Evaluation of Root Canal Morphology of Maxillary 2nd Premolars Using Cone Beam Computed Tomography in Chennai Population

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Abstract

Background: Using the CBCT, this technique has the ability to identify the root canal morphology as detailed as using the root canal staining and other clearing techniques that in the past have been of higher value to the other conventional techniques that can be implemented to give a three-dimensional perspective of the complete morphological details. With this, analysing the variation in root canal morphology of human maxillary second premolar between different gender in Chennai population can be done.

Methods:One hundred Cone Beam Computed Tomography (CBCT) images from different patients are selected randomly from Department of Oral Radiology of Saveetha Dental College and Hospital, India. All the CBCT images of patients are examined for the inclusion criteria in maxillary second premolars between different genders based on Vertucci classification. All root canal configurations of maxillary second premolars between different genders are investigated and compared withVertucci Classification.

Conclusion: Of all the 100 maxillary second premolars, the most common type of canal configuration for both the genders is Type I (41%), Type III (22%), and Type V (22%). In females, the most common type of canal configuration discovered is Type I (35%), Type III (63.6%) and Type V (83.3%). In males, the most common type of canal configuration determined is Type I (65%) and Type III (36.4%).

Keyword: *Root Canal Morphology, maxillary second premolar, Cone Beam Computed Tomography, Vertucci's classification.*

Introduction

An endodontic procedure can be deemed successful depending on the cleaning and shaping, the disinfection process and the filling of the root canal system. Each tooth has their own anatomical feature and if variations are present, it could pose as an important issue during a root canal treatment.[1] In cases when there are missing root canals, there could be a possibility of the presence of necrotic tissues and microorganisms. As time goes by, these microorganisms can proliferate and thus resulting in a periapical periodontitis. With that reason, clinicians should be aware of the complexity surrounding different root canal structures in order to provide proper treatment techniques and protocols allowing for an increase in the rate of success of the treatment. [2]

Premolars are generally considered as a challenging tooth when a root canal treatment is involved. For a

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maxillary first premolar, there could be either be two roots and two canals (56%) or one root with two canals (40%). In some studies, it was found that both maxillary and mandibular premolars more than often could have additional roots and canals.[3-7]Based on a study made by Vertucci and Gegauff, it was concluded that there were three root canals seen on approximately 5-6% of maxillary premolars. [6]On the other hand, a study made by Caliskan et al found that there was no three-seperate-rooted first maxillary premolars as a result. Second premolars will more than often have one roots with a single oval-shaped canal. [8]Based on a study made by Ok et al. it was established that one canal second maxillary premolars were seen in 59.7% of their cases while there were two canals in 40% of the cases and three canals in 0.30% of their cases. [9]Constant to this finding, Vertucci et al. even concluded that there was an incidence where there was 1% of three-rooted-plus-three-canal in second maxillary premolars. [10]

When the root canals are classified, various types of classification can be usedin which comprises of Weine, Vertucci and Gulabivala classifications. In describing the root canal morphology, Vertucci's classification is known to be the most commonly used classification and it comprises of eight categories: Type I (1), Type II (2-1), Type III (1-2-1), Type IV(2), Type V (1-2), Type VI (2-1-2), Type VII(1-2-1-2) and Type VIII(3).

In investigating the root canal anatomy of the tooth, various methods have been proposed which includes that of in vivo and in vitro methods. In vivo methods comprise of the basic clinical evaluation of the root canal treatment, the retrospective assessment of the patient records, any conventional radiographic evaluation, and advanced radiographic techniques like cone-beam computed tomography (CBCT).[11-13] In vitro methods comprise of the root canal staining and tooth clearing,[14,15] root sectioning, microscopic examination, examination of conventional radiographs and using three-dimensional modalities such as microcomputed tomography.[16,17,18]

Using the CBCT, this technique has the ability to identify the root canal morphology as detailed as using the root canal staining and other clearing techniques that in the past have been of higher value to the other conventional techniques that can be implemented to give a three-dimensional perspective of the complete morphological details.[2]

With these in mind, the purpose of this study is to analyse the variation in root canal morphology of human maxillary second premolar between different gender in Chennai population.

Materials and Methods

One hundred CBCT images of Saveetha Dental College patients (53 females and 47 males) which are aged between 16-60 years old, with an average of 45 years, whom were seeking the routine dental diagnosis for further dental treatment. These patients were referred to the Radiology Department of Saveetha Dental College between the years 2017-2018.

The samples that were collected and analysed were purposive where at the very least there was either one maxillary second premolar with fully developed roots; which was taken as the inclusion criteria. When determining which samples to examine, unclear or distorted CBCT images, beforehand endodontically initiated or treated teeth, teeth with posts or crowns, periapical lesions, and any physiological or pathological process such as immature apex was excluded. The final sample that was collected was 100 including both right and left second maxillary premolars, was further screened for the number of roots and root canal configuration. The total data observed and collected were then evaluated and classified under Vertucci's classification. Other additional data that was collected also included the number of canals, the distance between the occlusal pit to the pulp chamber, the distance between pulp floor to the furcation as well as the distance between the CEJ to the pulp chamber. The genders of each patients were also recorded in order to be analysed.

