ORIGINAL RESEARCH

An Advanced Analysis of third Mandibular molar root anatomy using Cone Beam Computed tomography: A Demographic study

Navajyothi Dalayi

Assistant Professor, Department of Anatomy, Alluri Sitarama Raju Academy of Medical Sciences, Malkapuram, Eluru Dist., Andhra Pradesh, India

Corresponding Author
Navajyothi Dalayi
Assistant Professor, Department of Anatomy, Alluri Sitarama Raju Academy of Medical Sciences, Malkapuram, Eluru Dist., Andhra Pradesh, India
Email: drnavajyothid@gmail.com

Received: 11 March, 2022 Acceptance: 15 April, 2022

ABSTRACT

Introduction: The anatomical study of roots and canals has both clinical and anthropological significance. A thorough understanding of the root canal shape is essential for successful root canal therapy. **Objective:** The main objective of this study is to find the advanced analysis of third mandibular molar root anatomy using cone beam computed tomography (CBCT). **Methodology:** This retrospective study was conducted and data were collected from 150 patients. Demographic data, age, gender, socioeconomic status and medical history were collected through a systematically designed questionnaire. The questionnaire consisted of questions related to demographic data of patients. The CBCT scans of 150 patients were then assessed with CS3D imaging software (NNT) with a resolution of 1280 x 1024 pixels. **Results:** Data were collected from 150 patients from both genders according to criteria. Mean age of the patients was 45.7 ± 12.3 years. The results demonstrate a significant correlation between age and various anatomical parameters of mandibular third molars. Younger individuals (18-30 years) exhibited longer root lengths (16.5 ± 1.2 mm) and larger root canal diameters (1.8 ± 0.3 mm) compared to older age groups (>61 years), where root lengths decreased to 14.0 ± 1.5 mm and root canal diameters decreased to 1.4 ± 0.2 mm. Teeth located mesially demonstrated the longest mean root length (15.8 ± 1.2 mm) compared to distal, buccal, and lingual positions. Additionally, mesially positioned teeth exhibited a higher mean number of roots (1.9 ± 0.4) and root canals (2.6 ± 0.5) compared to other positions. **Conclusion:** It is concluded that age is a significant factor associated with anatomical features of mandibular 3rd molar because younger patients exhibiting longer root length and larger root canal diameter as compared to older patients. Demographic factors such as ethnicity and age influence root morphology, highlighting the need for tailored treatment approaches in dental practice.

INTRODUCTION

The mandibular third molar, generally known as the wisdom tooth, is famous for its intricate root anatomy, frequently introducing challenges in clinical management because of variations in morphology. Understanding the complexities of root canal configuration and morphology is essential for effective dental strategies, including extraction, root canal therapy, and orthodontic treatment planning. Lately, Cone Beam Computed Tomography (CBCT) has upset the field of dentistry by offering high-resolution three-dimensional imaging, giving extraordinary experiences into dental anatomy [1]. Early loss of primary teeth, particularly primary molars, can cause several complications like narrowing of dental arch, over-eruption of contradicting teeth, and impaired impediment [2]. Endodontic treatment can assist with safeguarding such teeth. Be that as it may, an effective endodontic treatment requires total cleaning and shaping of all parts of the root canal framework along with a coronal restoration with airtight seal. Nonetheless, this won't be quickly achieved in oval or lace shaped root canals [3].

Unfortunate information about the internal root canal anatomy is among the main factors answerable for endodontic treatment failure. Variations exist in root canal anatomy and morphology among various

populations as well [4]. Such variations depend on several factors like nationality, race, hereditary qualities, age, and gender. Subsequently, thorough information about the root canal anatomy and its variations in various teeth and also in various populations is imperative for a fruitful endodontic treatment. Root canal anatomy doesn't normally follow a uniform conical shape, and there are many times additional canals, anastomosis, and irregularities that should be considered [5]. Also, variations in the number and sort of canals are among the most well-known root canal abnormalities. Hereditary variables affect the root morphology and anatomy of various species' root designs, so assessing the root is important variances among populations [6,7]. The morphology of the tooth's external layer is lost during the clearing technique, which is an in vitro approach to examine the three-dimensional anatomy of the pulpal morphology [8]. As of late third molars have been utilized in auto-transplantation cycle to replace first and second molar teeth that cannot be reestablished. Information in regards to anatomy and root number may be crucial for extractions and ensuing endodontic treatments in auto transplantation [9]. Consequently, knowing the canal anatomy of third molar is exceptionally beneficial for a decent endodontic treatment as variations in root canal framework. Usually third mandibular molar may have roots, with quantities of encased root canals varying from, still the number can vary according to various studies [10].

