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Localization of the Second Mesiobuccal (MB2) Root Canal in Maxillary Second Molars by Cone Beam Computed Tomography (CBCT) Analysis

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Abstract

Introduction: The Localization, cleaning, shaping and filling of the root canal system are essential keys to successful root canal treatment. The maxillary second molar has a complex anatomy, one of the reasons for the failure in its treatment is the lack of location and treatment of some of the canals, such as the second mesiobuccal (MB2) root canal, so it is important to know its prevalence. **Objective:** To determine the percentage of location of the MB2 root canal in maxillary second molars through the analysis of cone beam computed tomography (CBCT), obtained from patients who were treated at the Endodontics Clinic of the División de Estudios de Posgrado

e Investigación de la Facultad de Odontología, de la Universidad Nacional Autónoma de México. **Methods and materials:** The study was conducted on a sample of 129 tomographic images of maxillary second molars from 66 tomographies in the OnDemand3D™ software format. The scans were taken with the NewTom VGi EVO device, amperage: 1-20 mA, voltage: 110 kV, exposure time: 18 seconds, 360° rotation and voxel measurement of 0.3mm. The tomography scans were analyzed with the OnDemand3D™ software, and axial sections were made of each tooth, from the crown to the apical third to confirm the presence or absence of the MB2 root canal. The resulting data was captured in a Microsoft Excel spreadsheet and subsequently analysed using Stata 13 software. **Results:** A total of 69 MB2 root canals were located out of the total of 129 teeth analyzed, hence the location percentage was 53.49%. **Conclusion:** The high percentage of location obtained in this study of the MB2 root canal in maxillary second molars using CBCT, demonstrates the importance of the correct location, disinfection, conformation and obturation of the canal to achieve a successful treatment.

Keywords: Maxillary second molar, MB2 root canal, CBCT.

INTRODUCTION

Knowledge of the morphology of root canals and their variations is essential for the success of root canal treatment. Root canals that are not identified during endodontic treatment become a reservoir of bacteria, thus allowing the formation of new inflammatory lesions in the periapical tissues. Root canals of maxillary molars are particularly difficult to treat, with the most common examples being multiple canals and roots[1,2]. Teeth with non-localized root canals are 4.38 times more likely to be associated with periapical lesions[3]. Failure to locate root canals may lead to a guarded prognosis[4].

The maxillary second molar is a tooth very similar to the maxillary first molar in its crown and root structure. The distinctive morphological characteristic of the maxillary second molar is that its three roots are closer together and sometimes fused, they are also shorter and not as curved[5,6]. It usually has one canal for each root, however, it may have two or three mesiobuccal (MB) root canals. Probability of having four canals is lower in the second molar than in the first. In general, the orifices of the root canals of the maxillary second molar are closer to each other in the mesial direction. When there are four canals, the access cavity preparation has a rhomboidal shape and represents a smaller version of the access cavity of the maxillary first molar[2,5].

Literature reports often emphasize the need to identify an additional root canal in the mesiobuccal root. However, its incidence varies. This variation and the percentage of localization are related to the study population, the sample size, the study type (clinical or laboratory) and the localization method[2,7]. This root canal is often undetected and consequently becomes a cause of inflammatory lesions in the periapical tissues and failure in root canal treatment[2]. The canals are located symmetrically in the roots, meaning that if the MB root canal is buccal to the root, there is likely a second mesiobuccal (MB2) root canal. Its anatomical location is slightly mesial to the imaginary line between the palatine canal and the MB root canal. The use of cone beam computed tomography (CBCT) to detect the existence of the MB2 root canal has proven to be reliable[5,10].

The American Association of Endodontists (AAE) and The European Society of Endodontology (ESE) have published that the use of CBCT should be considered the imaging study of choice for root canal treatment, when there is suspicion of the existence of extra root canals or a complex morphology[8]. Since its introduction into endodontics in 1990, CBCT has increased the potential for non-invasive analysis of internal and external tooth morphology. CBCT scans can be useful diagnostic tools in endodontic practice and this type of scan has a lower radiation dose than conventional CT scanning[2,9,10].

Knowing the percentage of location of the MB2 root canal in maxillary second molars through CBCT analysis will be of great clinical use, so that the professional knows the importance of searching it, locating it and treating it. Localization of the canal in as many cases as possible will increase the control of pulpoperiapical disease and reduce the rate of treatment failures and, as a consequence, improve the long-term prognosis of root canal treatment. For this reason, the purpose of this study was to determine the percentage of location of the MB2 root canal in maxillary second molars through CBCT analysis.