The collected CBCT samples were retrieved and assessed at the Radiology Department of Saveetha Dental College, Chennai using the Galileo software used for viewing the CBCT that are taken.

Results and Discussion

The results of the study are presented in Tables 1-5 and the overall data has been graphically represented in Graph 1. Based on Table 1, of all the 100 maxillary second premolars, the most common type of canal configuration for both the genders is Type I (41%), Type III (22%), and Type V (22%). In females, the most common type of canal configuration discovered is Type I (35%), Type III (63.6%) and Type V (83.3%). In males, the most common type of canal configuration determined is Type I (65%) and Type III (36.4%).

Table 1 : Root Canal Configuration

		Type I (1)	Type II (2-1)	Type III (1-2-1)	Type IV (2)	Type V (1-2)	Type VI (2-1-2)	Type VII (1-2-1-2)	Type VIII (3)	Total
	Women	14 (35%)	4 (50%)	14 (63.6%)	2 (66.7%)	18 (83.3%)	0 (0%)	1 (50%)	0 (0%)	53 (100%)
Frequency (%)	Men	27 (65%)	5 (50%)	8 (36.4%)	1 (33.3%)	4 (16.7%)	0 (0%)	1 (50%)	1 (100%)	47 (100%)
	Total	41 (41%)	9 (9%)	22 (22%)	3 (3%)	22 (22%)	0 (0%)	2 (2%)	1 (1%)	100 (100%)

Based on Table 2, when the number of canals for each tooth were evaluated, female patients showed a mean value of 1.708 with a standard deviation of 0.470 while in male patients, the mean value is 1.888 with the standard deviation of 0.471. When both the genders were compared in terms of the number of canals, there was no significant difference (p-value: 0.9835).

Table 2: Number of Canals

Gender	N	Mean	Standard Deviation	Test of Significance	Degree of freedom	Sig. (2-tailed)
NO. OF CANALS						
Female	53	1.708	0.470	0.05912	95	0.9835
Male	47	1.888	0.471			

Based on table 3, when the distance between the occlusal pit and the pulp chamber was analysed and recorded, female patient showed a mean value of 3.706 with a standard deviation of 0.744 while in male patients, the mean value is 3.963 with a standard deviation is 0.840. With the p-value calculated, it was found that there was no significant difference between the genders

in terms of the distance between the occlusal pit to the pulp chamber (p-value: 0.3950).

Table 3: Distance between Pulp Floor to the Furcation

Gender	N	Mean	Standard Deviation	Test of Significance	Degree of freedom	Sig. (2-tailed)
DISTANCE BETWEEN OCCLUSAL PIT & PULP CHAMBER						
Female	53	3.706	0.744	0.1079	95	0.3950
Male	47	3.963	0.840			

Based on the table 4, out of all 100 samples, there was in total 42 (15 females and 27 males) second maxillary premolars that has two roots. In female patients, the mean value that was gathered was 4.835 with a standard deviation of 2.114 while in male patients, the mean value is 3.243 with a standard deviation of 0.518. Overall, there is a significant difference between the two genders (p-value: <0.0000001).

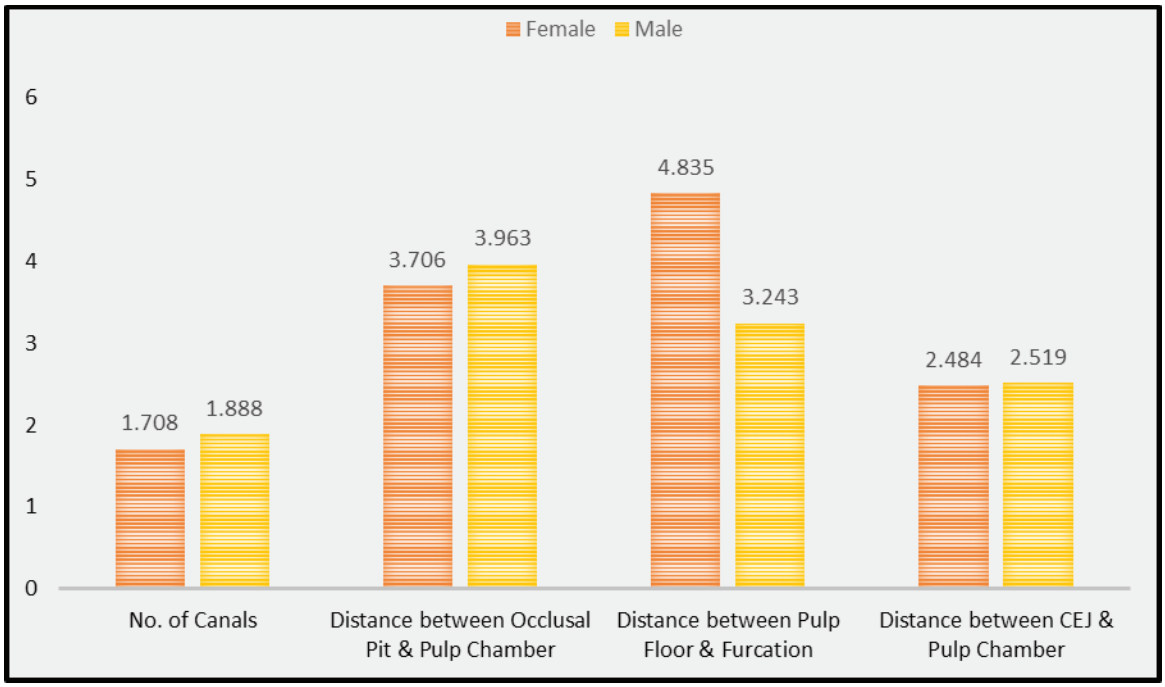
Table 4: Distance between the Pulp Floor to the Furcation

