

Occurrence of Second Mesio-buccal Canal in Permanent Maxillary First Molars Cone Beam Computed Tomography Images of Patients Attending Dental Clinics in Thane District – A Retrospective Study

Anamica Shinde

Corresponding Author

Anamica Shinde

E-mail ID: anamicashinde73@gmail.com



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Abstract:

Background: The mesio-buccal roots of first molars in the maxilla typically contain MB2 canals, which are a sign of a very complex root canal system. Since periapical (PA) radiographs are a 2D radiographic modality and are frequently used to evaluate root canal morphology, they are unable to adequately visualise the presence of extra canals, such as MB2, resulting in incomplete treatment and continued symptoms of pulpal infection even after root canal therapy.

Aim: The aim of this study was to investigate the occurrence and location of Second Mesio-buccal Canal in Permanent Maxillary First Molars Cone Beam Computed Tomography Images of Patients Attending Dental Clinics in Thane District.

Material and Methods: 100 patients were examined using a retrospective radiography analysis. They underwent CBCT scans using a Kodak CS 9300 digital imaging equipment. Each CBCT scan was evaluated using Carestream software. With excellent resolution and precision, cone beam computed tomography (CBCT) imaging is a non-invasive medical image capturing technique that can also lessen superposition and distortion of neighbouring anatomical structures while showing the internal structures of the teeth in three dimensions. Due to its short scan periods and low radiation exposure, it can be used for clinical applications and in vivo dental anatomy studies.

Results: The occurrence of MB2 canals observed in maxillary first molars has significantly grown in recent years with the aid of CBCT imaging and dental operating microscopes. Overall, 37% of maxillary first molars had an MB2 canal. Only 3 (8.1%) of the 37 MB2 canals possessed the Vertucci Type IV configuration, compared to 34 (91.9%) of the 37 MB2 canals.

Keywords: Maxillary First Molar, Mesiobuccal Canal, CBCT, Endodontic Therapy.

Introduction:

The maxillary first molar is among the most frequently treated teeth by endodontic practitioners due to its complex internal anatomy, which includes three roots (mesiobuccal, distobuccal, and palatal) with variations in size, structure, and internal architecture⁽¹⁾. Among the mesiobuccal root canals, the MB2 canal displays the most variety and is often overlooked by practitioners due to the acute mesial inclination of maxillary molars, making it difficult to locate and traverse⁽²⁾. Failure to identify and debride all canals, including the MB2 canal, can negatively impact the prognosis, treatment planning, and diagnosis of root canal therapy. Therefore, the accuracy and volume of data acquired during radiographic exams are essential for successful endodontic treatment. Conventional intraoral radiography provides insufficient information on pathological conditions, structural forms, and connections to locations in clinical practice. Clinical challenges, such as inadequate vision into the pulp chamber, raise the risk of perforation and may reduce the occurrence of a mesiobuccal second canal⁽³⁾. The complexity of navigation in root canal therapy is often attributed to the presence of dentin obstructions, which may

impede access to the MB2 canal orifice⁽⁴⁾. This phenomenon has been suggested as a possible explanation for the observed discrepancy between the incidence of second mesiobuccal canals in vivo and in vitro studies⁽⁵⁾.

The existence of MB2 canals in maxillary first molars has been a subject of extensive research, with varying results. In vitro studies have reported a prevalence ranging from 29% to 100%, while in vivo investigations have shown a prevalence between 19.7% and 51.1%^(6,7). The prevalence of MB2 canals also varies among different ethnicities, as demonstrated by comparative studies among Asian nations. However, little research has been conducted on the prevalence of MB2 canals in the Indian subpopulation⁽⁸⁾. Cone beam computed tomography (CBCT) imaging is a non-invasive medical image capture technology that eliminates superposition and distortion and provides precise three-dimensional (3D) information on the internal root canal structure of teeth with high resolution and accuracy⁽⁹⁾. CBCT imaging and dental operating microscopes have greatly enhanced the identification rate of MB2 canals in maxillary first molars in recent years⁽¹⁰⁾. CBCT images have emerged as an essential tool for MB2 diagnosis due to their capacity to offer

anatomical features, avoid needless tooth preparation, and minimize unfavourable occurrences such as instrument separation, canal transit, and perforation⁽¹¹⁾.

