

## MORPHOLOGICAL ANALYSIS OF MAXILLARY FIRST PREMOLAR USING CBCT IN CHENNAI POPULATION

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### Abstract of the study

**Title of the article:** Morphological analysis of Maxillary First Premolar using CBCT in Chennai population.

**Context:** All root canal procedures whether surgical or non-surgical require a thorough knowledge of tooth morphology, adequate access to and exploration of pulpal space, careful interpretations of radiographs are prerequisites. CBCT serves as an important diagnostic tool for complex root anatomies.

**Aim:** The aim of this study was to analyze by CBCT the radicular and canalicular morphology of Maxillary First Premolar in a Chennai population.

**Settings and Design:** The study was conducted in the University setting.

**Methods and Material:** An observational in vivo study was carried out with CBCT examinations of 80 maxillary first premolar, both left and right.

### Features evaluated:

- Number of roots
- Number of canals
- The thickness of cemento dentinal wall around the root canal at the level of 2mm, 4mm and 6mm from the apex.

**Statistical analysis used:**

Statistical analysis was carried out using SPSS Software version 23.0. The data were analyzed by descriptive statistics (mean (M), standard deviation (SD), 95 % confidence interval). Sub-group analysis was done for specific analysis pertaining to gender, sex, and specific tooth.

**Results:** At all the levels 2mm, 4mm, and 6mm from the apex, in a buccal canal, buccal cemento dentinal wall was found to be the thickest, and mesial wall was the thinnest. In the palatal canal, the buccal wall was thickest and the thinnest was the distal wall. It was statistically significant that in 14 teeth, at 2mm in the buccal canal, the mesial wall was the thinnest in all the samples.

**Conclusions:** The majority of Maxillary first premolar in Chennai population presented two roots with two root canals, followed by one root with two root canals. The least common was a single-rooted tooth with a single canal. At the level 2mm from the apex, in 14, the mesial wall was thinnest, and in 24 distal walls was thinnest. Care must be taken not to over-instrument the proximal walls to avoid perforations or fractures.

**Key-words:** Maxillary first premolar, root canal morphology, CBCT

**Introduction:**

The pulp in human dentition presents a variety of configurations and shapes throughout the dentition. All root canal procedures whether surgical or non-surgical require a thorough knowledge of tooth morphology, adequate access to and exploration of pulpal space, careful interpretations of radiographs are prerequisites. (Azeem & Sureshababu, 2018; Felicita, 2017; Felicita et al., 2012; A. R. Jain, 2017; Krishnan & Lakshmi, 2013; Kumar et al., 2006; Mp, 2017; Patturaja, 2016; Rao & Kumar, 2018; Sekar et al., 2019; Sivamurthy & Sundari, 2016)

To avoid technical errors possible during instrumentation of root canal treatment [(Nascimento et al., 2019)]. Common root canal morphology and its frequent variations is a basic requirement for success during root canal procedures. (R. K. Jain et al., 2014; Johnson et al., 2019; Keerthana & Thenmozhi, 2016; Lakshmi et al., 2015; Neelakantan et al., 2011) Classification and Newer system of classification of root canal systems are to be understood [(Ahmed et al., 2017)]

The maxillary first premolar is a tooth with a high rate of variance of root canal system especially at the apical third of the root [(Ahmad & Alenezi, 2016)] complicates the entire root canal treatment making the determination of proper working length, cleaning, shaping, disinfection, and irrigation also very difficult. The maxillary first premolar is the tooth that receives root canal treatment very commonly. The morphology of this tooth varies in population and geographical area, ethnicity plays an important role in determining the morphology of the tooth.

