Medical Science

pISSN 2321–7359; eISSN 2321–7367

Identification of the Mental Foremen Location VS The Dental Procedure: A Retrospective Study by A Cone Beam Computerized

Osama Qutub[1], **Khames T Alzahrani**[2], **Abdulrhman Alharbi**[3], **Muath Saeedi**[3], **Tlal Qutob**[3], **Yazeed Arif**[3], **Rawan Khallaf**[3], **Khalid Arif**[3], **Afnan Kamrani**[3], **Abdulelah Alrasheedi**[4], **Abdulaziz Alharbi**[3], **Sultanah Alahmari**[3], **Sarah Alshammari**[3], **Samar Abuzinadah**[5], **Abdulrahman Alhaddad**[6]

To Cite:
Qutub O, Alzahrani KT, Alharbi A, Saeedi M, Qutob T, Arif Y, Khallaf R, Arif K, Kamrani A, Alrasheedi A, Alharbi A, Alahmari S, Alshammari S, Abuzinadah S, Alhaddad A. Identification of the Mental Foremen Location VS The Dental Procedure: A Retrospective Study by A Cone Beam Computerized. *Medical Science* 2023; 27: e1ms2585.
doi: https://doi.org/10.54905/disssi/v27i131/e1ms2585

Authors' Affiliation:
[1]Associate professor and consultant, Oral & Maxillofacial Prosthodontics Department, King Abdulaziz University, Faculty of Dentistry, Jeddah, Saudi Arabia
[2]BDS, PGD in Endo, Saudi Board of Endodontic SR, King Faisal Specialist Hospital & Research Center, Riyadh, Saudi Arabia
[3]General dentist, SaudiArabia
[4]Dental intern, King Abdul-Aziz University, Jeddah, Saudi Arabia
[5]Consultant of Restorative and Digital Dentistry, Restorative Dentistry Department, King Abdul-Aziz University, Faculty of Dentistry, Jeddah, Saudi Arabia
[6]Consultant of Prosthodontics, Oral and Maxillofacial Prosthodontics Department, King Abdul-Aziz University, Faculty of Dentistry, Jeddah, Saudi Arabia

Peer-Review History
Received: 08 November 2022
Reviewed & Revised: 12/November/2022 to 13/December/2022
Accepted: 29 December 2022
Published: 1 January 2023

Peer-review Method
External peer-review was done through double-blind method.

URL: https://www.discoveryjournals.org/medicalscience

DISCOVERY SCIENTIFIC SOCIETY

ABSTRACT

Background: Recognizing the anatomical differences in the location of the mental-foramen (MF) is essential for various dental procedures. The purpose of this study to determine horizontal and vertical anatomical localization of MF in relation to the apex of second premolar, mandibular midline, superior-border of the mandible and inferior-border of the mandible. *Methods:* A retrospective cone beam computerized tomography was used for assessment the horizontal and vertical anatomical localization of MF in relation to the apex of second premolar, mandibular midline, superior-border of the mandibular and inferior border of the mandibular. A cone beam computerized tomography was obtained from Saudi patients visiting university dental clinics in western region, Saudi Arabia. X-rays were taken for a variety of diagnostic purposes. Statistical analysis was carried out using SPSS® version 26.0 for Windows (IBM®, Armonk, NY, USA), descriptive statistics of connected to age and gender. *Results:* In this study, CBCT images of the mandible were obtained from 500 patients. 39% of them were males and 61% were females. Almost half cases 49.8% showed mental foremen under the second premolar's apex in relation to the teeth on each side of the mandible, while, 32.2% of MF between 1st and 2nd pre-molar. *Conclusion:* Anatomical localization of MF was most frequently seenbelow the second-premolar among Saudi population. When doing dental implant, surgical extraction and surgical endodontic treatment in the premolar region, the anatomic location of the MF must be taken into consideration.

Keywords: Mental nerve, mental foramen, anatomical localization.

