Prevalence, detection, and negotiation of Second mesiobuccal canal in Maxillary Molars, literature review

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Abstract

Background: The usual suspect of complication in upper maxillary molars with endodontically treated teeth is ignored second Mesiobuccal canal. Studies show that ignored canals can be the reason for apical periodontitis and treatment failure. Hiding under tick deposition of the dentinal shelf the entrance of the second Mesiobuccal canal is not always visible. Two-dimensional X-ray is not a solution due to overlapping projection. Different tools like a Dental Operating Microscope, ultrasonic tips, and Cone Beam Computed Tomography can be useful for locating the second Mesiobuccal canal. Much research has been done on the prevalence of the second Mesiobuccal canal in different populations, however, awareness of distribution is still not high.

Aim: This literature review aims to discuss and analyze the existing literature on the prevalence, detection, and negotiation of the second Mesiobuccal canal.

Methods: Different scientific papers from Elsevier, PubMed, and Research Gate were selected between the years 2000- and 2022, which contain keywords that are associated with the prevalence, identification and negotiation of morphological variability of Maxillary Molars: Prevalence, second Mesiobuccal canal, Cone Beam Computed Tomography (CBCT), Dental operating microscope (DOM), maxillary molar canal morphology.

Results: The results of the research show difficulties existing with distinct information about the distribution of the second mesiobuccal canal, as well as the significance of the use of a Dental Operative Microscope, ultrasound tips, and Cone-beam Computed tomography for enhanced accuracy while locating and negotiating mesuibuccal canal in maxillary molars.

Conclusions: It is of high importance that clinicians be aware of the challenging anatomy of Maxillary molars, know the prevalence of the Mesiobuccal canal in their region, interpret data from CBCT scan, and for better results use a Dental Operating Microscope and ultrasound tips to ensure the quality treatment and prevention of formation apical periodontitis in the future. **(TCM-GMJ December 2024; 9 (2): P55-P59)**

Keywords: Prevalence, second Mesiobuccal canal, CBCT, DOM, maxillary molar canal morphology

Introduction

Successful endodontic treatment involves the identification, debridement, and disinfection of all root canals within the root, followed by obturation for further function(1,2) Missed and untreated canals are potential causes of apical periodontitis and can lead to endodontic treatment failure(2–9). Maxillary molars pose a challenge due to their variable morphology. The mesial root of these molars has a high probability of having an extra canal. This second mesiobuccal canal, also known as MB2, is considered the most missed canal. A study by Pereira et al. revealed that out of 210 maxillary molars, periapical lesions were observed in 85% of cases, and mostly, the periapical lesion was associated with missed and untreated MB2(9). From another study by Vizzotto et al. the upper molars that presented MB2 missed canals, 70 % were associated with apical periodontitis(10). Hess and Zucher first described MB2 in 1925, and it is still under investigation by various researchers. Different authors show different prevalence data(11–37). It is supposed that geography influences distribution from 33,5% to 97,6% in different regions. However, the inconsistency in the data could be attributed to variations in

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methodologies, study designs, and population demographics.(10)

Another difficulty associated with MB2 is detection. Research has demonstrated that conventional radiography may not be a dependable method for detecting MB2 due to its limited two-dimensional perspective and overlapping projections(13,37–41). Before introducing Cone Beam Computed Tomography (CBCT) and dental operating microscope (DOM) in dentistry, clinicians struggled to find MB2. CBCT is now an invaluable tool for assessing the anatomy and morphology of teeth(18,37,39,40,42–53) One can unleash 3-dimensional anatomies of the tooth and confirm the existence of MB2 in the mesial root. Using a Dental operative microscope (DOM) can enhance the visibility of the MB2 canal(44,47,54–61). Gentle troughing using ultrasound tips under high magnification is suggested for locating the MB2 canal(62–65). This canal is typically not visible when entering the access cavity, and without prior knowledge of its existence, clinicians may inadvertently miss it during treatment due to its high prevalence. Covered by a thick deposition of dentinal shelf MB2 is located palatal to the main mesiobuccal canal. The entrance in orifice is typically obscured by the dentinal layer, making it difficult to see. Even when it is visible, negotiating its multiple changes in direction can be challenging(66). Problems arise with deep positioning and the risk of perforation in the danger zone. Gorduysus et al. suggested performing deep troughing of 1-3 mm to access the MB2, which requires high-precision work(66). Nevertheless, there is still a possibility of missing the canal. The literature suggests various methods and diagnostic tools to enhance the likelihood of finding MB2. However, some of these methods are more effective than others.

