

Root Canal Configuration in Maxillary First Premolars: A Cone-Beam Computed Tomography Study in Gujarat Population

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Dr. Shylaja Attur,

Professor & Head, Department of Oral & Maxillofacial Pathology and Oral Microbiology, Narsinhbhai Patel Dental College and Hospital, Sankalchand Patel University, Visnagar, Gujarat, India.
9723563697, shylajamd@gmail.com

Dr. Pawan Gurjar,

Practicing Endodontist, Gandhinagar, Visnagar, Gujarat, India.
9041452219. ppgurjar@gmail.com

Dr. Kailash Attur,

Professor & Head, Department of Conservative Dentistry and Endodontics Narsinhbhai Patel Dental College and Hospital, Sankalchand Patel University, Visnagar, Gujarat, India.
9723563697, atturkailash@gmail.com

Dr. Nikunj Patel

Reader, Department of Conservative Dentistry and Endodontics Narsinhbhai Patel Dental College and Hospital, Sankalchand Patel University, Visnagar, Gujarat, India.
7383798549. tonikunjpatel@gmail.com

Dr. Siddharth Menon

Senior Lecturer, Department of Conservative Dentistry and Endodontics Narsinhbhai Patel Dental College and Hospital, Sankalchand Patel University, Visnagar, Gujarat, India.
9586036449, siddharthmenon93@gmail.com

Dr. Prateek J Pachore

Senior Lecturer, Department of Conservative Dentistry and Endodontics Narsinhbhai Patel Dental College and Hospital, Sankalchand Patel University, Visnagar, Gujarat, India.
8758265341, prateekjpachore@gmail.com

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Abstract

Introduction: Success of endodontic therapy is based on meticulous root-canal cleaning and shaping, proper obturation, and leakage proof coronal restorations. Understanding of the complex internal anatomy of the root canal system is critical for the same. Variations in Root canal anatomy exist among different ethnic background. Maxillary first premolars is the most arduous teeth to be treated endodontically due to its variation in number of roots, canal configuration, direction and longitudinal depressions on the roots, and various pulp cavity configurations. Recent advancement in imaging techniques provides additional information on 3D representation of the structures. Hence here is an attempt to evaluate root and root canal configuration of maxillary first premolars using pre-existing CBCT database.

Materials and Method: CBCT databases of 100 patients (53 male, 47 females; 17-70 years) were collected from different CBCT Centers with patient's personal. Maxillary first premolars were analyzed in 3 planes (sagittal, coronal and axial) for the number of roots and canal configuration as per Vertucci's classification.

Results: The most prevalent root canal configuration for single rooted and two rooted maxillary first premolar was Type IV. There was no significant difference observed among genders in Maxillary first premolars in Gujarat population.

Conclusion: Maxillary first premolar has more predominant single root and Type IV canal in Gujarat population.

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1. Introduction

Effective endodontic treatment depends on thorough root-canal cleaning and shaping, 3D sealed obturation, and impervious restorations, and this build on meticulous understanding of the intricate internal anatomy of pulp chamber and root canal system. Due to convolution of the root canal system, there exists risk of missing root canal during treatment which ultimately directs to endodontic failure. Factors that add to the deviations in root canal include - ethnicity, age, sex, and study design.

The maxillary first premolars are amongst the most onerous teeth to be treated endodontically owing to their complexities, which dictate the difficulty of root canal treatment, post-core restoration, and can be the commonest cause of root canal penetration and even root fracture. So, a thorough knowledge of the internal anatomy of maxillary first premolar is a necessity for achieving better prognosis during root canal therapy, restoration and also to minimize treatment complications. In addition aging demonstrate numerous external and internal alterations and this challenges the clinicians to perform endodontic therapy⁽¹⁾

Emerging technologies of imaging like Cone-Beam Computed Tomography (CBCT) and recently introduced micro-CT are being used for studying tooth anatomy for its ultra-high resolution and high-precision and 3D representation. It precisely measures tooth and constructs a series of cross-sectional images.

American Association of Endodontists (AAE) and the American Academy of Oral and Maxillofacial Radiology Joint Position Committee (2015) indicated in 3rd recommendation the “Limited FOV CBCT should be considered for the imaging modality of choice for initial treatment of teeth with the potential for extra canals and suspected complex morphology, such as mandibular anterior teeth, and maxillary and mandibular premolars and molars. Intraoral radiographs should be considered the imaging modality

of choice in the evaluation of the endodontic patient,” indicating CBCT shall not be an alternative for routine dental screening.⁽²⁾

Nonetheless, enormous data bases of CBCT images exists, which were taken for variety of clinical conditions, and the study of these may provide vital information about the typical / atypical root morphology for the study region. Hence herewith this study is an attempt to utilize the pre-existing imaging data to analyze the root canal morphology of maxillary first premolar known to have a complex anatomy.

