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# Root Canal Morphology of Mandibular Second Molars Using CBCT

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## Abstract

**Background:** A thorough knowledge of root canal system, anatomy and variation in morphological plays an important role in all scopes of endodontic treatment. The practitioner should have a great understanding of the detailed morphological anatomy of root canal system in order to utilize the proper technique and method during the endodontic treatment especially in mandibular second molar.

**Aim:** To evaluate root canal morphology of mandibular second molars using Cone Beam Computed Tomography (CBCT) in Chennai Population based on Vertucci's classification.

**Materials and Method:** The CBCT scans of patient age between 20 years to 40 years were retrieved from Department of Oral Medicine and Radiology, Saveetha Dental College, Chennai, India from September 2018 to January 2019. The teeth were observed for the root canals system using Vertucci classification, and other parameters. The comparison between males and female were made.

**Results:** Generally the parameter values are more in females when compared to males and the most prevalence root canal configuration are Type 4, followed by Type 2 in mesial and distal roots for both gender.

**Conclusion:** The study indicates the significant values to certain extendand can serve as aids to utilize the proper technique and method during the endodontic treatment especially in permanent mandibular second molar.

***Key words:*** *Root canal; Morphology; Second Mandibular Molar; CBCT; Chennai population*

## Introduction

A thorough knowledge of root canal system, anatomy and variation in morphological plays an important role in all scopes of endodontic treatment. The practitioner should have a great understanding of the detailed morphological anatomy of root canal system in order to utilize the proper technique and method during the endodontic treatment. The proper technique of the treatment will increase the success rate of the treatment.[1]

The anatomical variations of the root canal morphology are the most important aspect in the endodontic treatment.[2] The untreated missing root canal may lead to the abnormal pain caused by the contamination of microorganism colonies and production of necrotic tissue inside the canal. These condition will lead to the apical pathosis development.[3]

The study of the root canal anatomy and their variations has been reported in various research articles from the past and more recent update. Hence, it is show the importance of the morphology of root canals which dictates the final results of the root canal procedures.[5]

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Few types of root canal system morphology has been proposed by various authors. The different root canal systems classification of human permanent including the Weine's classification, Vertucci's classification, and Gulabivala classifications. Vertucci's classification is considered the most widely used and includes 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 (1-2-12), and Type VIII (3). [5, 6]

The methods that have been utilized to investigate the root canal system morphology can be divided into in vitro and in vivo methods. Methods in the in-vivo consist of clinical evaluation during root canal treatment, retrospective examination of patient records, conventional assessment of radiographic imaging, and advanced radiographic techniques such as CBCT. The methods in the in-vitro are canal staining and tooth clearing, root sectioning, microscopic examination, examination of conventional radiographs, and using three-dimensional modalities such as microcomputed tomography.[7]

The CBCT methods has the ability to examined and precise detection of root canal morphology same as the root canal staining and the clearing techniques, which in the past were considered as the advanced to conventional methods of studying root canal system because its ability to shows 3-dimensional views and details on complete morphologic.[8]

The CT application in the endodontic treatment had been reported at earliest by Tachibana and Matsumoto in 1990.[9] The advantage of CT is can shows the 3-dimensional views and facilitates the root canal system reconstruction. The recent introduction of CBCT has provide dentistry with advanced practical. The CBCT is a practical radiographic tools which is less invasive and provide 3D reconstruction imaging that can be used in endodontic and morphologic study.[10, 11]

The advantages of CBCT compared to the conventional radiography and tomography are its sub-millimeter resolution, 3D image view reconstruction, superimposed structures removal, showing normal anatomy and morphology of the root canalsystem without additional exposure, and more sensitive in supplemental detection of canals than radiographic images.[12, 13] CBCT also provide radiographic imaging of root canal morphology with excellent resolution than those obtained by normal conventional radiographs with lower cost and lower dose compared to conventional CT.[7]

The aim of this present cross-section study was to evaluate root canal morphology of mandibular second molars using CBCT in Chennai Population based on Vertucci's classification