This paper seeks to show prevalence data, analyze the literature, and summarize the most effective methods and tools for clinicians to overcome the challenges posed by MB2.

Methods

Assessment of literature was conducted from 4 electronic databases (ScienceDirect, PubMed, Research Gate, and Google scholar) Scientific papers were selected based on the following criteria: period 1925-2024; Keywords searched titles and abstracts: Prevalence, second Mesiobuccal canal, CBCT, DOM, maxillary molar canal morphology. Papers that have deciduous dentition studies and Case reports were excluded. Papers that did not have relevant data or sample size were excluded.

Results

75 scientific papers were selected and sorted to analyze the prevalence of MB2, the most relevant detection techniques, and negotiation issues. The prevalence of MB2 is one of the most investigated topics. Having a comprehensive understanding of the frequency and distribution of MB2 is crucial for all dental practitioners. Imura et al. experimented with treating extracted maxillary molars and then with the clearing technique saw the results, 52.3% of first and 40% of second molars had two canals obturated in the MB root(67). After clearing the same roots, the presence of MB2 canals rose to 80.9% and 66.6%, respectively, which is a significant difference. Researchers have conducted extensive studies to determine the prevalence of MB2 in various regions, and the findings vary depending on the population. Frequent use of CBCT in dental practice boosts the ability to see morphological variety easily. Martins et al. study the worldwide prevalence of MB2 based on CBCT which suggests specificities within the geographic region which varies widely(27). For example, the prevalence of MB2 in England is 91.2% in contrast to Venezuela, where the prevalence is 48,0% respectively. Belgium showed the highest number of MB2-97,7%, then comes South Africa and Syria, 95,6% and 95,2% respectively. In this study the range of distribution is between 48 % -97,6% among the regions, and global prevalence can be stated to be 73,8%. Approximately the same is the result of the study by Betancourt et al. the distribution of MB2 is 69,82% in the first Maxillary Molar and 46,91% in the second Maxillary Molar(46). Some other studies show different numbers of distributions of MB2 (68). We can suggest that while these studies rely heavily on data obtained from CBCT scans, certain factors can affect the accuracy of the research, such as FOV, voxel size, resolution, scanner quality, examiner, and sample size (69,70). The axial plane of CBCT can show the morphological variation of the mesial root and determine if it contains one or more canals. Interestingly, in the study done by Bauman et al, correct identification of MB2 canal on CBCT was not correlated with a higher level of clinical experience but a significantly higher detection rate was found in high-resolution 0, 125mm voxel size than low-resolution voxel size like 0,4mm(71). The difference in voxel size between studies may also be due to variations in the use of diagnostic accuracy measurements. The significance of precise diagnostic measurements in these studies is emphasized by Camacho—Aparicio(62). These measurements are essential for evaluating the method's ability to accurately distinguish individuals with or without a specific condition when compared to a widely recognized gold standard. As Stropko suggested in late 1999, clinical data usually differs from In Vitro studies(72). The author suggests that results will be dependent on the method used. This theory can be supported by a study done by Betancourt et al. where a systemic review of the literature showed a significant difference between in vitro and in Vivo studies(52). In Vitro studies, CBCT showed a 92% distribution of MB 2 while in Vivo 70,7 %, dental operating microscope showed 92,3% detection In vitro, while In vivo 73,2% respectively. We can suggest that clinically obtained data and laboratory research can have different results. Literature suggests a high incidence of MB2 which is clinically hard to detect. Nowadays, using a dental operating microscope has an important role in locating the MB2 canal. While high magnification enhances clinicians' vision ability, we need to understand that experience and special troughing tools are important in locating and negotiating the Mb2 canal. A laboratory study by Go¨rduysus et al. examined 45 extracted maxillary molars first without magnification, resulting in 93% (42 teeth) of located MB2 canals(66). Negotiation of MB2 was successful in 31 teeth