1. INTRODUCTION

Due to their proximity to the root apices of the teeth, adequate understanding of vital anatomical structures is fundamental in the practice of endodontics (Direk et al., 2018). This understanding is critical for diagnosis, especially during radiographic examinations, root canal treatments (RCT) (Ayob et al., 2022) and surgical endodontic. One such structure is the mental foramen (MF) (Costamagna et al., 2021). The mental-foramen (MF) is a funnel-like aperture of the mental canal on to the mandible's lateral side (Altimimi et al., 2022). The mental nerve is a branch of the inferior alveolar nerve that comes from the foramen to the mandible's anterior area. It provides sensory innervations to the lower lip, teeth, buccal and gingival tissue of the premolar and the front portion of the jaw (Elangkovan and Ganapathy, 2021). During dental procedures, misdiagnosed of mental foramen positions may cause serious injury to mental nerve for that the recognizing anatomical location of mental foramen's is essential (Udhaya et al., 2013). In 54 percent of the mandibles assessed, the MF is oval, whereas in 46 percent, it is round. The foramen opens superiorly in 44% of cases, poster superiorly in 40% of cases, labially in 10% of cases, mesially (anteriorly) in 3 percent of cases and posteriorly in 3% of cases (Aminoshariae et al., 2014).

The location of MF must be determined clinically in order to avoid iatrogenic nerve damage, par aesthesia, anesthesia and numbness of the teeth or lower lip, as well as skin and mucosa surrounding the MF (Doh et al., 2018). Cone beam computed tomography (CBCT) is a 3D radiography technology used in a variety of dental surgical procedures to evaluate normal anatomical features and detect abnormalities (Shaban et al., 2017). It is impossible to precisely detect the exit pattern of MN using two-dimensional (2D) radiography methods such as intra-oral periapical imaging (IOPA) or ortho-pantomo-graphy (OPG) due to the limitations of overlapping structures. (3D) radiography techniques are superior to two-dimensional (2D) radiographic modalities (Alyami et al., 2021). High-resolution CBCT is currently the most effective and accurate tool for detecting the positioning of MF and the presence of AL quantitatively (Al-Mahalawy et al., 2017).

In 2018 study was assess the mental foremen location and size the study found the MF is usually found between the mandibular premolars, approximately two mm under the (apex) of the 2nd pre-molars (Bello et al., 2018). Sheth et al., (2022) showed that the MF was most closely approached by the root-apices of mandibular-second-premolars (Left: 71 percent and Right: 62 percent) in an Indian population. Many investigations have shown differences between ethnic groupings and genders (Afkhami et al., 2013). However, only a few researchers have described on the location of mental foramen in Saudi Arabia. Therefore, the purpose of this study to determine horizontal and vertical anatomical localization of MF in relation to the apex of 2nd-premolar, mandibular midline, superior-border of the mandibular and inferior-border of the mandibular.

2. MATERIALS AND METHODS

A retrospective study by cone beam computerized tomography analysis, the study was performed from July 2021 to October 2022. The study design was approved by research ethics committee with IRB number (001-01-22). The authors used cone beam computerized tomography which was taken before for diagnostic necessity and different treatment procedure from University Dental Clinics in western region, Saudi Arabia, based on (Open-Epic v.2.3) software program calculations, a sample size of 500 cone beam computerized tomography.

Assessments of Cone beam computerized tomography were previously performed for a variety of purposes, which include diagnosis of trauma, impacted 3rd molar, treatment planning prior to endodontic therapy and preoperative assessments for surgical intervention, assessing the interactions between teeth and clinically significant anatomical structures, dental surgery and the identification of radiolucent lesions. Following standardization, a pilot study with 30 scans was conducted to test the methodology's viability and feasibility. The cone beam computerized tomography images were included based on the presence of MF, absence of lesions in the apical-area of premolars and MF, absence of bone resorption. The investigation only included images that provided information about the patients. Images having extensive pathological lesions in the mandibular, osteoporotic fractures in examination areas, existence of primary teeth, poor pic quality will be excluded (Figure 1).