## Materials and Method

All the mandibular CBCT scans taken at the Department of Oral Medicine and Radiology, Saveetha Institute of Medical and Technical Sciences, Chennai, India from September 2018 to January 2019 were reviewed. The CBCT scans from the department were taken from patients who were indicated for the evaluation of mandibular impacted third molars, orthodontic treatment, assessment of pre-implant and post-implant procedure, root calcifications, and non-specied reasons were included in the study. The CBCT scans were taken from the hospital data system and were stored and converted to the software that integrated for viewing and assessing. In this current research, the Galileos Viewer 1.9 was used for diagnostic and assessment purposes.

The study included of all CBCT scans with adequate quality for diagnostics, void of artifacts and showing full erupted permanent second molars without any periapical lesion. The age of patients are between 20 years to 40 years, with 50 teeth examined from males and 33 teeth examined from females. The study had excluded few teeth conditions such as incomplete formation of root, drifted of permanent third molars to the mesial position of second molars, teeth with generalized disorder, open apices of root canals, resorption and calcification of second mandibular molars with root canal fillings and posts and crown restoration teeth.

The radiographic images generated by CBCT were processed and analysed for these parameters of current research. The pattern of the root canals was evaluated and classified according to Vertucci's classification shown in Figure 1. There are 6 types of root canals system based on Vertucci's classification. The types of root canals system was observed in mesial and distal roots of the mandibular second molars. The mesial and distal root length, the distance between occlusal pit and pulp chamber, the distance between pulp floor to furcation, were observed by using the digital system. Later, the the descriptive analysis of all parameters were analysed in term of mean values, standard deviation and their significance of result. The comparison between descriptive values were done between males and females.

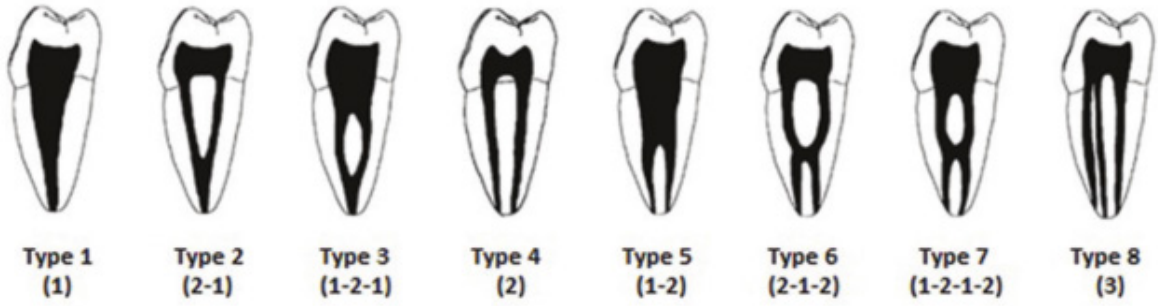


**Figure 1: Vertucci's Classification of root canal system**

## Result

A total of 83 teeth were examined by the using the CBCT scans in the current study. Out of the total, 28 are males 22 are females. The result for both genders can be seen as mean value and standard deviation, p-values and its significance of result. The p-value less than 0.5 shown the significant value.

The descriptive analysis of permanent mandibular second molar root canal types in males can be seen in Table 1. Out of 50 teeth examined and assessed, the most common root canal morphology in males are Type 1 and Type 4 morphology, which are 46% and 20% respectively. Both Type 1 and Type 4 are dominant in the mesial root and distal root of mandibular second molar. There are no finding of Type 7 and Type 8 during the examination in mesial roots and distal roots.

In females, out of 33 mandibular second molar teeth examined and assessed, the descriptive analysis of root canal types shown that Type 1 and Type 4 are the most dominant root morphology in distal roots and mesial roots with total percentage of 53% and 19.6% respectively [Table 2].

