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Middle Mesial Canals Prevalence percentage and Its Configuration type with "Egyptian subpopulation" by CBCT

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ABSTRACT

The Aims of This Study*: were to detect the middle mesial canals (MMCs) prevalence in mandibular 1st molars, its configuration type, and its percentage of incidence with age by Cone-Beam Computed Tomography (CBCT) analysis.*

Methods: *CBCT scan of 1650 patients were observed between January 2021 to February 2022 were collected using the CBCT imaging system from the database of the department of oral radiology, faculty of dental medicine, Al-Azhar University - Assiut branch. CBCT scan images were analyzed by Sidexis software. CBCT images were examined to detect the following: (1) The percentage of incidence frequency of the MMCs, (2) MMCs classification, and (3) Frequency of occurrence of MMCs according to age.*

Results: *The incidence frequency percentage of the presence of MMCs among the Egyptian population was 10.79 % (208/1926) with no statistically significant due to gender, While MMCs configuration types showed 77% (160/208) confluent anatomy merging with either the mesio buccal or mesio lingual canals, 16.3% (34/208) fin anatomy and only 6.7% (14/208) showed independent MMCs with separate orifices and apical foramen. lastly the incidence frequency percentage of the presence of MMCs decreases with age.*

Conclusions: *The MMCs prevalence in mandibular 1st molars among some Egyptian population was 10.79%, and CBCT scan is helpful way to detect the presence of MMCs.*

Keywords

Middle mesial canals, Cone-Beam Computed Tomography, Configuration type.

Abbreviations

MMCs: Middle Mesial Canals, CBCT: Cone-Beam Computed Tomography.

Introduction

The successful of endodontic treatment requires to find and detect all root canal for further removal of all debris, and bacteria for good sealing of all canals. On other hand, the dentist should be fulfillment of the internal anatomy of the teeth and its variations [1].

Abnormal root canal morphology maybe contributes to the root canal failure because of lack of knowledge of all root canal anatomy variation. The success of endodontic treatment necessitates chemo mechanical preparation for all root canal spaces. Complete chemo mechanical preparation for lateral canals, ramifications, and intercanal communications is very important to facilitate healing of the periapical tissues [2].

Mandibular molars are one of the teeth with abnormal root canal morphology. High incidence of internal morphology variation as C-shaped canals, isthmus, and its mesial root may possess mor than two canals [3,4].

De Pablo discovered the existence of a third canal in the mesial root of lower 1st molars. After that, Pomeranz et al. classified this third canal to three types: independent, confluent, and fin. After that, this canal was named "middle mesial canal", and "accessory mesial canal". More studies were held to detect this canal by different ways, and its incidence rate ranges from 0.26 to 46.15% [5].

Magnification has enhanced the ability to detect canals that could not usually be observed by clinical inspection alone [6]. This has increased the number of published case reports showing unsuccessful endodontic treatment because Accessory Mesial Canals are not always visible without the aid of magnification [7].

In vivo studies utilizing radiograph, CBCT, MICRO CT, guided troughing, and use of CBCT has been used for evaluating middle mesial canals in North America, South America, Europe, and South Asia. The Presence of the middle mesial canal in the range of 4-28% is recorded. An *in vivo* study was done in mandibular first molars with the utilization of ultrasonic tips and endodontic explorer under a Dental Operating Microscope in the north Indian population. 28.3% of the negotiable middle mesial canal has been reported in the study [1].

In recent years CBCT was devolved and become widely used due to its low radiation dose with high image resolution, three-dimensional reconstruction more than apical film or panoramic images [8,9]. On other hand CBCT was used in different studies to detect the presence of MMCs reliable clinical imaging data [10,11]. Therefore, this study aims to determine the percentage of incidence frequency of the middle mesial canals (MMCs) of mandibular 1st molars, Its configuration type, and its percentage of incidence with age among some Egyptian population by CBCT scan.

Methods

The study design of this study research was passed on Yang et al. design [5].

Samples Selection

This study was approved by the Medical Ethics Committee of the Faculty of Dental Medicine, Al Azhar University, Assuit, which granted approval for the research with number (AUAREC20200315-11). The procedures were carried out in conformity with applicable laws and regulations. All patients provided signed consent forms after being given written information.