Gender	N	Mean	Standard Deviation	Test of Significance	Degree of freedom	Sig. (2-tailed)
DISTANCE BETWEEN PULP FLOOR TO FURCATION						
Female	15	4.835	2.114	0.0005611	95	<0.0000001
Male	27	3.243	0.518			

Based on the table 5, in regard to the distance between the CEJ to the pulp chamber, the female patients have a mean value of 2.484 with a standard deviation of 0.396 while in male patients, the mean value is 2.519 with a standard deviation of 0.547. Overall, when the two genders were compared, the distance between the CEJ to the pulp chamber showed a significant difference (p-value: 0.02465).

Table 5: Distance between the CEJ to the Pulp Chamber

Gender	N	Mean	Standard Deviation	Test of Significance	Degree of freedom	Sig. (2-tailed)
DISTANCE BETWEEN CEJ TO PULP CHAMBER						
Female	53	2.484	0.396	0.7126	95	0.02465
Male	47	2.519	0.547			



Graph 1: Overall Tabulated Data

To achieve a successful treatment in endodontics, a proper comprehension of both the root canal anatomy and the morphology is of outmost importance. A proper endodontic treatment involves procedures where all the canals are properly debrided, disinfected, shaped and obturated completely. [19]When an endodontist come across failures in an endodontic treatment, the main cause to this is either because of an untreated canal, incomplete debridement or incomplete obturation. [8] Because of these possible scenarios, a cautious clinical and radiographical examination should be of importance and essential criteria for a successful prognosis. [1]

Anotherstudy that was done presented an intricate investigation on the root canal morphology of maxillary second premolars in Chennai population using Cone Beam Computed Tomography (CBCT). With various techniques being introduced and used till this day for the purpose of assessing the root canal morphology and configuration like macroscopic sections, transparent samples and polyester resin impressions,[1] CBCT is considered as the most excellent technique for a proper three-dimensional assessment of the root canal morphology.[20]

Overall, there are various studies that have attempted to fully investigate the root canal morphology and the root numbers of the maxillary second premolar. In terms of the number of canals present in the maxillary second premolar, a study that was made by Pineda and Kuttler[21]showed that there was one canal in 55% of the obtained sample while there were two canals in 45% of the total samples. Vertucci et al, on the other hand discovered that 48 of the maxillary second premolars have one canal while there were two canals in 51 of the premolars and three canals in 1 premolar. [6]Similar to the latter study, a study made by Bellizi and Hartwell reported that there were 40.3% of premolars that have one canal while 58.6% have been discovered to have two canals and 1.1% have three canals. [22]

In regard to the root canal configurations based upon Vertucci's classification, in the Turkish population,it was reported that the most common type of canal configuration is Type IV (60%) and Type I (38%). On the other hand, in females, the most common type of canal configuration is Type IV (63%) and Type V (34%). Based upon a study made by Ok et al. on the

Turkish population, for the maxillary second premolar, the frequency of canals is that of one canal (59.7%) and Type I (54.5%) of Vertucci's root canal configuration. [9](PM 1). Comparing these studies to a study made by Abella et al. the most frequently seen canal configuration if of Type I (47.2%); which is seen in the Spanish population. [23]Additionally, in the Pakistani population, commonly there were 84% of premolars that were single rooted with a Type I (53.4%) canal configuration.[24]

In the current study that was made, out of all the 100 maxillary second premolars, the most common type of canal configuration for both the genders is Type I (41%), Type III (22%), and Type V (22%). In females, the most common type of canal configuration discovered is Type I (35%), Type III (63.6%) and Type V (83.3%). In males, the most common type of canal configuration determined is Type I (65%) and Type III (36.4%).

In terms of the number of canals, female patients showed a mean value of 1.708 with a standard deviation of 0.470 while in male patients, the mean value is 1.888 with the standard deviation of 0.471. When both the genders were compared in terms of the number of canals, there was no significant difference (p-value: 0.9835). These results are consistent with our study.

Conclusion

Within the limited number of samples available, it is proven that the Chennai population have maxillary second premolars with a root canal morphology of one canal and a Type I Vertucci's classification. In addition to that, there some instances when there is more than one root with various canal configurations that have been identified. In order for a proper generalization of results to be produced, future studies should include even larger sample sizes.

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