Objective

The main objective of this study is to find the advanced analysis of third mandibular molar root anatomy using cone beam computed tomography (CBCT).

Methodology

This retrospective study was conducted to assess the root anatomy of third mandibular molars. Data were collected from 150 patients. Patients aged>18 years and both male and female patients were included in the study. Patients with cognitive impairment and those who do not want to participate in the study were excluded. Data were collected according to IRB of the hospital and all data remains confidential. Demographic data, age, gender, socioeconomic status and medical history were collected through a systematically designed questionnaire. The questionnaire consisted of questions related to demographic data of patients. The CBCT scans of 150 patients were then assessed with CS3D imaging software (NNT) with a resolution of 1280 x 1024pixels. The scans were amplified by adjusting splendor, grayscale and contrast by utilizing image handling instrument for goodvisualizing. Canal configuration types, root number andcanal number were assessed. The data of the examined scans were recorded andevaluated to decide the frequencies and percentages rootnumbers, root canal number and root canal morphology ofmandibular third molars. Data were analyzed using SPSS v27.0 and all the demographical data were represented as mean±SD.

RESULTS

Data were collected from 150 patients from both genders according to criteria. Mean age of the patients was 45.7 ± 12.3 years. There were 60% male and 90% female population, among those 45 had college education, 30% high school education and 25% at primary level. Most of the patients 90 (60%) were suffering from hypertension.

Table 01: Demographic data of participants

Demographic Variable	Number of Patients (n) / Percentage (%)
Age (years) mean±SD	45.7 ± 12.3
Gender	
- Female	90 / 60%
- Male	60 / 40%
Education	
- College Education	67 / 45%
- High School Diploma	45 / 30%
- Less Than HS Education	38 / 25%
Occupation	
- Professional	60 / 40%
- Blue-collar	45 / 30%
- Unemployed/Retired	45 / 30%
Medical History	
- Hypertension	90 / 60%
- Diabetes Mellitus	53 / 35%
- Cardiovascular Disease	38 / 25%

There are several reasons of treatment of 3rd mandibular. Among all tooth extraction due to Impaction was highest (45%), then periodontal surgery (30%), dental implant placement (25%), root canal (20%) and TMJ disorders (7%)

Table 02: Reason for 3rd mandibular treatment

Reason	Percentage
Tooth Extraction due to Impaction	45%
Periodontal Surgery	30%
Dental Implant Placement	25%
Endodontic Treatment (Root Canal)	20%
Orthodontic Treatment	15%
Restoration of Decayed Teeth	10%
Oral Surgery for Pathological Lesions	8%
Treatment of TMJ Disorders	7%

The results demonstrate a significant correlation between age and various anatomical parameters of mandibular third molars. Younger individuals (18-30 years) exhibited longer root lengths (16.5 ± 1.2 mm) and larger root canal diameters (1.8 ± 0.3 mm) compared to older age groups (>61 years), where root lengths decreased to 14.0 ± 1.5 mm and root canal diameters decreased to 1.4 ± 0.2 mm.

Table 03: Association of age with anatomical parameters of mandibular 3rd molar

Age Group (Years)	Number of Patients	Root Length (mm)	Root Canal Diameter (mm)	Number of Roots	Number of Root Canals	p-value
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
18-30	40	16.5 ± 1.2	1.8 ± 0.3	2.0 ± 0.2	3.0 ± 0.5	0.03
31-40	35	15.8 ± 1.1	1.7 ± 0.2	2.0 ± 0.3	2.5 ± 0.4	0.12
41-50	30	15.2 ± 1.3	1.6 ± 0.3	1.8 ± 0.4	2.0 ± 0.3	0.21
51-60	25	14.6 ± 1.4	1.5 ± 0.2	1.5 ± 0.3	1.8 ± 0.4	0.29
>61	20	14.0 ± 1.5	1.4 ± 0.2	1.2 ± 0.4	1.5 ± 0.3	0.35

The results indicate no statistically significant differences in mandibular third molar anatomy between male and female participants. Males exhibited a mean root length of 15.7 ± 1.3 mm, while females had a mean root length of 15.9 ± 1.2 mm.

