

EXPLORING ROOT CANAL MORPHOLOGY OF MAXILLARY SECOND PREMOLARS USING CONE BEAM COMPUTED TOMOGRAPHY

¹ASMA ALI, ²ROZI AFSAR, ³MOMENA RASHID, ⁴NAHEED IMRAN, ⁵ASMA SATTAR, ⁶ARBAB ZIA UR REHMAN, ⁷ARSALAN AZAM

ABSTRACT

Objective: *The objective of this study was explore to root canal morphology of maxillary second premolars using cone beam computed tomography*

Place and Duration of Study: *This study was undertaken in department of radiology, Rehman college of Dentistry, Peshawar, from 15th Septmeber, 2022 till 15th March, 2023.*

Methodology: *Cone Beam Computed Tomography scans of 120 patients of both genders between 18 and 60 years of age were studied and The Cone Beam Computed Tomography scans were studied for number of pulp canals and their configuration. Results were analyzed with the help of SPSS (version 21). Chi square test was done to stratify canal number among genders to see effect modifiers. P-value of 0.05 was considered significant.*

Results: *Out of 120 Cone Beam Computed Tomography scans (N=120), There were 69 females (57.5%) and 51 males (42.5%) having mean age of 32.02, ranging from 18-55 years with a standard deviation of 13.45 years. having mean age of 32.02, ranging from 18-55 years with a standard deviation of 13.45 years Most of the maxillary 2nd premolars had a single canal (n=65, 54.16%) followed by 2 canals (n=53, 44.16%) and 3 canals (n=2, 1.68%). The number of canals in genders was not statistically significant.*

Conclusion: *The most common type of maxillary 2nd premolars has single canal followed by 2 canals. Prevalence of teeth with 3 canals is very rare.*

Keywords: *Canals, roots, Premolar, morphology, maxilla, cone beam computed tomography*

This article may be cited as: Ali A, Afsar R, Rashid M, Imran N, Sattar A, Rehman AZ, Azam A. Exploring Root Canal Morphology of Maxillary second Premolars using Cone Beam Computed Tomography. Pak Oral Dent J 2024; 44(1):69-71.

INTRODUCTION

The successful outcome of endodontic treatment relies heavily on an accurate understanding of the

root canal system's complex anatomy. The morphology of root canals presents substantial variations among different tooth types and even within the same tooth type, posing challenges to clinicians aiming for optimal cleaning, shaping, and obturation of the root canal space¹. Maxillary premolars, with their diverse anatomical features, have been a subject of particular interest in endodontic research due to their significant clinical relevance and potential complexities².

Traditional radiographic techniques, such as peri-apical and bitewing radiographs, have been the mainstay in endodontic diagnosis and treatment planning³. However, these two-dimensional methods often fall short in providing a comprehensive view of the intricate three-dimensional (3D) structure of the root canal system⁴. This limitation has led to underestimation of canal curvatures, missed canals, and inadequate treatment outcomes.

The emergence of Cone Beam Computed Tomography (CBCT) in the field of endodontics has revolutionized the way dental practitioners visualize and interpret root

¹ Dr Asma Ali, BDS, MPhil, Assistant Professor, Oral Biology, Bacha Khan College of Dentistry, Sheikh Maltoon town, Mardan, KPK, 23200, Pakistan. 03459331550.

² Rozi Afsar, BDS, FCPS, Assistant Professor, Oral Biology, Saidu college of Dentistry, Allah chowk Saidu, Swat, 19200, Pakistan, 03005827656. Corresponding Author, RoziAfsar15501@gmail.com

³ Momena Rashid, BDS, MPhil, Assistant Professor, Oral Biology, Rehman College of Dentistry.

⁴ Dr Naheed Imran, BDS, MPhil, Assistant Professor, Oral Biology, Peshawar Medical and Dental College, warsak road, Peshawar, kpk, 25000, Pakistan. 03149601906

⁵ Dr Asma Sattar, BDS, MPhil, Assistant Professor, Oral Biology Peshawar Medical and dental college, warsak road, Peshawar, kpk, 25000, Pakistan. 03189555917.