Patients required radiographic examination of CBCT as part of their dental treatment. The images were taken as part of the routine examination, diagnosis, and treatment planning of patients that included those suffering facial trauma who required oral surgery, orthodontic treatment or who needed implant treatment. With the informed consent of the patients. CBCT was used to scan the mandibular region of the patient to obtain a continuous image of the mandibular 1st molar and its periodontal tissue. CBCT scan of 1650 patients were observed between January 2021 to February 2022 were collected using the CBCT imaging system from the database of the department of oral radiology, faculty of dental medicine, Al-Azhar university - Assiut branch. All images were included in the study and further analysis according to the following inclusion criteria:

- Age between 20 and 60 years.
- Lower 1st molars that had not been received root canal treatment.
- Lower 1st molars without periapical disease.
- Lower 1st molars exhibit absence of coronal or post and core restorations, which may obscure the imaging study.

Exclusion Criteria

- Cases where physiological or pathological processes compromised the anatomy and the original root canal morphology was not clear.
- Images with missing all mandibular molars.

CBCT scanning

CBCT images were acquired using Orthophos S 3D extraoral imaging system (Dentsply Sirona) A scout view was acquired, and adjustments were made to ensure that all patients were correctly adjusted in the scanner according to light beam before acquisition. the Feld-Of-View size (FOV) of 8×8 cm, a peak voltage of 90 kV, a beam current of 16 mA and an exposure time of 14.s for a full arch. The voxel size was 160 µm×160 µm, and the minimum layer thickness was 0.16 mm. The detector resolution was 1024×1024 pixels, and the pixel size was 127 µm×127 µm.

After acquisition, data were exported and transferred to Sidexis software (Sirona, DICOM viewer software, version 4.0.2, Germany) Serial axial, coronal, and sagittal CBCT images were thoroughly examined from the pulp orifice to the apex. All the images were assessed separately by two endodontists. In cases of disagreement, these two endodontists discussed the data until a consensus was reached. An oral radiologist provided guidance when necessary. CBCT was used to scan the mandibular region of the patient to obtain a continuous image of the mandibular 1st molar and its periodontal tissue.

Variables to Be Analysed In This Study

1. Incidence frequency of the MMCs present in lower 1st molars (Figure 1).

2. Middle Mesial Canals classification (Figure 2) according to the classification of Pomeranz et al. [12]:
3. Confluent either with the mesio buccal canal or with the mesio lingual canal, b) Independent, and c) Fin type (no separate orifice).
4. Frequency of occurrence of MM canals according to age.

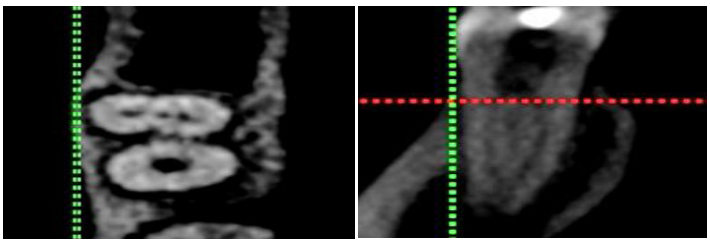

Figure 1: A photograph showing the presence of MMC in axial view in CBCT scan.

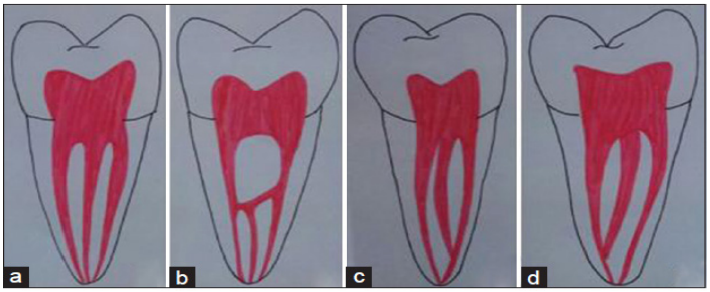

Figure 2: A diagram of Pomeranz et al. classification of middle mesial canal. (a) Independent b) Fin (c) Confluent with mesio buccal d) Confluent with mesio lingual [13].