The result of the descriptive analysis of mesial root length for permanent mandibular second molar in males and females are shown in Table 3. The mean value of mesial length for males is 11.9468mm meanwhile for females is 12.6313mm. This shown that females having longer length of mesial roots compared to males. Both the values collected from males and females sample having significant value of p-value.

The result of the descriptive analysis of distal root length for permanent mandibular second molar in males and females are shown in Table 4. The mean value of distal root length for males is 11.1636mm meanwhile for females is 11.8147mm. This shown that females having longer length of distal roots compared to males. Both the values collected from males and females sample having significant value of p-value which are less than 0.5.

The result of the descriptive analysis of distance between occlusal pit and pulp chamber for permanent mandibular second molar in males and females are shown in Table 5. The mean value of distance between occlusal pit and pulp chamber for males is 4.165mm meanwhile for females is 4.262mm. This shown that females having more distance between occlusal pit and pulp compared to males. Both the values collected from males and females sample having significant value of p-value which are less than 0.5.

The result of the descriptive analysis of distance between pulp floor to furcation for permanent mandibular second molar in males and females are shown in Table 6. The mean value of distance between pulp floor to furcation for males is 2.5977mm meanwhile for females is 2.5993mm. This shown that there is no significant differences between males and females for distance between occlusal pit and pulp. The standard deviation between both genders also shown slight differences. Both the values collected from males and females sample having significant value of p-value which are less than 0.5.

**Table 1: The result of the descriptive analysis of permanent mandibular second molar root canal types in males**

| Type | Mesial Root, n (%) | Distal root, n (%) | Total, n (%) |
|---|---|---|---|
| Type 1 | 21 (21%) | 25 (25%) | 46 (46%) |
| Type 2 | 8 (8%) | 5 (5%) | 13 (13%) |
| Type 3 | 5 (5%) | 5 (5%) | 10 (10%) |
| Type 4 | 10 (10%) | 10 (10%) | 20 (20%) |
| Type 5 | 4 (4%) | 4 (4%) | 8 (8%) |
| Type 6 | 2 (2%) | 1 (1%) | 3 (3%) |
| Type 7 | 0 | 0 | 0 |
| Type 8 | 0 | 0 | 0 |

**Table 2: The result of the descriptive analysis of permanent mandibular second molar root canal types in females**

| Type | Mesial Root, n (%) | Distal root, n (%) | Total, n (%) |
|---|---|---|---|
| Type 1 | 13 (19.6%) | 22 (33.3%) | 35 (53%) |
| Type 2 | 5 (7.6%) | 1 (1.5%) | 6 (9.1%) |
| Type 3 | 3 (4.5%) | 2 (3%) | 5 (7.6%) |
| Type 4 | 7 (10.6%) | 6 (9%) | 13 (19.6%) |
| Type 5 | 2 (3%) | 2 (3%) | 4 (6.1%) |
| Type 6 | 3 (4.5%) | 0 | 3 (4.5%) |
| Type 7 | 0 | 0 | 0 |
| Type 8 | 0 | 0 | 0 |

**Table 3: The result of the descriptive analysis of mesial root length for permanent mandibular second molar in males and females**

| Gender | N | Mean value (mm) | Standard deviation | Test of Significance | Degree of freedom | P-value | Significance |
|---|---|---|---|---|---|---|---|
| Male | 50 | 11.9468 | 1.1046 | 4.020331 | 95 | 0.000619 | Significant |
| Female | 33 | 12.6313 | 1.3506 | 4.831118 | 95 | 0.00022 | Significant |

**Table 4: The result of the descriptive analysis of distal root length for permanent mandibular second molar in males and females**

| Gender | N | Mean value (mm) | Standard deviation | Test of Significance | Degree of freedom | P-value | Significance |
|---|---|---|---|---|---|---|---|
| Male | 50 | 11.1636 | 1.679 | -2.336465 | 95 | 0.029457 | Significant |
| Female | 33 | 11.8147 | 2.4361 | 2.885045 | 95 | 0.011991 | Significant |