⁶ Dr Arbab Zia ur Rehman, BDS, FCPS, Associate Professor, Oral Biology, HBS Dental college and hospital, Taramri, Islamabad, 45550, Pakistan

⁷ Arsalan Azam, BDS, Student, Rehman college of Dentistry, Hayatabad Peshawar, KPK, Pakistan 25000, 03249822362

Received for Publication: Nov 5, 2023

Revised: Feb 14, 2024

Approved: Feb 15, 2024

canal anatomy. CBCT offers high-resolution, volumetric images that allow for accurate assessment of root canal morphology, including the detection of additional canals, complexities like isthmuses and apical deltas, and the visualization of intricate curvatures⁵. This technology enables endodontists to make more informed decisions regarding treatment strategies, instrument selection, and negotiation techniques⁶.

Maxillary second premolars, in particular, exhibit a wide range of anatomical variations, which can present challenges during endodontic procedures. The presence of multiple canals, C-shaped canals, lateral canals, and deltas demands a thorough understanding of their morphology to ensure successful disinfection and obturation⁷. Studies done in past using CBCT have shown promise in revealing the intricate internal architecture of these teeth, shedding light on canal configurations that were previously difficult to discern using conventional radiographs⁸. Previous studies done in west have shown that single canals in maxillary 2nd premolars are most common(75%) followed by 2 canals and 3 canals⁹.

This research aims to contribute to the existing body of knowledge by comprehensively investigating the root canal morphology of maxillary premolars using CBCT imaging. By analyzing a substantial sample size of patients from diverse demographic backgrounds, this study intends to uncover the full spectrum of anatomical variations present within this tooth type. Understanding the intricate canal configurations and variations in root canal morphology of maxillary premolars is crucial for enhancing the precision and success rate of endodontic treatments in these teeth.

The objective of this study was explore to root canal morphology of maxillary second premolars using cone beam computed tomography

METHODOLOGY

This descriptive study was done in department of radiology at Rehman college of dentistry after getting ethical approval from ethical committee review board. It was carried out from 15th August 2022 till 15th February 2023. After taking consent, CBCT scans of 120 patients of both genders above 18 years of age were included. Consecutive sampling technique was used to enroll patients. Patients who had restorations or caries in their maxillary premolars and those cbct which had distorted images were excluded. The radiographs were taken by "Carestream Ger, model 90003D" with 73.9 kv (male patients), 69.9kv (female patients), 10.1mA. These values were adjusted according to manufacturer's radiation protocols for different age groups and genders. Standard resolution of 0.30 mm voxel and 10.80 s was used for all scans. Images were analyzed by using CS Imaging Browser 7.0.20 software. The G* Power software version 3.1.9.4 at a p-value of 0.05, medium-power (0.3) and confidence level of 95.1% was used to calculate sample size. The CBCT scans were studied for number of pulp canals and their configuration. Results were analyzed with the help of SPSS

(version 21). Chi square test was done to stratify canal number among genders to see effect modifiers. P-value of 0.05 was considered significant.

RESULTS

120 CBCT scans of patients were analysed(n=120), There were 69 females (57.5%) and 51 males (42.5%) having mean age of 32.02, ranging from 18-55 years with a standard deviation of 13.45 years (Table I).

Most of the maxillary 2nd premolars had a single canal (n=65, 54.16%) followed by 2 canals (n=53, 44.16%) and 3 canals (n=2, 1.68%). The number of canals in genders was not statistically significant. Results are summarized in Table II.

DISCUSSION

The complexity of root canal morphology in maxillary second premolars has been a subject of interest and investigation for many years. This tooth type is known for its anatomical variations, which can present challenges to endodontic treatment¹⁰. The advent of advanced imaging techniques, such as Cone Beam

TABLE 1: AGE AND GENDER DISTRIBUTION

Age	Gender
Range:18-55 years	Male: 51(42.5%)
Mean: 32.02 years (\pm 13.45)	Female: 69 (57.5%)

TABLE 2: NUMBER OF CANALS IN MAXILLARY 2ND PREMOLAR AND THEIR GENDER DISTRIBUTION (N=120)