Most maxillary first premolars have two root canals, regardless of the number of roots. A

furcation groove or developmental depression on the palatal aspect of the buccal root is an anatomic feature. Prevalence of furcation groove has been reported as 62 to 100% [(Awawdeh et al., 2008)]. This groove may pose a risk to root canal and restorative procedures in this tooth[(Tamse et al., 2000)]. The pulp chamber of the maxillary first premolar is considered wider buccolingually than mesiodistally. Mesial cervical concavity is also known to present. Mesial cervical concavity was recorded in 64.5% of single-root maxillary premolars. The prevalence of two-root maxillary first premolars with mesial cervical concavity was found to be 73.8%[(Fan et al., 2018)].

The aim of this in vivo study was to analyze by CBCT the radicular and canalicular morphology of Maxillary First Premolar in a Chennai population.

### **MATERIALS AND METHODS:**

The study was approved by Saveetha Dental College Research Board, Chennai. An observational in vivo study was carried out with CBCT examinations of 80 MFP, both left and right. The CBCT used in the study had been requested as part of the examination, diagnosis, and dental treatment planning of the patients who came to our Radiology Department between the months of November 2020 and February 2021. No personal information of the patients were revealed except age and sex.

#### **Inclusion criteria:**

- Patients above 18 years of age.
- Complete root formation should have occurred.
- Both right and left maxillary first premolar should be present in patients.

#### **Exclusion Criteria:**

- Patients below 18 years of age.
- Incomplete root formation
- Restored tooth, endodontically treated tooth
- Presence of posts
- Rehabilitation with fixed prosthesis
- Calcified canals

The CBCT analysis was done by two endodontists, in case of doubt, opinion was taken from an experienced radiologist with knowledge in endodontics.

#### **Features evaluated:**

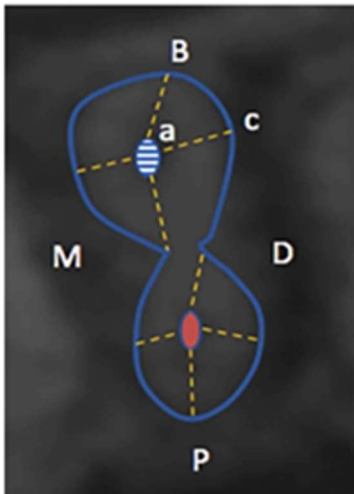
- Number of roots
- Number of canals
- The thickness of the cemento dental wall around the root canal at the level of 2mm, 4mm and 6mm from the apex.

**Method of CBCT Analysis:**

- The MFP was located and a coronal-apical exploration of the whole length of the root was carried out. Exploration followed the axial axis of each tooth to determine the number of roots and canals.
- Vertex of each root was located and tomography advanced to coronal in 2 mm sections, observing the surfaces at 2, 4 and 6 mm (apico-coronal exploration)
- In each sample the number of roots and canals was observed, as well as the thickness of the cemento dentinal walls around the root canal at the level of 2mm,4mm and 6mm from the apex of the root straight was measured.

**Measuring Cemento Dentinal Wall Thickness:**

To calculate this parameter, a line was drawn from A (most concave point of the canal wall) to B (external surface of the root wall analyzed) This procedure was repeated for all the four walls in each of the canals.



**Figure 1:** a- most concave point of corresponding canalicular wall. c-outer surface of root wall. Shaded in blue- Buccal Canal. Shaded in red-palatal canal. Buccal-B, Palatal-P, Mesial-M, Distal -D