MATERIALS AND METHODS

A descriptive observational study was performed using non-probabilistic, convenience sampling. A total 129 of tomographic images of maxillary second molars were taken from 66 tomographs obtained from patients who were treated at the Endodontics Clinic of the División de Estudios de Posgrado e Investigación de la Facultad de Odontología, de la Universidad Nacional Autónoma de México. The tomography scans were taken with the NewTom VGi EVO (NEWTOM CEFLA S.C., Imola, Italy) device, amperage of 1-20mA, voltage of 110kV, exposure time of 18 seconds, 360° rotation and voxel measurement of 0.3mm.

The inclusion criteria were tomographic images of the right and/or left maxillary second molar of patients between 19 and 50 years of age, as exclusion criteria were tomography scans where maxillary second molars were not present and cases in which previous root canal treatment was observed. Tomography scans with poor quality were excluded, which could not be analysed correctly. The variables were the age and sex of the patients, number of roots, number of canals and the presence or absence of the MB2 root canal in maxillary second molars analysed by CBCT.

CBCT analysis was performed on each tooth to confirm the presence or absence of the MB2 root canal. The same computer with CD player and the OnDemand3D™ (Cybermed Inc., Daejeon, Korea) software was used. The canal was considered present if, when analysing the tomographic image of the mesial root in a 0.3mm axial section, from the pulp chamber floor to the apex, a point attached to the first mesiobuccal (MB1) root canal was observed, with a continuous trajectory from the pulpal floor of the canal to at least the middle third, in the axial view (Figure 1-3).

A descriptive analysis was carried out to report the average age, the distribution of frequencies by gender, frequency of right and left maxillary second molars, percentage of location of the MB2 root canal and in how many of them the canal was found bilaterally were also evaluated. Statistical analysis of the data was performed using the Stata 13 version 13.1 (StataCorp LLC., Texas, USA) software.

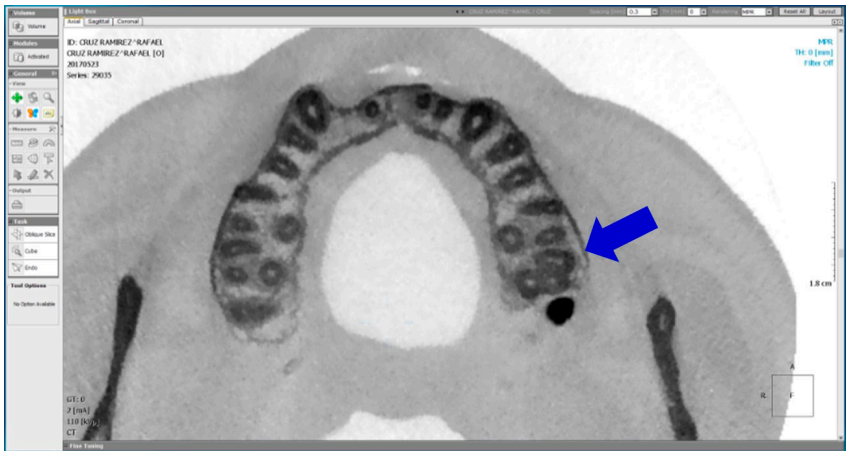

Figure 1. Tomographic section from an axial view, the arrow points to a left maxillary second molar with the presence of MB2 canal in the mesiobuccal root.

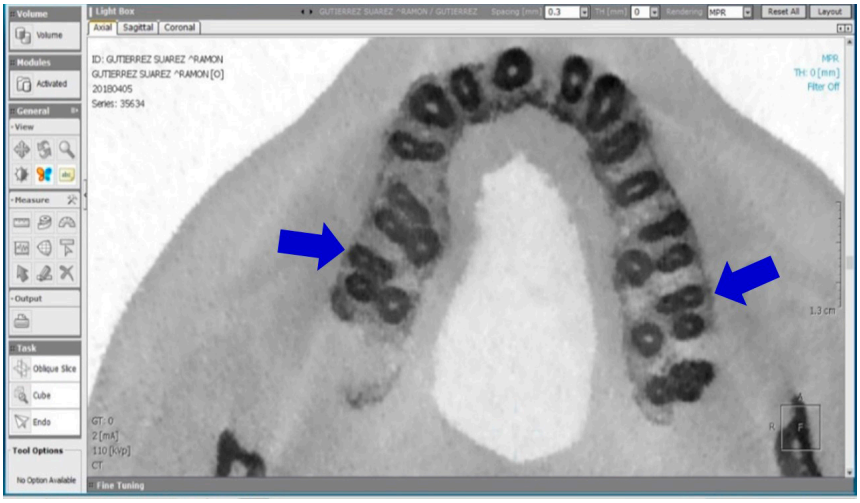

Figure 2. Tomographic section from an axial view, the arrows point to a left and a right maxillary second molar with the presence of MB2 canal in the mesiobuccal root.

