine that the high prevalence of Vertucci type V configurations was caused by a high prevalence of apical deltas. However, apical deltas are comprised of accessory apical canals, and no other author analyzing premolars in any other study has reported the inclusion of apical deltas as part of the Vertucci major canal classification. The results of Burklein et al, which indicate type V prevalence to be much above the other study, aren't comparable the literature due to their distinctive interpretation of the Vertucci classification. Similarly, small variations within the observation team associated with demographic differences in the samples make it difficult to compare prevalence results between regions in the present study.4

The MB roots of maxillary molars in a gujarati population were found to have more variation in their canal system compared with other roots. The incidence of two canals in the MB roots in the first molars was higher in females than that of the males in left quadrant. These findings demonstrate the potential of CBCT as a useful clinical tool

for endodontic diagnosis and treatment planning, and should also function a basis for improving the success of endodontic treatment. 36

MB2 prevalence is reduced with increasing age. This is to be expected, as dental structural changes occurs with ageing. The most significant of those is that the continued deposition of secondary dentine, resulting in dentinal sclerosis and pulpal recession. Thus, canals become obliterated as there's a reduction in pulpal volume, making it difficult to locate the MB2 canal, if it's in the least present. This study, however, had fewer patients over the age of 50, with the oldest patient in our sample being 72-years old. Though, results showed MB2 canals to be equally prevalent across all age groups, which is unexpected, this has also been documented in the study performed by Kim et al., whose oldest patient was 69-years old. Clinicians should be hence informed of the fact that MB2 canals may be present at any age.4

Regarding the effect of gender, a clearing study conducted by Sert and Bayirli concluded that gender and race were important factors to consider in the preoperative evaluation of canal morphology for endodontic treatment. However, Neaverth et al. and Zheng et al concluded that the gender of the patient was not associated with the number of MB root canals in the maxillary molars. This study concurred with those of Neaverth et al. and Zheng et al.; we established that male and female patients had equal distributions of MB2 canals.[36]

In the presented retrospective study, 400 scans were included. Out of the total study population, 137 belonged to 20-30 years age group. Among them 64 (46.72%) were males and 73 (53.28%) were females. 111 study subjects belonged to 31-40 years age group. Among them 47 (42.34%) were males and 64 (57.66%) were females. 99 study subjects belonged to 41-50 years age group. Among them 48 (48.48%) were males and 51 (51.51%) were females. 53 study subjects belonged to above 51-60 years age group. Among them 32 (60.38%) were males and 21 (39.62%) were females.

Out of the total study population, 137 study subjects belonged to 20-30 years old age group. Among them 93 (67.9%) study subjects had 2nd mesiobuccal root canal on right quadrant and 73 (53.3%) study subjects had 2nd mesiobuccal root canal on left quadrant.. 111 study subjects belonged to 31-40 years old age group. Among them 52 (46.8%) study subjects had 2nd mesiobuccal root canal on right quadrant and 49 (44.10%) study subjects had 2nd mesiobuccal root canal on left quadrant. 99 study subjects belonged to 41-50 years old age group. Among them 41 (41.4%) study subjects had 2nd mesiobuccal root canal on right quadrant and 42 (42.4%) study subjects had 2nd mesiobuccal root canal on left quadrant. 53 study subjects belonged to 51-60 years old age group. Among them 6 (11.3%) study subjects had 2nd mesiobuccal root canal on right quadrant and 7 (13.2%) study subjects had 2nd mesiobuccal root canal on left quadrant and statistically significant result was observed among age groups in relation to presence of 2nd mesiobuccal root canal on both quadrants.

Documentation reaffirms that a greater prevalence of MB2 canals is present in patients than is understood or conventionally taught. Of primary significance, should be the stress on the importance of being clinically conscious of the presence of such canals, which can leave better (improved) endodontic therapy, as well as allocation of sufficient treatment time. The overall outcome would thus be an improvement of endodontic success within the treatment of those teeth.[1]

Another concern that can't be ignored is that the differences in CBCT interpretation between the observers.

Although efforts were made to calibrate the observer's assessment skills by sharing images, instructional videos, references, and a uniform timetable, each observer's past experiences and private beliefs may have an influence also. The group intraclass coefficient of correlation and therefore the percentage of agreement were extremely high but not perfect, which still allows a little space for private variations. In this study, more than the standardization of the CBCT scanners, which was not completely possible because of the no marketing of all scanner brands at the worldwide level and whose maximum voxel size was set at 250 mm, which has been stated as a resolution with high accuracy (0.82) within the identification of MB2 canals in mesiobuccal roots with canals not instrumented , a good standardization of the step-by-step MB2 assessment process was the main objective. One example of this observer interpretation variations are often exemplified in Burklein et al , an analysis of premolar anatomy in Germany.

This study was conducted to investigate the efficacy of CBCT imaging in the detection of MB2 canals in maxillary first molars in Gujarat population. 1000 scans were included in this retrospective study with the objective of evaluating the frequency of second mesiobuccal root canal in maxillary first molars using CBCT in co-relation with gender and sides of the jaw.

Conclusion

In the present in-vitro CBCT study, it was shown that the prevalence of MB2 canals in permanent maxillary molar teeth is very high, in the first molar teeth. The likelihood of those canals being present in contralateral and adjacent molar teeth was also found to be high.

Though endodontic therapy remains a viable treatment option for many teeth with high levels of success, the explanations for treatment failure in maxillary molar teeth may partially be attributed to a scarcity of data regarding the prevalence of those canals, and difficulty in locating them intra-operatively. Untreated MB2 canals is a source of persistent microbial infection and contamination leads to endodontic treatment failure.

CBCT enables the identification of root and canal configuration. The present retrospective study shows that the Indian subpopulation has a higher prevalence of 3-rooted first and second molars. The MB roots of maxillary molar had varying anatomy in their canal system than the opposite roots. These anatomic variations should be considered during root canal treatment of maxillary molars, which could potentially facilitate root canal therapy.

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