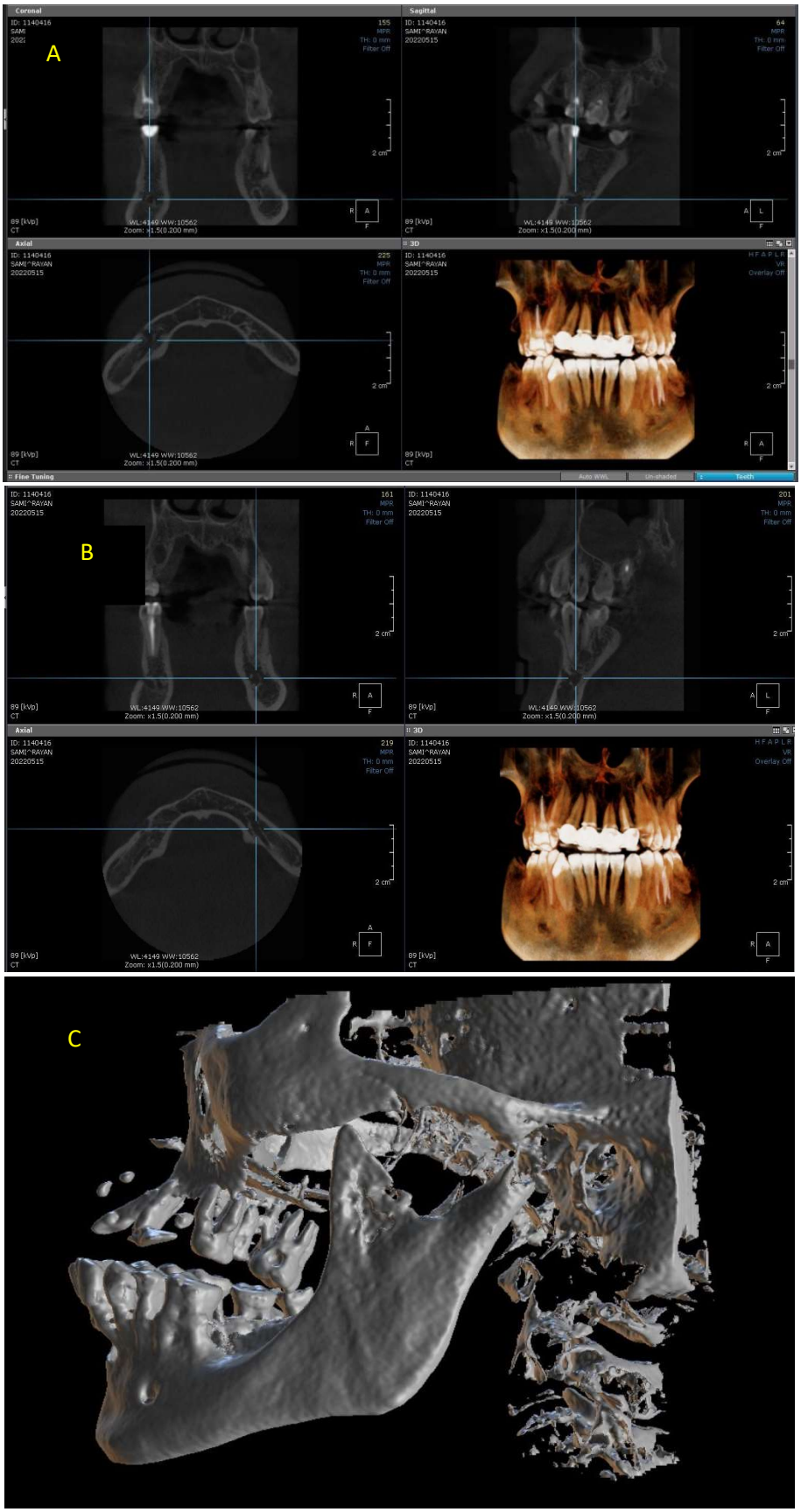

Figure 1 Cone beam computerized tomography Images (A, B, C)

The MF was determined as:

(I) Between the 1st and 2nd premolar, (II) Under the 2nd premolar, (III) Under the 1st premolar, (IV) After the 2nd premolar (V) Before the 1st premolar.

The mental-foramen dimensions according tothe distance of the (mental foramen center) to other landmarks was documented as:

a. The distance between MF and nearest root apex of adjacentmidline, the superior and inferior borders of the mandible.
b. The distance between the apexes of the 2end-premolar to the mental foramen.
c. The distance between the mandibular midline to the mental foramen.
d. The distance between two mental foramens.
e. The distance between the superior-border of the mandibular and the mental foramen.
f. The distance between the inferior-border of the mandibular and the mental foramen.

The mental foramen and other landmarks were measured by viewing, axial, sagittal and coronal cuts of the CBCT scan. Data analysis and tabulation was performed using the IBM statistics SPSS version 26.0. We used descriptive statistical for analysis. The Pearson chi-square test was used to assess the relationship between the site of the mental-foramen to gender and age in addition to those factors. P-value of 0.05 or above was considered statistically significant.

3. RESULTS

Table 1 shows demographic characteristics of the study patients. In this study, CBCT images of the mandible were obtained from 500 patients. 39% of them were males and 61% were females. 56.4% of patients aged between 31- 40 years old, 23.8% less than 20 and 19.8% aged between 20-30 years old. The mean age of the study patients was 29.21±9.43 years. 88.8% are having Saudi nationality. The majority of patients 97% were from western region.