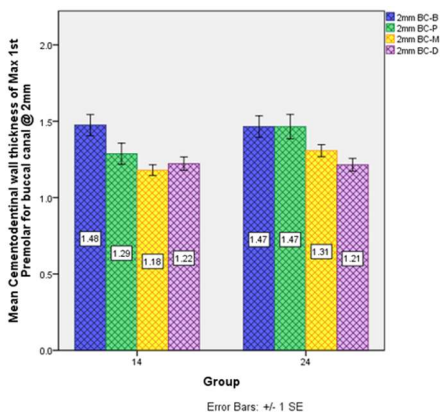
**RESULTS:**

**Statistical Analysis:**

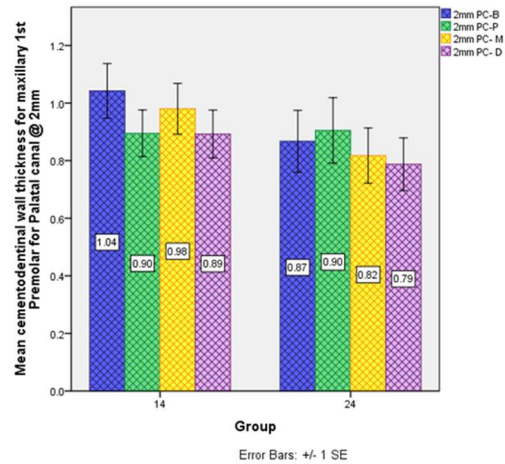
Statistical analysis was carried out using SPSS Software version 23.0. The data were analyzed by descriptive statistics (mean (M), standard deviation (SD), 95 % confidence interval). Sub-group analysis was done for specific analysis pertaining to gender, sex, and specific tooth.

**Table 1: Mean comparison of cemento dentinal wall thickness of maxillary first premolar.**

Side	Canal	mm from Apex	Mean ± SD			
			Buccal	Palatal	Mesial	Distal
Right	Buccal	2mm	1.475±0.439	1.287±0.436	1.180±0.223	1.222±0.279
Left			1.465±0.445	1.465±0.506	1.308±0.249	1.215±0.265
p value			<b>0.920</b>	<b>0.097</b>	<b>0.018*</b>	<b>0.902</b>
Right	Palatal		1.043±0.599	0.895±0.513	0.980±0.559	0.893±0.525
Left			0.868±0.679	0.905±0.720	0.818±0.606	0.787±0.578
p value			<b>0.226</b>	<b>0.943</b>	<b>0.217</b>	<b>0.398</b>
Right	Buccal	4mm	1.790±0.377	1.617±0.398	1.445±0.252	1.480±0.288
Left			1.775±0.392	1.705±0.446	1.495±0.249	1.450±0.284
p value			<b>0.862</b>	<b>0.358</b>	<b>0.375</b>	<b>0.641</b>
Right	Palatal		1.373±0.646	1.333±0.608	1.280±0.622	1.275±0.599
Left			1.205±0.659	1.275±0.691	1.160±0.622	1.115±0.606
p value			<b>0.255</b>	<b>0.694</b>	<b>0.391</b>	<b>0.239</b>
Right	Buccal	6mm	2.010±0.343	1.853±0.404	1.657±0.229	1.700±0.286
Left			2.038±0.342	1.945±0.404	1.720±0.290	1.720±0.322
p value			<b>0.721</b>	<b>0.310</b>	<b>0.289</b>	<b>0.770</b>
Right	Palatal		1.717±0.467	1.715±0.515	1.552±0.479	1.573±0.466
Left			1.638±0.609	1.768±0.685	1.488±0.566	1.453±0.549
p value			<b>0.512</b>	<b>0.700</b>	<b>0.581</b>	<b>0.296</b>