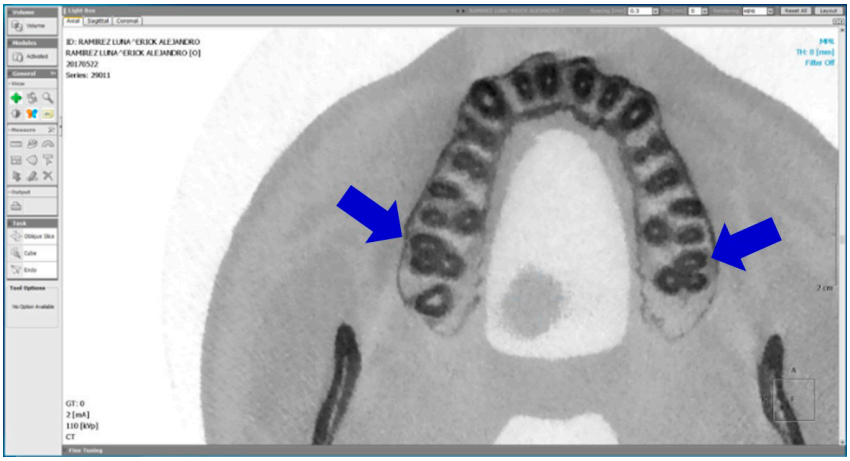

Figure 3. Tomographic section from an axial view, the arrows point to a left and a right maxillary second molar with the presence of MB2 canal in the mesiobuccal root.

RESULTS

In the distribution of patients by age and sex, a mean age of 35 years was obtained, with a standard deviation of 8.96, the maximum age recorded was 50 years and the minimum age was 19 years. From the 66 patients study population, 42 (64%) were women and 24 (36%) were men. Of the 129 maxillary second molars that were included, 70 (54%) were right and 59 (46%) were left. Of the total of 129 teeth, 69 MB2 root canals were located, so the percentage of location was 53.49% and 46.51% had only 3 canals (Table 1).

Table 1.
Percentage of MB2 root canal location.

MB2	FREQUENCY	PERCENTAGE
ABSENT	60	46.51%
PRESENT	**69**	**53.49%**
TOTAL	129	100%

There was a total number of 62 patients who had both right and left maxillary molars and at least one of which was MB2. Of these, in order to evaluate whether or not it was bilateral, 41 teeth were analysed, resulting in 61% (25) that presented bilaterality of the MB2 root canal and were absent in the remaining 39% (16).

DISCUSSION

In this study, the use of CBCT to locate the MB2 root canal in the maxillary second molars reported relatively high values, obtaining 53.49%. Ratanajirasut *et al.*, used CBCT to locate the MB2 root canal in a sample of 457 maxillary second molars and reported 29.4%[11]. In their own study, Olczak & Pawlicka performed the same technique, with 207 maxillary second molars and reported the presence of the MB2 root canal in 23.2%[2]. Blattner *et al.*, obtained a location percentage of 57.9% with CBCT, which was higher compared to our research, which was 20 molars, combined between maxillary first and second molars[12].

In the research carried out by Buhrley *et al.* in patients, it was found that the percentage of location of the MB2 root canal of 316 maxillary first and second molars was 57.4% with a microscope, 55.3% with loupes and 18.2% without any type of magnification[19]. Likewise, Degerness & Bowles reported a location percentage of 60.3%, with a sample of 63 sectioned maxillary second molars. Performing the study on extracted teeth increased the probability of location, since in the mouth they are located in a posterior position and the complex vision makes proper location difficult[21]. Stropko found that the detection of the MB2 root canal increases when using magnification. After examining 611 maxillary second molars, he found that the MB2 root canal was present in 50.7% and the percentage increased to 60.4% with surgical microscope and other specific instruments[22].

In our study, CBCT was used as the gold standard, since it is a reliable method for locating the MB2 root canal of maxillary second molars in patients. Blattner *et al.*, demonstrated that CBCT scanning is a valid method to detect the MB2 root canal in maxillary molars[12]. In the last decade, the use of CBCT has been introduced into clinical dentistry as a diagnostic method and has been widely applied in various fields of dentistry[25]. Although the same technique is used to

locate canals, the percentages present discrepancies, because in each of the studies the sample sizes, population, age, sex and the variables used changed.

CONCLUSIONS

Cleaning, shaping and filling the root canal system are the keys to successful root canal treatment. The use of CBCT is one of the most reliable methods to confirm the existence of a MB2 root canal in maxillary molars, in order to obtain a more accurate diagnosis. By applying this imaging technique, we obtained a 53.49% location of the MB2 root canal in maxillary second molars, which represents a high percentage. Our finding tells us about the importance of carrying out a correct search for the canal, since not being located and treated adequately can be the cause of treatment failure in the maxillary second molar. For this reason, the professional must use all the necessary methods and techniques for adequate localization and treatment of this canal and thus improve the long-term prognosis.

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