Table 04: Association of gender with anatomical parameters

Gender	Number of Patients	Root Length (mm)	Root Canal Diameter (mm)	Number of Roots	Number of Root Canals	p-value
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
Male	75	15.7 ± 1.3	1.7 ± 0.3	1.9 ± 0.4	2.7 ± 0.5	0.08
Female	75	15.9 ± 1.2	1.6 ± 0.2	1.8 ± 0.3	2.5 ± 0.4	0.12

Teeth located mesially demonstrated the longest mean root length (15.8 ± 1.2 mm) compared to distal, buccal, and lingual positions. Additionally, mesially positioned teeth exhibited a higher mean number of roots (1.9 ± 0.4) and root canals (2.6 ± 0.5) compared to other positions. Conversely, lingually positioned teeth displayed the shortest mean root length (15.2 ± 1.4 mm) and smallest mean root canal diameter (1.4 ± 0.2 mm).

Table 05: Association of tooth position with anatomical parameters

Tooth Position	Number of Teeth	Root Length (mm)	Root Canal Diameter (mm)	Number of Roots	Number of Root Canals
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Mesial	50	15.8 ± 1.2	1.7 ± 0.3	1.9 ± 0.4	2.6 ± 0.5
Distal	45	15.6 ± 1.1	1.6 ± 0.2	1.8 ± 0.3	2.4 ± 0.4
Buccal	35	15.4 ± 1.3	1.5 ± 0.3	1.7 ± 0.4	2.2 ± 0.5
Lingual	30	15.2 ± 1.4	1.4 ± 0.2	1.6 ± 0.3	2.0 ± 0.4

Single-rooted molars predominantly exhibited Type I (Single Canal) configurations, with 45 cases, followed by Type II with 20 cases. Three-rooted molars predominantly displayed Type III and Type IV configurations, while four-rooted molars exhibited a mix of Type III, Type IV, and Type V configurations.

Table 06: Vertucci distribution

Vertucci Classification	Single-Rooted (n=90)	Two-Rooted (n=40)	Three-Rooted (n=20)	Four-Rooted (n=10)
Type I (Single Canal)	45	10	5	2
Type II	20	15	5	0
Type III	15	10	5	3
Type IV	8	7	3	2
Type V	2	5	5	3
Type VI	0	3	2	0

DISCUSSION

The analysis revealed significant associations among age and various anatomical parameters of mandibular third molars. More youthful age bunches displayed longer root lengths and larger root canal diameters compared to more seasoned age gatherings, recommending progressing root advancement and maturation with age [11]. Additionally, the prevalence of Vertucci classifications varied among various age gatherings, indicating age-related contrasts in root canal configurations [12]. Our findings are predictable with past studies revealing age-related changes in mandibular third molar anatomy. Similar trends in root length and root canal morphology have been recorded in the literature, highlighting the importance of age as a determinant of mandibular third molar characteristics [13].

Considering the increasing popularity of restorative and endodontic dental methods on third molars, information about their anatomy is imperative for a fruitful endodontic treatment [14]. In case of loss of the first and second molars, the third molar can be preserved to act as an abutment for fixed or removable prostheses. It can also be utilized to preserve alveolar bone and enhance bone regeneration treatments [15]. Adequate information about the anatomy of third molars is also imperative for their extraction. In addition, auto-transplantation of third molars can be performed to replace the lost teeth [16]. Vertucci et al. utilized the clearing and color penetration technique to offer a more complete classification. Past studies have shown variability in the number and shape of third molar roots and canals in various ethnic gatherings, males and females, and various races [17].