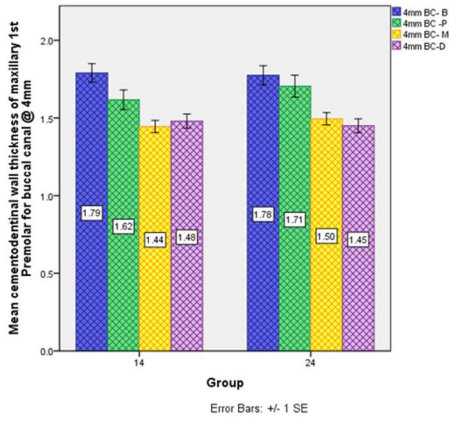


**Figure 1:** Cemento dentinal wall thickness of buccal canal at 2mm from apex

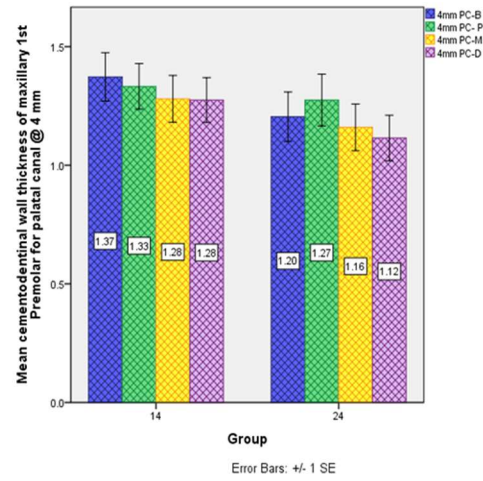


**Figure 2:** Cemento dentinal wall of palatal canal at 2mm from apex

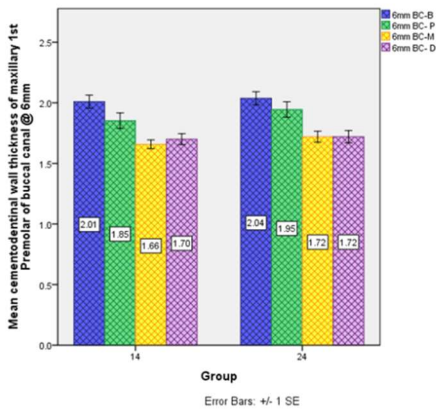




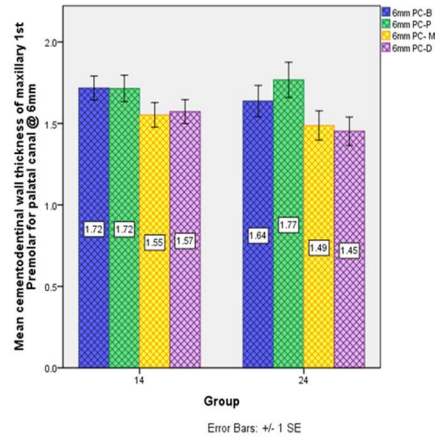
**Figure 3:** Cemento dental wall thickness of buccal canal at 4mm from apex



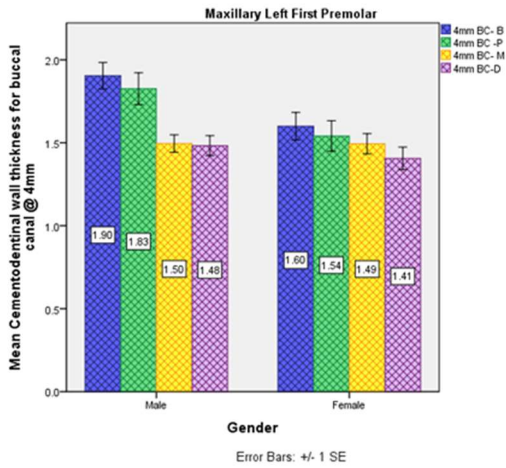
**Figure 4:** Cemento dental wall thickness of palatal canal at 4mm from apex



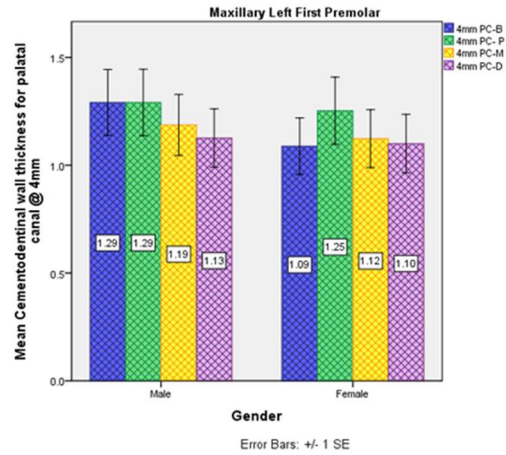
**Figure 5:** Cemento dental wall thickness of buccal canal at 6mm from apex