The purpose of this research is to evaluate the occurrence and location of the MB2 root canal in the maxillary first molar among residents of Thane City. The study seeks to establish a connection between the presence of an MB2 canal and the distribution of canal orifices^(12,13). The maxillary first permanent molar is a frequently affected tooth that often requires endodontic therapy due to its early eruption, significant masticatory function, and high susceptibility to dental cavities. The results of this study may assist in enhancing the success rate of root canal therapy for maxillary first molars. Dental practitioners have extensively researched the number and morphology of the root canals in the mesiobuccal root, particularly the presence of the MB2 canal, which is often minuscule, contorted, and concealed by additional dentin⁽¹⁴⁾. The identification rate of MB2 canals has greatly increased in recent years due to the utilization of cutting-edge procedures and techniques such as CBCT imaging, clinical operating ultrasonography, and dental operating microscopes. Studies have shown that these techniques can improve the rate at which MB2 canals are discovered⁽¹⁵⁾.

Materials And Methods:

The present study reports on a retrospective radiographic investigation that utilized cone beam computed tomography (CBCT) scans acquired with a Kodak CS 9300 digital imaging system on a sample of 100 individuals. The primary objective of the study was to evaluate the presence or absence of a second mesiobuccal (MB2) canal in teeth without any open apices, periapical lesions, resorption, root fractures, intra-radicular fillings, posts, metallic restorations, or other permanent prostheses. The images acquired for the study were of high quality and were analyzed using Carestream software, which enabled the adjustment of brightness and contrast settings. The MB2 canal was evaluated by observing the mesiobuccal root continuously, and Vertucci's taxonomy of canal types was employed to gather information on the anatomy of the MB2 orifice and Type IV configuration was employed in the present study.

Results And Discussion:

The study in question presents an interesting finding that contrasts with the results of previous investigations. Specifically, the study discovered that a significant proportion of individuals (37%) had an MB2 canal in their maxillary first molar, which is a higher incidence rate than what was previously reported by other studies^(16,17). For example, previous investigations found that only 33.3% of 201 teeth had an MB2 canal, while in vitro studies revealed a higher rate of 62%. However, the in vivo investigation only discovered 31% of the 100 teeth, which could be attributed to the combined data from other teeth⁽¹⁸⁾.

It is worth noting that previous studies on the Indian population have reported considerable variability in the incidence of MB2 canals⁽¹⁹⁾. These differences can be attributed to various factors, such as demographic group analysis, sample size, research methodology, the author's definition of a canal, and the average age of the population under investigation⁽²⁰⁾. For instance, the study observed an incidence of 61.9%, which is higher than the 44.1% and 47.1% reported by Neelakantan P et al. and Karunakar et al., respectively^(21,22).

Furthermore, the results of the study are different from those of Kashyap RR et al., who found MB2 canals in 76.5% of maxillary first molars. However, the study under consideration focused on a particular geographic area and investigated the prevalence of MB2 canals in the Indian population. The study's findings indicate that of the 37 scans of maxillary first molars that revealed MB2 canals, 34 (91.9%) had Vertucci's Type II configuration, while 8.1% had Vertucci's Type IV structure⁽²³⁾. In contrast, Neelakantan P et al. discovered 51.8% and 38.6%, respectively, which is higher than the results of the current study^(21,22).

Overall, this study provides valuable insights into the prevalence of MB2 canals in the Indian population, highlighting the need for further research to understand the factors that contribute to the variability in the incidence of MB2 canals.

Limitations:

It should be noted that our study has certain limitations that should be taken into consideration. These limitations include a relatively small sample size and the utilization of a sample from only one site. Furthermore, it is important to acknowledge that this study did not evaluate the frequency of the MB2 canal on gender or side of the root canal.

Conclusion:

The maxillary first molars are known for their complex root canal system, particularly in the mesiobuccal roots which exhibit a high prevalence of MB2 canals. However, conventional periapical radiographs, being a two-dimensional imaging modality, often fail to reveal the intricate anatomy of the root canal system, leading to incomplete treatment and persistent pulpal infection symptoms even after root canal therapy. In this regard, cone beam computed tomography (CBCT) is a superior imaging technique in depicting the internal architecture of root canals, especially in the case of MB2 canals, which are frequently missed by clinicians when using two-dimensional radiography.