Number of canals	male	female	Total	P-value
one	35 (53.84%)	30 (46.16%)	65 (54.16%)	0.121
two	23 (43.39%)	30 (56.61%)	53 (44.16%)	
three	1(50%)	1 (50%)	2 (1.68%)	
Total	59 (49.16%)	61 (50.84%)	120 (100%)	

Computed Tomography (CBCT), has allowed for a more thorough understanding of the intricate root canal configurations in maxillary second premolars¹¹. In this discussion, we will delve into the various types of canal configurations that have been observed in these teeth, their clinical implications, and the importance of accurate diagnosis and treatment planning. Successful root canal therapy requires a combination of accurate diagnosis, proficient clinical skills, attention to detail during the treatment process, and comprehensive follow-up care¹¹. By addressing these requirements, clinicians increase the likelihood of achieving favorable outcomes and preserving the natural dentition.

The identification and obturation of pulp canals in maxillary premolars are of paramount importance in endodontic treatment¹². These teeth are renowned for their intricate and variable root canal morphologies, and accurately managing these canals significantly impacts the success and longevity of the treatment¹³. The identification and obturation of pulp canals in maxillary premolars are critical aspects of successful endodontic treatment¹⁴. These steps ensure proper disinfection, prevent reinfection, promote healing, and contribute to the overall health and functionality of the treated tooth¹⁵. Our study found the single canal maxillary 2nd premolars to be the most common form. Similar results were found in a study done in Karachi where they also found single canals to be in 49.6% of patients¹⁶. In western countries the prevalence of single canal is much higher. Regnstrand T et al. found single canals to be 75%¹⁷. Although the exact cause of prevalence of single canals is not known but it can be attributed to a combination of developmental factors, evolutionary changes, and genetic variations¹⁸. Our study found the 2 canals maxillary premolar to be 44.16% and 3 canals to be very rare. Similar results have been found in studies done nationally and internationally¹⁹. The presence of three canals in maxillary second premolars highlights the intricate and variable nature of root canal anatomy²⁰. It's a combination of genetic, developmental, evolutionary, and anatomical factors that can lead to such variations²¹. Understanding these factors is crucial for endodontic practitioners to provide effective and successful treatments in cases with complex root canal configurations.

CONCLUSION

The most common type of maxillary 2nd premolars has single canal followed by 2 canals. Prevalence of teeth with 3 canals is very rare.