Statistical Analysis

Categorical data were presented as frequencies (n) and percentages (%) and were analyzed utilizing Fisher's exact test. Numerical data were explored for normality by checking the data distribution, calculating the mean and median values, and using Kolmogorov-Smirnov and Shapiro-Wilk tests. Data showed parametric distribution, so they were presented as mean and standard deviation (SD) values and were analyzed using one-way ANOVA test. The significance level was set at $p \leq 0.05$ within all tests. Statistical analysis was performed with R statistical analysis software version 4.0.3 for windows ® Core Team (2020).

Results

CBCT scan of 1650 patients were observed, and 1926 CBCT images of 1200 patients met the inclusion criteria, among which 208 CBCT images contained MMC. The incidence of MMCs in our experimental study was 10.79 % (208/1926) as illustrated in figure 3. Among them, there were 108 (51.9%) males and 100 (48.1%) females, and the difference was not statistically significant (P = 0.215). Moreover, there was no significant difference in the distribution of MMCs between the right and left side. These results are illustrated in figure 4.

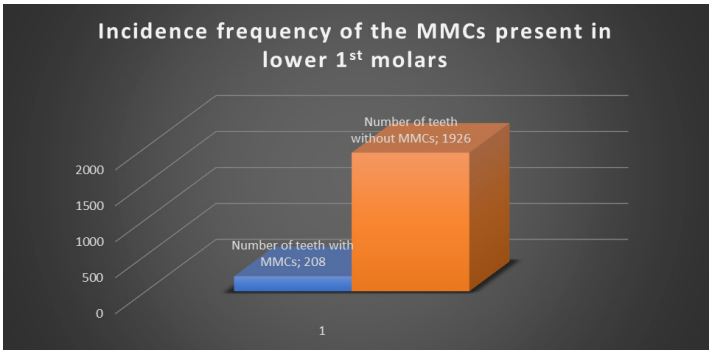

Figure 3: A bar chart showing incidence frequency of the MMCs present in lower 1st molars.

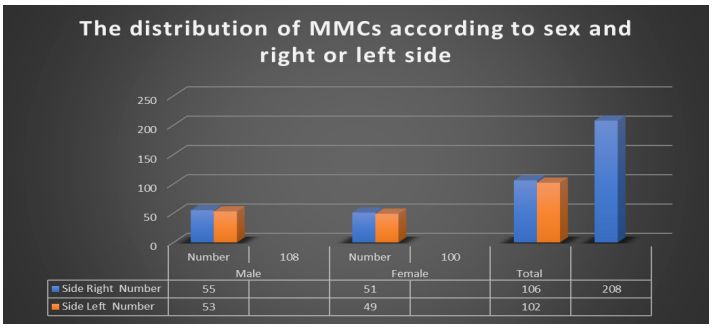

Figure 4: A bar chart showing distribution of MMCs according to sex and right or left side.

The results of this study concerning the frequency occurrence of MMCs in three age groups (group A: < 30, group B: 30–50, and group C > 50 years) revealed that group A exhibited a greater occurrence of MMCs (96/208) than group B (73/208) or C (39/208) but with significant deference where P = 0.002 as illustrated in figure 5.

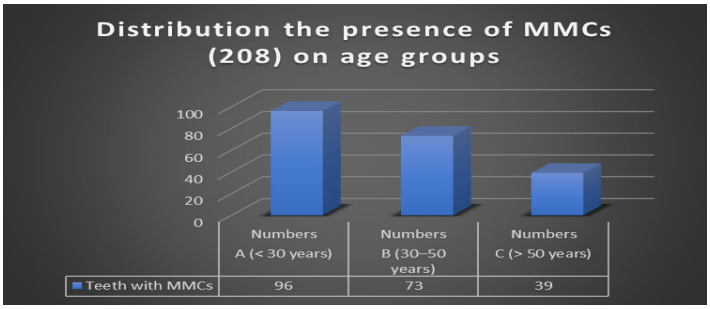

Figure 5: A bar chart showing distribution the presence of MMCs according to age groups.