(69%). After these teeth were examined and negotiated under a dental operating microscope MB2 was found in one additional tooth and negotiated in five additional teeth. Non-negotiable teeth were cross-sectioned and examined under magnification, which confirmed that MB2 was absent. The main factor in identifying the mb2 canal was not magnification regarding this study but mostly the negotiation part was carried out successfully under magnification. Contrary to a previous study, Buhrley et al. conducted a study where the results show that the use of magnification leads to an MB2 detection rate approximately three times that of the non-magnification group and that the use of no magnification results in the location of significantly fewer MB2 canals(73). The result of an investigation by Liang et al. supports a previous study where the sensitivity and accuracy of the microscope group were 0.78 and 0.76, higher than 0.61 and 0.65 of the naked eye group ($P<0.05$)(56). Interestingly, in the study by Camacho—Aparicio the authors compare three groups. 1st with only direct vision with mirror, explorer, and hand files, second with Operating microscope, and third with microscope and ultrasound tips. Results from this study suggest that while the use of magnification and ultrasound can be advantageous, they are not critical or essential due to a non-significant increase in sensitivity (7%) and accuracy (6%) between the 1st and 3rd groups. Authors suggest that in this study 1st group was effective due to their clinical experience and knowledge. The findings of this study emphasize the critical importance of understanding dental morphology and knowing where to look for MB2.

Problems with MB2 detection were also associated with the deep position of the canal under the dentinal shelf which highly interrupts the negotiation of the canal (**Fig. 1; Fig. 2**). Many authors suggest using Ultrasonic tips under magnification as a crucial way to increase the incidence of finding and also negotiating MB2 canal(55,62,63,74,75). It was also shown that 13% of MB2 could not be detected because canal calcification or branching located more apically(66). Despite the comprehensive literature on the detection and negotiation of Mb2, more clinical studies are needed to make a more predictable and easy protocol to manage MB2 in daily practice.

Conclusion

It is crucial to locate the MB2 in maxillary molars for successful treatment. While there is still no unified data about prevalence, we should suggest that every maxillary molar has an additional mesiobuccal canal and clinicians need to search for it. Understanding the morphological variation of the MB2 canal is key, and using CBCT, dental operating microscopes, and ultrasound is important for successful treatment.

Fig.1 – Thick dentinal deposition over the MB2 canal.

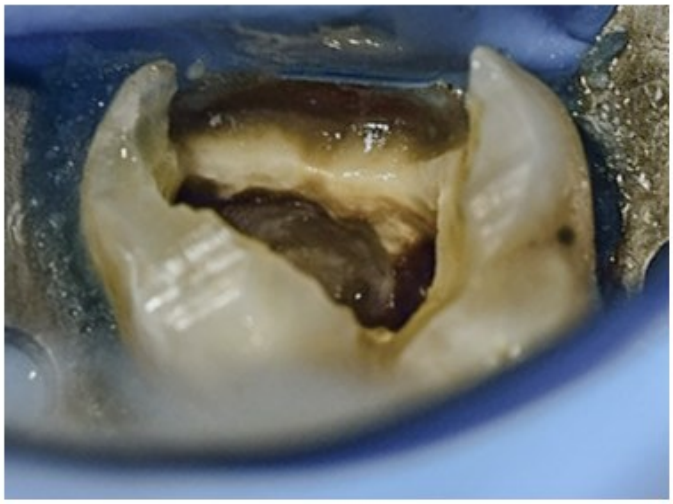
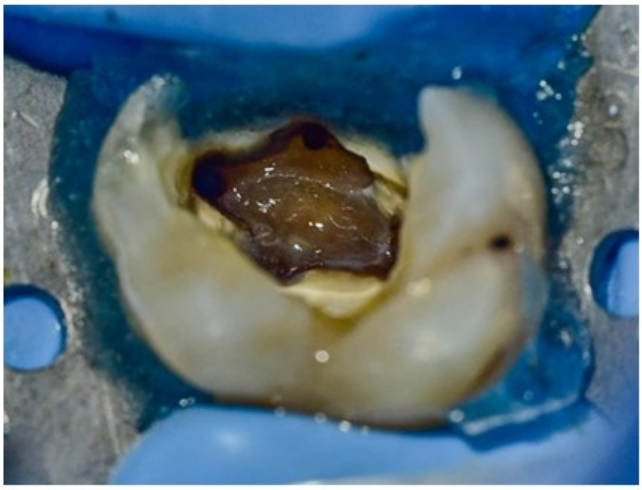


Fig.2- Position of MB2 canal. The dentinal shelf is removed with ultrasound tips to achieve direct entrance to MB2



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