2. Methodology

CBCT images were collected from various imaging centers from major cities of Gujarat state, India to analyze the root canal configuration of Maxillary first premolar. The images of patients with an age range of 17 – 70 years were collected for the study. Among these high quality CBCT images with desired area of interest (Maxillary canine-premolar region) were selected. Teeth with complete root canal apposition, without resorption and calcification were included. Images which had canal filling, posts or crown, restorations in the area of interest were excluded. The personal details of the included images were collected. The images were studied only for the maxillary first premolar in all three planes (sagittal, coronal and axial) to establish the number of roots and root canal configuration, as per the Vertucci system of classification.

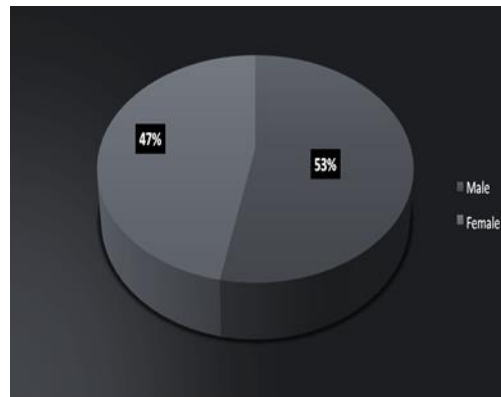
The data obtained were tabulated and analyzed using SPSS version 20.0, and One way ANOVA test was applied to know the significance.

3. Result:

The The most common root canal configuration for single rooted and two rooted maxillary first premolar was Type IV. There was no statistically significant difference observed among genders in relation to number of roots in Maxillary first pre molars.

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Graph 1: Distribution of study subjects based on gender.



Graph 1 shows the gender wise distribution of study sample. The total study population enumerated and

assessed were 100, comprising of 53 (53%) males and 47 (47%) females.

Table 1: Gender and number of roots in Maxillary first premolars.

Gender	1 Root N (%)	2 Roots N (%)	Total	P value
Male	26 (49.06%)	27 (50.94%)	53 (100%)	≥ 0.05
Female	28 (59.57%)	19 (40.43%)	47 (100%)	
Total	54 (54%)	46 (46%)	100 (100%)	

Table 1 showing; out of 53 Males, 26 (49.06%) had 1 root and 27 (50.94%) had 2 roots. Out of 47 Females, 28 (59.57%) had 1 root and 19 (40.43%) had 2 root.

Statistically, no significant difference was observed among genders in relation to number roots in Maxillary first premolars. ($p \geq 0.05$).

Table 2: Number of root canals in Maxillary first premolars.

Gender	1 Root Canal (%)	2 Root Canals (%)	Total	P value
Male	6 (11.32%)	47 (88.68%)	53 (100%)	≥ 0.05
Female	8 (17.02%)	39 (82.98%)	47 (100%)	
Total	14 (14%)	86 (86%)	100 (100%)	

Table 2 showing; out of 53 Males, 6 (11.32%) had 1 root canal and 47 (88.68%) had 2 root canals. Out of 47 Females, 8 (17.02%) had 1 root canal and 39 (82.98%)

had 2 root canals. Statistically, no significant difference was observed among genders in relation to number of roots in Maxillary first premolars ($p \geq 0.05$).

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Table 3: Root configuration in Maxillary first premolars.

Gender	Root canal Configuration	N (%)	Total	P value
Male	Type I	5 (9.43%)	53 (100%)	≥ 0.05
	Type II	4 (7.55%)		
	Type III	5 (9.43%)		
	Type IV	23 (43.40%)		
	Type V	16 (30.19%)		
Female	Type I	6 (12.77%)	47 (100%)	
	Type II	7 (14.89%)		
	Type III	3 (6.38%)		
	Type IV	19 (40.43%)		
	Type V	12 (25.53%)		

Table 3 showing; type of root configuration in Maxillary first premolars. Out of 53 Males, 5 (9.43%) had type I, 4 (7.55%) had type II, 5 (9.43%) had type III, 23 (43.40%) had type IV and 16 (30.19%) had type V root configuration. Out of 47 Females, 6 (12.77%) had type I, 7 (14.89%) had type II, 3 (6.38%) had type

III, 19 (40.43%) had type IV and 12 (25.53%) had type V root configuration. Statistically, no significant difference was observed among genders in relation to type of root configuration in Maxillary first premolars ($p \geq 0.05$).

Table 4: Number of roots and type of root configuration in Maxillary first premolars.