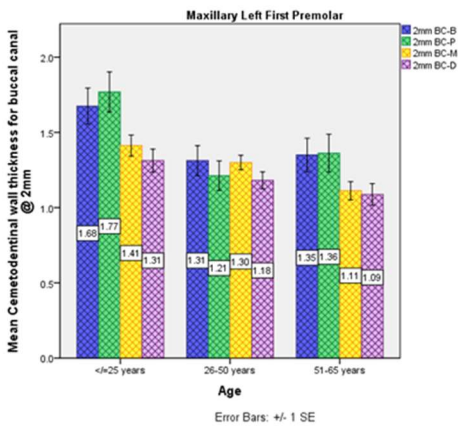
**Figure 6:** Cemento dental wall thickness of palatal canal at 6mm from apex



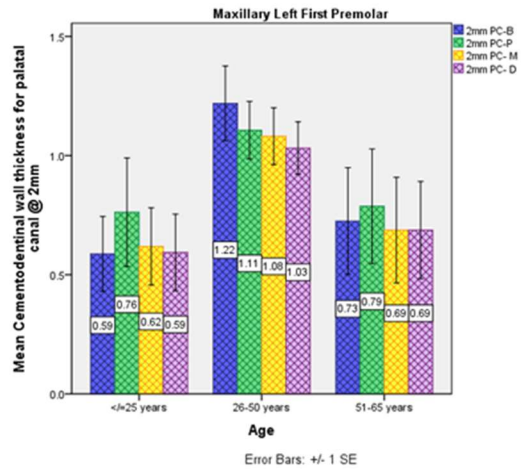
**Figure 7:** Cemento dentinal wall thickness buccal canal at 4mm from apex among and females



**Figure 8:** Cemento dentinal wall thickness of of palatal canal at 4mm from apex males among males and females



**Figure 9:** Cemento dentinal wall thickness of buccal canal from apex among apex different age groups



**Figure 10:** Cemento dentinal wall of of palatal canal at 2mm from among different age groups

### Important interpretations

- At all the levels 2mm,4mm and 6mm from the apex, in a buccal canal, buccal cemento dentinal wall was found to be the thickest and mesial wall was the thinnest. In the palatal canal, the buccal wall was thickest and the thinnest was the distal wall.
- It was statistically significant that in 14 teeth, at 2mm in the buccal canal, the mesial wall was the thinnest in all the samples.
- It was statistically significant that in 24 teeth, in the age group between 26 to 50 years, at 2mm level from the apex in both the canals, the buccal wall was thickest and the distal wall was thinnest.
- It was statistically significant that in 24 teeth, at 4mm level, in both the canals, the buccal wall was thickest in males compared to females.

### DISCUSSION:

The root canal morphology of each tooth is unique and it is of utmost importance to have complete knowledge of each tooth's internal anatomy[(Vertucci & Gegauff, 1979)]. The number of roots, number of canals that are present commonly is to be known. Also, the morphological variability of the individual teeth should be thoroughly known.

The tooth which shows high morphological variance is maxillary first premolar which complicates the treatments given to the tooth especially root canal treatment, presence of mesial concavity must be analyzed [(Fan et al., 2018)]. Incidences of three roots have also been reported in the literature, So enough knowledge in this regard must be obtained[(Borghesi et al., 2019)][(Agwan & Sheikh, 2016)]. Three rooted maxillary first premolars have also been reported by [(Beltes et al., 2017)]There can be difficulty in determining working length, cleaning, and shaping, irrigation, and disinfection especially the apical 3rd of the tooth. Unprepared root canal surfaces are very difficult to irrigate and disinfect, this can have an impact on the clinical performance of the involved tooth[(Siqueira Junior et al., 2018)]. Also, there is a need for proper obturation which becomes difficult in such cases[(Burkovski & Karl, 2019)]. This can ultimately lead to endodontic failure[(Alghamdi & Shakir, 2020)].