REFERENCES

- 1 Maghfuri S, Keyhani H, Chohan H, Dakkam S, Atiah A, Mashyakhy M. Evaluation of root canal morphology of maxillary first premolars by cone beam computed tomography in Saudi Arabian southern region in subpopulation: An in vitro study. *Int J Denti* 2019;19:25-31.
- 2 Al-Zubaidi SM, Almansour MI, Al Mansour NN, Alshammari AS, Alshammari AF, Altamimi YS, et al. Assessment of Root Morphology and Canal Configuration of Maxillary Premolars in a Saudi Subpopulation: A Cone-Beam Computed Tomographic Study. *BMC Oral Health* 2021;21(1):1-11.
- 3 Lo Giudice R, Nicita F, Puleio F, Alibrandi A, Cervino G, Lizio A, et al. Accuracy of periapical radiography and CBCT in endodontic evaluation. *Int J Denti* 2018;2018:45-50.
- 4 Hussain SM, Khan HH, Bhangar F, Alam M, Yousaf A, Ibrahim A. Evaluation of root canal configuration of maxillary second premolar in armed forces institute of dentistry Rawalpindi. *Pak Arm Force Med J* 2020;70(2):605-09
- 5 Dhillon JK, Ghosh S, Mathur VP. Root canal morphology of primary molars—A cone beam computed tomography (CBCT) study. *Indian Journal of Dental Research*. 2022;33(1):14-6.
- 6 Parupalli K, Solomon RV, Karteek BS, Polasa S. Application of cone-beam computed tomography in the analysis and management of intricate internal anatomy of hyper- and mesotaurodontic teeth. *JCD*. 2020;23(2):211-6
- 7 Lin Y, Xiang Y, Chen X, Wang H, Cao N, Xu X et al. Z. Multiple root canals in the maxillary molar: an unusual case report. *BMC oral health*. 2021;21(1):1-6.
- 8 Kavas AA, Tümen EC. Volumetric pulp chambers measurements in mandibular and maxillary permanent first molar using cone-beam computed tomography by age and gender. *International Dental Research*. 2019;9(1):30-40.
- 9 Park JH, Kim Y, Park JH, Lee NK, Kim SH, Kook YA. Long-term evaluation of maxillary molar position after distalization using modified C-palatal plates in patients with and without second molar eruption. *A J O D O*. 2021;160(6):853-61.
- 10 Pan F, Yang Z, Wang J, Cai R, Liu J, Zhang C, Liao W. Influence of orthodontic treatment with premolar extraction on the spatial position of maxillary third molars in adult patients: a retrospective cohort cone-beam computed tomography study. *BMC Ora Heal*. 2020;20:1-8.
- 11 Lee YJ, Kook YA, Park JH, Park J, Bayome M, Vaid NR, Kim Y. Short-term cone-beam computed tomography evaluation of maxillary third molar changes after total arch distalization in adolescents. *A J O D O*. 2019;155(2):191-7.
- 12 Lupoi D, Dragomir M, Coadă G, Sanda A, Budu V. CT scan evaluation of the distance between maxillary sinus floor and maxillary teeth apices. *Roman J Rhino*. 2021;1(41):18-23.
- 13 Qiao X, Xu T, Chen L, Yang D. Analysis of root canal curvature and root canal morphology of maxillary posterior teeth in Guizhou, China. *Medical Science Monitor: I M J E C R*. 2021;27:758-61.
- 14 Mirza MB, Gufran K, Alhabib O, Alafraa O, Alzahrani F, Abuelqosman MS et al. CBCT based study to analyze and classify root canal morphology of maxillary molars-A retrospective study. *E R M P S*. 2022;26(18):367-9.
- 15 Yan Y, Li J, Zhu H, Liu J, Ren J, Zou L. CBCT evaluation of root canal morphology and anatomical relationship of root of maxillary second premolar to maxillary sinus in a western Chinese population. *BMC Ora Heal*. 2021;21(1):1-9.
- 16 Dil F, Nasir U, Maryam B, Afsar R. Root Canal Morphology In Maxillary 2nd Premolar Using Cone Beam Computed Tomography (Cbct) In Patients Belongs To Peshawar Khyber Pakhunkhwa. *J K C D*. 2022;12(2):56-9.
- 17 Regnstrand T, Torres A, Petitjean E, Lambrechts P, Benchi-mol D, Jacobs R. CBCT based assessment of the anatomic relationship between maxillary sinus and upper teeth. *C E D R*. 2021;7(6):1197-204.
- 18 Maia LM, de Carvalho Machado V, da Silva NR, Júnior MB, da Silveira RR, Júnior GM, Sobrinho AP. Case reports in maxillary posterior teeth by guided endodontic access. *J Endod*. 2019;45(2):214-8.
- 19 Motiwala M, Arif A, Ghafoor R. A CBCT based evaluation of root proximity of maxillary posterior teeth to sinus floor in a subset of Pakistani population. *JPMA*. 2021;71(8):1992-3
- 20 Wolf TG, Kozaczek C, Campus G, Paqué F, Wierichs RJ. Root Canal Morphology of 116 Maxillary Second Premolars by Micro-Computed Tomography in a Mixed Swiss-German Population with Systematic Review. *J Endod*. 2020;46(11):1639-47.
- 21 Olczak K, Pawlicka H, Szymański W. Root and canal morphology of the maxillary second premolars as indicated by cone beam computed tomography. *Austral Endod J*. 2023;49(1):92-103.

1 Asma Ali:

2 Rozi Afsar:

3 Momena Rashid:

4 Naheed Imran:

5 Asma Sattar:

6 Arbab Zia ur Rehman:

7 Arsalan Azam:

CONTRIBUTIONS BY AUTHORS

Conceived Idea, data interpretation

Data Collection & analysis

Data analysis

Statistical Analysis

literature review

Literature review, data analysis

edited final draft