Table 1 The socio-demographic of the patients (n=500)

Parameter		No.	%
Gender	Male	195	39
	Female	305	61
Age	Less than 20	143	28.5
	20 – 30	120	24
	31 – 40	237	47.5
Region	western region	485	97
	Others	15	3
Nationality	Saudi	460	92
	Non-Saudi	40	8

Table 2 shows that almost half cases 49.8% showed mental foremen under the second premolar's apex in relation to the teeth on each side of the mandible, while, 32.2% of MF between 1st and 2nd pre-molarand 10.9% of cases, it was located below the apex of 1st premolar and 4.9% was after the 2nd premolar. Only 2.3% were detected before the 1st premolar. Statistically, no significant findings were observed ($p < 0.05$).

Table 2 The mental foramen Position on both sides of the mandible, in relation to the surrounding teeth

The mental foramen Position	Between the 1st and 2nd premolar	Under the 2nd premolar	Under the 1st premolar	After the 2nd premolar	Before the 1st premolar
Right mental foramen	84	128 (25.6%)	31	13	7
Left mental foramen	77	121 (24.2%)	24	12	3
Total	161(32.2%)	249 (49.8%)	55(11%)	25 (5%)	10 (2.2%)

As illustrated in (Table 3); the mean of distance (mm) from the core of the mental-foramen to other-landmarks. The Right MF to apex of 2nd premolar (6.2 mm) and the mental foramen to the inferior-border of the lower-arch (11.5 mm). The Left MF to apex of 2nd premolar (5.9 mm) and the mental foramen to the inferior-border of the lower-arch (11.2 mm) (Figure 2).

Table 3 The distance (mm) of mental foramen measurements in female from the core of the mental-foramen to other-landmarks

Mental Foramen Measurements	Female (mm)	
	Right mental foramen	Left mental foramen
Mental foramen to the apex of second premolar	6.2	5.9

Mental foramen to the mandibular midline	27.2	26.9
Between two mental foramen	51.4	51.9
Mental foramen to the superior-border of the lower-arch	15.9	15.2
Mental foramen to the inferior-border of the lower-arch	11.5	11.2

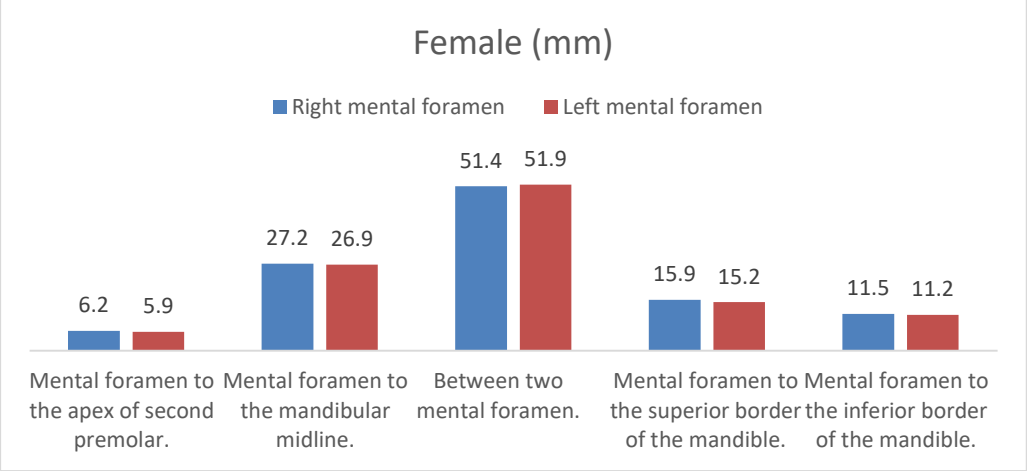

Figure 2 The distance (mm) of mental foramen measurements in female from the core of the mental-foramen to other-landmarks

As shown in (Table 4); the mean of distance (mm) from the core of the mental-foramen to other-landmarks. The right MF to apex of 2nd premolar (5.9 mm) and the mental foramen to the inferior-border of the mandibular (11.7 mm), the left MF to apex of 2nd premolar (5.7 mm) and the mental foramen to the inferior-border of the mandibular (11.3 mm) (Figure 3).