Our study was done to analyze the radicular and canalicular morphology of maxillary first premolar in the Chennai population using CBCT as a diagnostic tool. The cemento dentinal wall thickness at 2mm, 4mm, and 6mm from apex have been analyzed in both genders and among various age groups.

The majority of Maxillary First Premolar in a Chennai population presented two roots with two root canals, followed by one root with two root canals. The least common was a single-rooted tooth with a single canal three roots.

At the level of 2mm and 4mm from the apex, the thickest wall in the buccal canal was the buccal wall in both right and left maxillary first premolar and the thinnest wall was mesial wall



in right side and distal wall in left maxillary 1st premolar. In the palatal canal at 2mm from apex, the thickest wall was buccal wall in 14 tooth and palatal wall in 24 teeth. The thinnest wall at this level was distal wall.

At 6mm from the apex, the thickest wall in buccal canal was buccal and thinnest was mesial in 14 teeth and in 24, both the proximal surfaces were thin with the same thickness. In the palatal canal, the thickest was a palatal wall, the thinnest was mesial in 14 and distal in 24.

It was statistically significant that at 4mm from the apex, in the maxillary upper left premolar, the thickest wall was buccal wall in buccal canal, the thinnest was distal wall in both males and females. But in the palatal canal, the thickest wall was palatal wall and the thinnest being a distal wall in both genders. Males showed more thick cemento dentinal wall thickness compared to females at all the levels in both the canals.

Different age groups showed different morphological variance. In the age group of fewer than 25 years at the level, 2mm from the apex in both the canals, the thickest wall was a palatal wall and the thinnest being the distal wall. In the age group 26 to 50 years, at the level of 2mm from the apex, in both the canals, the thickest wall was buccal and thinnest being distal. In the age group of above 50 years, the thickest wall was palatal, thinnest distal at a level of 2mm from the apex in both the buccal and palatal canals.

The buccal and palatal walls were thick and the thinnest were the proximal walls through the entire analysis. Care must be taken to avoid perforation or transportation while working towards the proximal surfaces especially at the apical 3rd.

A similar study was conducted in the past in different geographical areas and among different populations. A number of roots and root canal configuration was studied in the Egyptian population [(Saber et al., 2019)]. In the Chinese population, the morphology of maxillary first premolar has been analyzed [(Liu et al., 2019) and also by [(Hu et al., 2016)]. A similar study was conducted in Spanish population by [(Abella et al., 2015; Hu et al., 2016)], Yemeni population by [(Senan et al., 2018)], Saudi population by [(Atieh, 2008)] in Jordanian population by [(Awawdeh et al., 2008)] and Israeli population by [(Kfir et al., 2020)].

In India also similar studies were conducted in different regions and states. Study was conducted among south Indian population [(Dinakar et al., 2018)], among the north Indian population [(Gupta et al., 2015)], Indo Dravidian population by [(Karunakaran et al., 2020)].

Aging changes to the root canal morphology of maxillary first premolars have been analyzed [(Hu et al., 2016)]. Changes in canal isthmus before and after instrumentation in maxillary first premolars have been studied [(Zhu et al., 2013)].

The results of our survey were in accordance with that obtained by [(Karunakaran et al., 2020)]. The most common presentation was two rooted teeth with two canals. The thickest cemento

dentinal walls were buccal and palatal, thinnest being the proximal walls. Care must be taken while instrumenting the proximal walls.

### **CONCLUSION:**

- The root morphology of the MFP is highly variable
- The majority of MFP in a Chennai population presented two roots with two root canals, followed by one root with two root canals. The least common was a single-rooted tooth with a single canal.
- At the level 2mm from the apex, in 14, the mesial wall was thinnest, and in 24 distal walls was thinnest. Care must be taken not to over-instrument the proximal walls to avoid perforations or fractures.
- CBCT can be considered as a useful diagnostic aid for studying the morphology of a tooth and its internal anatomy.

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### **Conflict of Interest:**

No conflict of interest declared.

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