**Table 5: The result of the descriptive analysis of distance between occlusal pit and pulp chamber for permanent mandibular second molar in males and females**

| Gender | N | Mean value (mm) | Standard deviation | Test of Significance | Degree of freedom | P-value | Significance |
|---|---|---|---|---|---|---|---|
| Male | 50 | 4.165 | 0.834 | 4.02137 | 95 | 0.000617 | Significant |
| Female | 33 | 4.262 | 1.0154 | 2.906381 | 95 | 0.011496 | Significant |

**Table 6: The result of the descriptive analysis of distance between pulp floor to furcation for permanent mandibular second molar in males and females**

| Gender | N | Mean value (mm) | Standard deviation | Test of Significance | Degree of freedom | P-value | Significance |
|---|---|---|---|---|---|---|---|
| Male | 50 | 2.5977 | 0.5795 | 4.838027 | 95 | 0.000088 | Significant |
| Female | 33 | 2.5993 | 0.5756 | 4.032468 | 95 | 0 .001235 | Significant |

## Discussion

The study of the root canal morphology of mandibular second molars using CBCT had been studied in various research papers previously. The CBCT is a practical radiographic tools which is less invasive and provide 3D reconstruction imaging that can be used in endodontic and morphologic study.[14]

In the current study in Chennai population, 83 permanent mandibular second molars were examined and assessed by using CBCT. In this study, Type 4 and Type 2 root canals configuration was the most common in mesial and distal roots, both males and females. The finding of this current study is consistent with other research result in few previous studies.

The study done in 850 south-eastern Turkish population by Bil Gulsum Nur et al. shown that Type 4 configuration was the most prevalent which were 89% in females and 93% in males for mesial roots. Type 4 canal configuration was the most common in the mesial roots, whereas type 1 canal configuration was the most common in the distal roots. Moreover, type 2, type 3, and type 5 canal configurations were also observed in mesial and distal roots, and the incidences of varying root canal configurations did not statistically differ between females and males with p-valued more than 0.05 ($P>0.05$), with the exception being the mesial canal of the left mandibular second molars with its p-values less than 0.05 ($P<0.05$).[15]

The study done by Zaatar et al. and al-Nazhan et al. shown that type 2 were the most common root canals configuration followed by Type 4 configuration. In their studies, only one female patient had a Type 8 root canal configuration in the mesial root. [3, 16]

The present study shown the contrast with the previous study done by Vertucci and Williams in a Caucasian population. In their studies, they observed Type 1 as the most common root canal configuration in both males and females for mandibular permanent second molars.[17]

In the previous study by Marwan et al. between 2005 and 2007 where he investigated four hundred and thirty-six mandibular molars in an Egyptian Ismailia population shown that most common root canals configuration of mandibular second molars was Type 2 (57.71%) in the mesial roots and Type 1 (95.02%) in distal roots. He also concluded that there are not gender roles in determination of any root canals configuration.[18]

The study by Gulabivana et al. in 2002 in Mongoloid traits shown the same results as in the Korean population. The author had concluded that the root and canal morphology of mandibular second molars also can be used in tracing the racial origins of populations.[20]

In the current study, there are few limitations that may affect the precision of result in an evaluation of root canal morphology of mandibular second molars by using CBCT. The specific technique and methods need to be used during the handling of CBCT software. Technical defect may contribute in wrong evaluation of canal configuration.

## Conclusion

The study concluded that the root canal morphology of mandibular second molars using CBCT in Chennai Population based on Vertucci's classification shows significant result in certain extend. . There is a significant difference which can be differentiated between the genders. Generally the parameter values are more in females when compared to males and the most prevalence root canal configuration are Type 4, followed by Type 2 in both gender. Therefore the study indicates that the study can serve as aids to utilize the proper technique and method during the endodontic treatment especially in permanent mandibular second molar.

**Ethical Clearance**- All datas are taken from examination of outpatients of Saveetha Dental College and Hospital

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**Conflict of Interest** - Nil

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