Table 4 The distance (mm) of mental foramen measurements in Male from the core of the mental-foramen to other-landmarks

Mental Foramen Measurements	Male (mm)	
	Right mental foramen	Left mental foramen
Mental foramen to the apex of second premolar	5.9	5.7
Mental foramen to the mandibular midline	27.4	28.9
Between two mental foramen	51	51.4
Mental foramen to the superior-border of the lower-arch	15.8	15.3
Mental foramen to the inferior-border of the mandibular	11.7	11.3

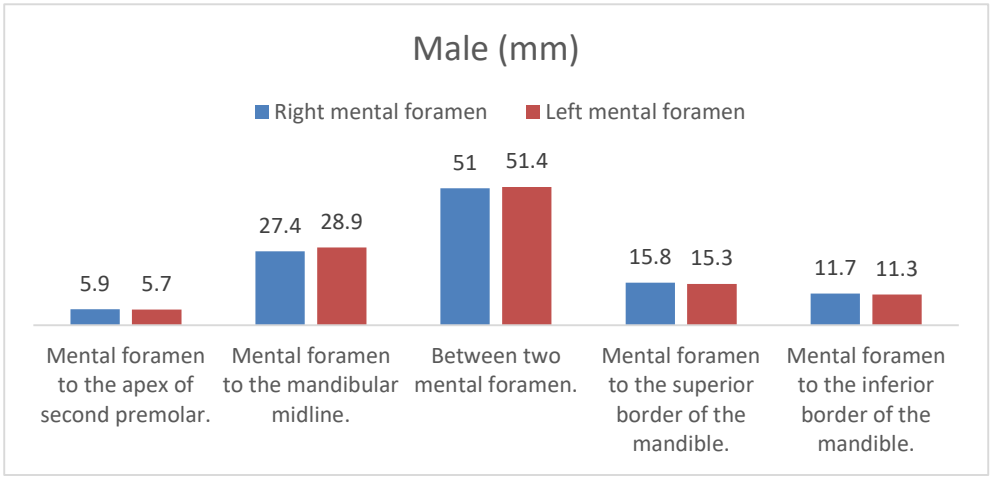

Figure 3 The distance (mm) of mental foramen measurements in Male from the core of the mental-foramen to other-landmarks

As shows in (Table 5) the mental foramen measurements according to age groups and sides the MF was determined as (i) Between the 1st and 2nd premolar, (ii) Under the 2nd premolar, (iii) Under the 1st premolar, (iv) After the 2nd premolar (v) Before the 1st premolar. The right MF according to age between 31-40 years old was (i=n (34), ii=n (54), iii=n (16), iv=n (7), v=n (5)).

Table 5 The mental foramen measurements according to age groups and sides

Age group	I		II		III		IV		V	
	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left
Less than 20	28	26	40	33	9	7	4	2	1	0
20-30	22	19	34	28	6	5	2	0	1	1
31-40	34	31	54	61	16	12	7	10	5	2

The mental foramen measurements according to age groups and sides, the MF was determined as (i) Between the 1st and 2nd premolar, (ii) Under the 2nd premolar, (iii) Under the 1st premolar, (iv) After the 2nd premolar (v) Before the 1st premolar. The right MF according to female gender was (i=n (52), ii=n (74), iii=n (18), iv=n (7), v=n (4)) (Table 6).

Table 6 The Mental foramen measurements according to gender groups and sides

Gender group	I		II		III		IV		V	
	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left
Male	32	29	51	46	16	8	6	2	3	2
Female	52	48	74	75	18	16	7	10	4	1

4. DISCUSSION

The current study utilized cone beam computerized tomography imaging to identify the horizontal and vertical anatomical localization of mental foramen among patients visiting university dental clinics in western region, Saudi Arabia. Whenever performing a mental nerve block and carrying out surgical-procedures in the targeted location, the accurate identification of MF is assumed to be a crucial aspect to prevent significant complications. Several methods have been proposed by our authors to detect and recognize the MF. Manual-recognition, direct-observation throughout surgeries, OPG or PA images, MRI, computed tomography (CT) and (CBCT) cone-beam-computed-tomography are all examples. The majority of these technologies have limitations, including high costs, extra radiation and magnification (Aminoshariae et al., 2014).