Source of support : Nil

Conflict of interest : Nil

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References

- Krasner P, Rankow HJ. Anatomy of the pulp-chamber floor. *J Endod* 2004;30(1):516.
- Hasan M, Khan FR. Diagnosis of Second Mesio Buccal Canal in Maxillary First Molars among Patients Visiting a Tertiary Care Hospital. *Int J Biomed Sci* 2015;11(2):1078.
- Alnowailaty Y, Alghamdi F. The Prevalence and Location of the Second Mesio Buccal Canals in Maxillary First and Second Molars Assessed by Cone-Beam Computed Tomography. *Cureus* 2022;14(5):e24900.
- Chan MYC, Cheung V, Lee AHC, Zhang C. A Literature Review of Minimally Invasive Endodontic Access Cavities - Past, Present and Future. *Eur Endod J* 2022;7(1):110.
- Shetty A, Bhat R, Babu B, Hegde MN, Shetty C, Shetty P, et al. Occurrence and Morphology of MB2 Canals in Maxillary First Molars in an Indian Subpopulation: A Cone Beam Computed Tomography Study. *Journal of Health and Allied Sciences NU* 2022;12(02):1015.
- Vertucci FJ. Root canal morphology and its relationship to endodontic procedures. *Endod Topics* 2005;10(1):329.
- Wolcott J, Ishley D, Kennedy W, Johnson S, Minnich S, Meyers J. A 5 yr clinical investigation of second mesio buccal canals in endodontically treated and retreated maxillary molars. *J Endod* 2005;31(4):2624.
- Onn HY, Sikun MSYA, Abdul Rahman H, Dhaliwal JS. Prevalence of mesio buccal-2 canals in maxillary first and second molars among the Bruneian population- CBCT analysis. *BDJ Open* 2022;8(1):32.
- Zheng QH, Wang Y, Zhou XD, Wang Q, Zheng GN, Huang DM. A cone-beam computed tomography study of maxillary first permanent molar root and canal morphology in a Chinese population. *J Endod* 2010;36(9):14804.
- Tian XM, Yang XW, Qian L, Wei B, Gong Y. Analysis of the Root and Canal Morphologies in Maxillary First and Second Molars in a Chinese Population Using Cone-beam Computed Tomography. *J Endod* 2016;42(5):696701.
- Guo J, Vahidnia A, Sedghizadeh P, Enciso R. Evaluation of root and canal morphology of maxillary permanent first molars in a North American population by cone-beam computed tomography. *J Endod* 2014;40(5):6359.
- Hess W, Zürcher E. The anatomy of the root-canals of the teeth of the permanent dentition. *J. Bale, sons & Danielsson, Limited*; 1925.
- Cantatore G, Berutti E, Castellucci A. Missed anatomy: frequency and clinical impact. *Endod Topics* 2006;15(1):331.
- Peeters HH, Suardita K, Setijanto D. Prevalence of a second canal in the mesio buccal root of permanent maxillary first molars from an Indonesian population. *J Oral Sci* 2011;53(4):48994.
- Al-Habib M, Howait M. Assessment of Mesio buccal Canal Configuration, Prevalence and Inter-Orifice Distance at Different Root Thirds of Maxillary First Molars: A CBCT Study. *Clin Cosmet Investig Dent* 2021;13:10511.
- Nagahara T, Takeda K, Wada K, Naruse T, Shiba H. Rare root canal morphology of maxillary second molars: A report of three cases. *Clin Case Rep* 2023;11(7):e7547.
- Liu D, Qiu L, Yu J. A Rare Root Canal Configuration of a Maxillary Second Molar with Fused C-shaped Buccal Root and Five Canals: A Case Report and Review of literature. *Iran Endod J* 2019;14(3):22531.
- Xu YQ, Lin JQ, Guan WQ. Cone-beam computed tomography study of the incidence and characteristics of the second mesio buccal canal in maxillary permanent molars. *Front Physiol* 2022;13:993006.
- Anirudhan S, Suneelkumar C, Uppalapati H, Anumula L, Kirubakaran R. Detection of second mesio buccal canals in maxillary first molars of the Indian population - a systematic review and meta-analysis. *Evid Based Dent [Internet]* 2022; Available from: <http://dx.doi.org/10.1038/s41432-022-0233-3>
- Sharma M, Gupta S, Bhayya DP, Upadhyay K, Pandya D, Srivastava A, et al. CBCT Analysis of Maxillary First Molar in Indian Population. *Int J Clin Pediatr Dent* 2022;15(3):25862.
- Karunakar P, Solomon RV, Byragoni C, Sanjana L, Komali G. Demystifying the mesio buccal root of maxillary first molar using cone-beam computed tomography. *Indian J Dent Res* 2015;26(1):636.
- Neelakantan P, Subbarao C, Ahuja R, Subbarao CV, Gutmann JL. Cone-beam computed tomography study of root and canal morphology of maxillary first and second molars in an Indian population. *J Endod* 2010;36(10):16227.
- Kashyap RR, Beedubail SP, Kini R, Rao PK. Assessment of the number of root canals in the maxillary and mandibular molars: A radiographic study using cone beam computed tomography. *J Conserv Dent* 2017;20(5):28891.