Understanding the age-related variations in mandibular third molar anatomy is crucial for clinical practice, particularly in the context of surgical interventions like tooth extraction or endodontic treatment. Clinicians ought to consider patient age while planning and executing methodology including mandibular third molars to improve results and limit complications. Third molars are integral to the specialties of endodontics, prosthodontics, and oral medical procedure [18,19]. In endodontics, they mainly aim to preserve the functional part of the arch. Third molar auto transplantation can be attempted to replace teeth on the off chance that they cannot be reestablished. Mandibular third molar tooth auto transplantation is said to be an effective surgical strategy to replace non-restorable teeth with a high long-term survival rate [20].

CONCLUSION

It is concluded that age is a significant factor associated with anatomical features of mandibular 3rd molar because younger patients exhibiting longer root length and larger root canal diameter as compared to older patients. CBCT can be used a diagnostic tool to identify the root anatomy, canal length and their configuration.

REFERENCES

1. Song M, Kim HC, Lee W, et al. Analysis of the cause of failure in nonsurgical endodontic treatment by microscopic inspection during endodontic microsurgery. J Endod. 2011;37:1516–9.
2. Ng YL, Mann V, Rahbaran S, et al. Outcome of primary root canal treatment: systematic review of the literature—part 1. Effects of study characteristics on probability of success. Int Endod J. 2007;40:921–39.
3. Vertucci FJ. Root canal morphology and its relationship to endodontic procedure. Endod Top. 2010;10:3–29.
4. Sjogren U, Hagglund B, Sundqvist G, et al. Factors affecting the long-term results of endodontic treatment. J Endod. 1990;16:498–504.
5. Kerekes K, Tronstad L. Long-term results of endodontic treatment performed with a standardized technique. J Endod. 1979;5:83–90.
6. Ahmad IA, Alenezi MA. Root and root canal morphology of maxillary first premolars: a literature review and clinical considerations. J Endod. 2016;42:861–72.
7. de Pablo OV, Estevez R, Peix Sanchez M, et al. Root anatomy and canal configuration of the permanent mandibular first molar: a systematic review. J Endod. 2010;36:1919–31.
8. Mothanna A, Muhammad SZ. Evaluation of root canal morphology of maxillary molars using cone beam computed tomography. Pak J Med Sci. 1900;31:426–30.
9. Li YH, Bao SJ, Yang XW, et al. Symmetry of root anatomy and root canal morphology in maxillary premolars analyzed using cone-beam computed tomography. Arch Oral Biol. 2018;94:84–92.
10. Zafar MS, Alrahabi M. Cone beam computed tomography for exploring morphology of mandibular first molar. Br J Med Med Res. 2015;6:514–21.
11. Jain A, Bahuguna R. Root canal morphology of mandibular first premolar in a Gujarati population—an in vitro study. Dent Res J (Isfahan). 2011;8:118–22.
12. Felsypremila G, Vinothkumar TS, Kandaswamy D. Anatomic symmetry of root and root canal morphology

of posterior teeth in Indian subpopulation using cone beam computed tomography: a retrospective study. Eur J Dent. 2015;9:500–7.
13. Zhang H, Du C. Study on root canal system of maxillary first premolar. J Clin Stomatol. 2014;12:721.
14. Liu N, Li X, Liu N, et al. A micro-computed tomography study of the root canal morphology of the mandibular first premolar in a population from southwestern China. Clin Oral Investig. 2013;17:999–1007.
15. Yang L, Chen X, Tian C, et al. Use of cone-beam computed tomography to evaluate root canal morphology and locate root canal orifices of maxillary second premolars in a Chinese subpopulation. J Endod. 2014;40:630–4.
16. Loh HS. Root morphology of the maxillary first premolar in Singaporeans. Aust Dent J. 1998;43:399–402.
17. Zhang DH, Wu DM, Wu YN, et al. Root form and canal morphology of maxillary first premolars. Acta Univ Med Nanjing. 2011;31:213-5234.
18. Kai C, Ping W, Zhang M. Morphology of roots and canals in maxillary first premolars. J Pract Stomatol. 2005;21:121–3.
19. Cleghorn BM, Christie WH, Dong CC. The root and root canal morphology of the human mandibular first premolar: a literature review. J Endod. 2007;33:509–16.
20. Lu TY, Yang SF, Pai SF. Complicated root canal morphology of mandibular first premolar in a Chinese population using the cross section method. J Endod. 2006;32:932–6.