Cone-beam-computed-tomography one of the most accurate and successful methods currently available to accurately identify the exact location of horizontal and vertical anatomical localization of mental foramen for that the author suggested to detected the MF by the (CBCT). On the other hand, periapical radiographs could not reveal the location of the foramina if it lies beneath the films border (Vujanovic et al., 2015). There are variances as far as how MF is seen by various races. Another research using panoramic radiography in the Saudi population revealed that male patients' mental foramen typically in the area between the 1st and 2end pre-molars, whereas it was more frequently found apical to the mandibular 2nd premolar in female patients (Al-Khateeb et al., 1994). In our result demonstrated that the most prevalent MF position considered (i) Between the 1st & 2nd premolar 49.8% among mans and women's pt, which coincided with a comparable investigation utilizing OPG radiography was a chosen Saudi population (AljasserandNwoku, 1998). Significant variations in MF location were detected in our research when compared to age group.

Some studies shows that MF is frequently observed between the 1st & 2nd premolar (Currie et al., 2016; Gungor et al., 2006; Verma et al., 2015; Von et al., 2013). As according to some of previous-research was done on the KSA population, the MF is often present below the 2nd pre-molar (Al-Mahalawy et al., 2017; Aljasser and Nwoku, 1998). Our findings confirmed that the MF was positioned below the second premolar in 249/500 (49.8%), 128/500 (25.6%) on the left side and 121/500 (24.2%) on the right side of the images. Studies may differ due to various assessment techniques and investigations using CBCT are thought to be more precise and provide more information about the actual position than research using panoramic X-rays. When performing some surgical operations, such as apicoectomy and genioplasty, the distance between the mental foremen and the root-apex of the next nearby root is a significant element to consider. To minimize these risks to the neurovascular bundle leaving the mental-foremen, a surgeon must be aware of the exact distance of the MF from the roots.

According to our findings, the right mental foramen was most typically placed at 6.2mm and the left mental foramen at 5.9mm to the apex of the 2nd in females, whereas the right mental foramen was positioned at 5.9mm and the left mental foramen at 5.7mm in males, which this similar to comparable research conducted in 2013 utilizing conebeam computed tomography (Von et al., 2013). Our paper showed, a mental foramen measurement from MF to the superior-border of the lower-arch was present right mental foramen at of 15.2 and left mental foramen at of 15.9 among Female and right mental foramen at of 15.3 and left mental foramen at of 15.8 among male the mean value; 15.55 mm. This result was near to the result was performed by Haktanir et al., (2010) which

presented a mean-distance of 14.2 mm of mental foramen measurements from MF to the superior-border. The explanation for the marked difference might be due to alveolar bone loss.

Some investigators proposed utilizing the cemento-enamal junction of neighboring teeth as a trustworthy point of reference instead of crestal bone resorption to cancel out the variations caused by alveolar bone resorption (Ahmadi et al., 2010). The mental canal connects the mandible's posterior and superior boundaries. Position variation in the mental canal appears to be caused by developmental problems with the jaw during the fetal period. The mental-foramen's position may shift as a result of tooth loss and age. Al-Mahalawy et al., (2017) also said that gender influences the mental-foramen's position furthermore; genetics influences the morphology of tooth structures.

Our result finds, a mental foramen measurement from MF to the inferior-border of the mandibular was present in right mental foramen at of 11.2 and present in left mental foramen at 11.5 among female and in right mental foramen at of 11.3 and left mental foramen at 11.7 among male the mean value; 11.43 mm in study was done by Kalender et al., (2012) among Turkish patients and the paper estimated the MF to be 12.4 mm above the inferior boundary of mandible. It is important to note that studies with larger distances between the lower border of the mandible and the mental foramen (MF) utilized the MF's center rather than its inferior edge as the starting point for measurement (Guo et al., 2009; Shalash et al., 2020).

5. CONCLUSION

In summary, this paper was done to obtained distance (mm) of mental foramen measurements in male and female from the core of the mental-foramen to other-landmarks and compering the mental foramen measurements with gender groups, age group and sides. The most common position of MF considered (i) Between the 1st & 2nd premolar 49.8% among male and female pt. Dental practitioners may use the study's findings as a reference while doing dental implant, mental nerve block, apicoectomy and surgical extraction in that area to help them distinguish the MF to prevent nerve injury.

Ethical approval

The research proposal was approved by the Regional Research and Ethics committee of King Abdulaziz University with Ethical approval number (135-11-22).

Acknowledgements

Special thanks to the Deanship of Scientific Research (DSR) and the Faculty of Dentistry at King Abdulaziz University, Jeddah, for supporting this project.

Funding

This study has not received any external funding.

Conflict of interest

The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

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