Our study results that concerning MMCs type was illustrated in figure 6, and it showed that 77% (160/208) confluent anatomy merging with either the mesio buccal or mesio lingual canals, 16.3% (34/208) fin anatomy and only 6.7% (14/208) showed independent MMCs with separate orifices and apical foramen.

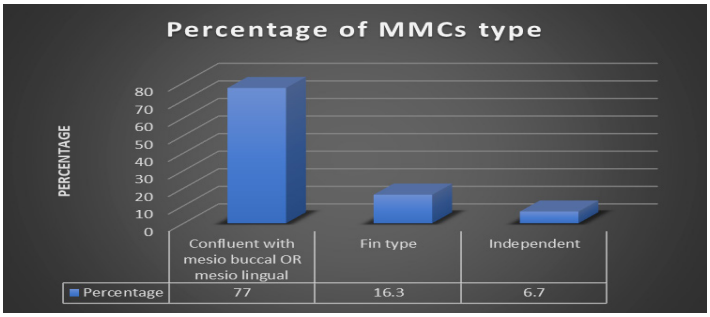

Figure 6: A bar chart showing the percentage of MMCs types.

Discussion

Racial and ethnic factors explained the presence of certain abnormalities as the prevalence of MMCs in the mesial root of lower molars that may occur at different rates in different parts of the world. On other hand the methods used to detect root canal abnormalities also plays a big role in detection the prevalence of MMCs [14].

CBCT image scans were used in our research study to visualize the root canal anatomy with low radiation dosage, and high resolution [15].

In vivo and *in vitro* studies were reported the incidence of MMCs [6, 16 – 22]. The detection of the increased incidence rates reported of accessory canals were done under magnification, moreover occurrence percentage of MMCs was reported as 46.2% [19].

In our study, the incidence frequency percentage of the presence of MMCs among the Egyptian population was 10.79 % (208/1926) with no statistically significant due to gender, while the frequency of the prevalence of MMCs in the studies searched with different populations varied from (1%) to (46%) the variability in results can be attributed to several possible reasons such as ethnic population, sample size, study design and methods to detect the middle mesial canal.

Our study is the 1st study about detecting the frequency percentage of the presence of MMCs among the Egyptian population dealing with large number of CBCT image scans.

The differences in age groups of this study revealed high frequency of the prevalence of MMCs at the young age and decrease with ageing so it is easier to detect the MMCs in younger patients because they have less physiologic or pathologic pulp calcifications than older patients, these results agree with the previous studies reporting the effect of age on frequency of the prevalence of MMCs [14,16,17,20-22]. Similar results were reported by Sherwani et al., [2] who observed that there was a significant decrease in the incidence of MMCs with an increase in age in an Indian population.

Deposition of secondary dentine within the canal at the cervical, middle, and apical thirds in the mesiodistal direction was explained by Hess [23] to be the cause of root canal variations that causes canal separation. At 30 - 40 years of age in lower first and second molars was confirmed that canal differentiation is completed at this range of age [24].

The most frequent canal configuration type among the Egyptian population was showed that 77% (160/208) confluent anatomy merging with either the mesio buccal or mesio lingual canals, 16.3% (34/208) fin anatomy, and only 6.7% (14/208) independent MMCs with separate orifices and apical foramen.

Our results are like other studies. These studies reported high percentage rate of confluent anatomy of MMCs [20,21]. On other side there was disagreement of our result to the result of Karapinar-Kazandag et al. [22] they reported that no incidence of independent or fin anatomy, and all MMCs have confluent anatomy.

Conclusion

The MMCs prevalence in mandibular 1st molars among some Egyptian population was 10.79 %, and CBCT scan is helpful way to detect the presence of MMCs.

Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request. Data cannot be deposited in a public repository since this research is not yet published. For that reason and for data confidentiality data will be granted upon reasonable request.

Declarations

Ethics Approval and Consent to Participate

This study was approved by the Medical Ethics Committee of the Faculty of Dental Medicine, Al Azhar University, Assuit, which granted approval for the research with number (AUAREC20200315-11). A written informed consent signed was obtained from all participants and/or their legal guardians. All methods were carried out in accordance with relevant guidelines and regulations of Helsinki Declaration of the World Medical Association regarding using human participants. All the data used in this study were anonymized before its use.

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