Root	Root canal Configuration	N (%)	Total	P value
1	Type I	11 (20.37%)	54 (100%)	≤ 0.05
	Type II	11 (20.37%)		
	Type III	8 (14.82%)		
	Type IV	13 (24.07%)		
	Type V	11 (20.37%)		
	Type I	0 (0%)		
	Type II	0 (0%)		

2	Type III	0 (0%)	46 (100%)
	Type IV	29 (63.04%)	
	Type V	17 (36.96%)	

Table 4 showing; study subjects based on number of root and type of root configuration in Maxillary first premolars. Out of 54 subjects having 1 root, 11 (20.37%) had type I, 11 (20.37%) had type II, 8 (14.82%) had type III, 13 (24.07%) had type IV and 11 (20.37%) had type V root configuration. Out of 46 subjects having 2 roots, 29 (63.04%) had type IV and 17 (37.96%) had type V root configuration. Statistically, significant difference was observed among study subjects in relation to type of root configuration in Maxillary first premolars. ($p \leq 0.05$)

4. Discussion

Morphological variations of root canal anatomy are significantly different among various populations and thus across the globe. Various methods are employed to provide 3D root canal anatomy, which are the transparent tooth model technique, CBCT, micro-CBCT imaging techniques. In the present study, CBCT was used to determine the number of roots and canal configuration.

Maxillary premolars are believed to be the teeth that are difficult to treat endodontically due to their dissimilarity in number of roots, canal configuration and longitudinal depressions on root. Literature suggests paucity of data in Indian Population on maxillary first premolars regarding its root and canal complexity.

Our study noted that majority of the teeth of interest were single rooted (54%) followed by two rooted (46%) (Table 1), and is in accordance with the studies on Asian population. Maxillary first premolar with single root was noted in 53.6% by Gupta *et al*⁽³⁾ on Indian population and 58% by Dashrath *et al*⁽⁴⁾ on Nepalese population. Tian *et al*⁽⁵⁾, Chengand Weng⁽⁶⁾ and Walker⁽⁷⁾ in the Chinese population noted 54% of maxillary first premolar with single root, and 58% in European Population by Peiris *et al*⁽⁸⁾.

In contrast to our result, Neelakantan *et al*⁽⁹⁾ found that 11.7% of maxillary first premolars with single root,

86% with two roots, and 2.3% with three roots and Banga KS *et al*⁽¹⁰⁾ noted 88% with two roots and 9% with one root. Non-Asian population reported predominance of two rooted maxillary first premolar in Polish population (70%)⁽¹¹⁾, Kosovar (70.1%)⁽¹²⁾, Ugandan (73.3%)⁽¹³⁾, Saudi (71.7%)⁽¹⁴⁾, and Turkish (61.3%)⁽¹⁵⁾ populations.

Limited literature is available in relation to number of root canals in different genders. Maxillary first premolar with two root canals (86%) was present in majority of the cases studied, and single root canal in 14%, but the difference was not significant (Table 2). This was unswerving with Spanish studies.⁽¹⁶⁾ Chinese revealed double-rooted teeth were twofold common in men (62.68%) than women (33.33%), and three rooted teeth were seen in 3.73% of men, but were absent in women.⁽¹⁷⁾

Root canal configuration of maxillary first premolar was studied as per Vetrucchi's grading system. Type IV canals (43.40% and 40.43%) was most commonly seen in both males and females respectively (Table 3). It was also noted that single rooted maxillary first premolar with Type IV root canal configuration (24.07%) was followed by Type I, II and V (20.37.4%). Maximum number of two-rooted maxillary first premolar had Type IV root canal configuration (63.04%) followed by Type V (36.96%). Type IV root canal configuration was the commonest maxillary first premolar among all related studies reviewed which was a significant observation even in our study (Table 4).

Gupta *et al*⁽³⁾ studied maxillary premolars in Indian population and noted Type IV root canal configuration in 33.2% cases, similarly Sharma and Mathur⁽¹⁸⁾ examined 45% of cases in the same configuration. Considerable variation was noted from different countries and various parts within a country which may be attributed to ethnicity, which greatly augment to root canal morphology and their variations.

It was noted that CBCT gave an apparent 3D revelation of the canal trajectory which improved to an exact

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identification of canal morphologies. It is non-invasive technique which provided 3D assessments without superimposition of structures, and can be used in clinical settings whenever required. CBCT is a better tool when given as an alternative for appraising the distinctiveness of root canal system: though radiation exposure to the patient still remains a concern.

5. Conclusion:

Within constraint of the present study, it can be concluded that single rooted maxillary first premolar is the most predominant type in Gujarat population. The most prevalent root canal configuration for both single rooted and two rooted maxillary first premolar is Type IV Vertucci. Similar studies with larger sample size are in need among different groups of the Indian population, which would help to develop a standardized baseline data for root canal anatomy and comparison to improve and make prognosis more predictive and effective.

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