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Sex Identification Through Mental Foramen Position Utilizing Cone Beam Computed Tomography (CBCT) In Iraqi Inhabitants Sample (A Retrospective Study)

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Abstract

Background: *One of the hardest jobs in forensic dentistry has been to identify and determine the sex of unidentified remnants of human skeletal tissue.*

Aim of the study: *By assessing measurements of the foramen of mental location in an Iraqi inhabitant's specimen, this study seeks to define cone beam computed tomography's (CBCT) role in sex definition and assess the foramen of mental magnitude as a tool for sex identification.*

Materials and Methods: *To examine the foramen mental, 50 CBCT radiographs were chosen, 25 for both sexes. It has been detected the distance between the inferior and superior borders of the foramen of mental and the lower border of the mandible on both sides by drawing tangents to the inferior and superior borders of the foramen of mental and then erecting perpendiculars to the lower border of the jaw from those tangents. The obtained data was statistically analyzed using the chi-square test and PSSP version 25 to assess the two sexes.*

Results: *Males had significantly greater average magnitudes of IL and SL on the left-side of the body than females. However, the study sample's right-side distances were not statistically significant.*

Keywords: *Cone beam Computed tomography, linear metrics, the foramen of mental and sex assignment.*

Introduction:

Sexual dimorphism is traditionally utilized as a method for human identification in forensic dentistry. Sex human remains identification is a crucial aspect of several medico-legal assessments and forensic anthropology. Numerous approaches are available; nevertheless, DNA testing provides the most accurate method. Compared to histological and biochemical approaches, radiography is the most cost-effective and straightforward tool for diagnosing sex and estimating age (1, 2). The sex could be determined confidently when the whole adult skeleton is available for analysis, which is not always accurate when fragmented bones are frequently found in mass catastrophe scenarios. The accessibility of skeletons significantly influences the outcome. (1-3). After the pelvis, the skull is the skeletal component most readily identifiable by sex and exhibits significant dimorphism, with an accuracy of up to 92%. (1). The mandible might significantly contribute to sex identification when a whole skull is unavailable because it is the cranium's most prominent, vital, and dimorphic bone. (4, 5). The mandible is the most robust human bone and endures the longest in good condition. Consequently, anthropologists and forensic odontologists often analyze the physical traits of the mandible to ascertain sex (6).

The foramen of mental is a funnel-shaped opening located 1.1 to 1.5 cm above the mandible inferior border, facilitating the passage of mental nerves. The sensory innervation of the gingiva, buccal vestibule, and lower lip, extending from the oral cavity to the mandibular teeth, is provided by nerves and arteries. As the foramen wall consists of cortical bone, the foramen of mental visibility on radiographs diminishes with increasing bone density. The foramen of mental, a prominent anatomical marker of the mandible, helps in analyzing anatomical features in forensics and oral pathology (7, 8, 9).

Previous studies indicate that CBCT scans are the preferred imaging modality for locating the foramen of mental in radiographic approaches. CBCT is the predominant diagnostic modality among radiographic modalities due to its capacity for enhanced localization of the mental foramen (10).

CBCT is a contemporary CT technique focusing on the neck and head zones, utilizing a dynamic X-ray beam and detecting apparatus. CBCT is extensively utilized for diagnostic purposes across several dental disciplines, involving maxillofacial surgery, periodontics, orthodontics, endodontics, and forensics (11). Compared to multidetector computed tomography (MDCT) systems, CBCT is a more cost-effective and compact technique that maintains the accuracy and reliability of MDCT pictures. The rising CBCT utilization has lately heightened interest in the anatomical features and the human mandible variations (12, 14). Panoramic radiography lacks the measuring accuracy of CBCT for three-dimensional assessment of the mandible (15). In linear assessments within the coronal and axial image planes and other maxillofacial regions, CBCT demonstrates exceptional accuracy and reproducibility (16). This research aimed to assess the contribution of CBCT to sex identification by identifying the foramen of mental in a specimen of Iraqi individuals.

Material and Mouthed:

Study design

The current retrospective investigation, performed in the Radiology and Diagnosis department of the Baquba Specialty Dental Center in Diyala, involved outpatients aged 18 to 60 who came in for regular dental checkups. Fifty CBCT radiographs, 25 of both sexes, have been involved in the sample, leading to the examination of one hundred mental foramen.

Criteria for patient selection:

Inclusion Criteria

1. CBCT scans already performed for root fracture, endodontic, or implant remediations.
2. Participants who are under 60 years old and over the age of 18.
3. Radiographs showed that subjects without maxillofacial surgery showed symptoms.
4. No artifact-free radiographic pictures at the measuring point.

Exclusion Criteria

1. Age under 18 due to the foramen of mental invisibility because of mixed dentition
2. Image distortion.
3. Availability of artifacts.
4. Existence of pathological lesions or fractures in the mandible where measurements were taken.

Images analysis

CBCT scans were conducted utilizing the New Tom VGi CBCT unit, adhering to the standardized protocol for all patients.

The scanning parameters included 110 VP, a duration of 24 sec, 5.7 mA, a voxel size of 0.05cm, and a field of view measuring 24×19 cm for the CBCT images.

Data from CBCT scans has been exported in Digital Imaging and Communications in Medicine (DICOM) format for reconstructing three-dimensional volumes using the NNT application.

Tomographic measurements

In CBCT panoramic images, the left and right foramina of mental measurements were obtained in cross-section. Tangents were constructed at the inferior and superior margins of the foramen of the mental on the right and left sides, respectively, with perpendiculars extending from these tangents to the mandible inferior border on both sides, utilizing the NNT tools of the machine's software.

1. Superior The foramen of mental (SMeF): The investigated from the foramen of mental superior extremity to the mandible inferior margin.
2. Inferior The foramen of mental (IMeF): The investigated from the foramen of mental inferior terminus to the mandible inferior margin.

Statistical analysis

The two metrics have been evaluated between sexes utilizing SPSS version 25 for statistical analysis. Quantitative variables are characterized by average, standard deviation (SD), t-test, chi-square, and p-magnitude. These were utilized to evaluate their differences, including the average magnitudes for men and females on both sides right and left one.

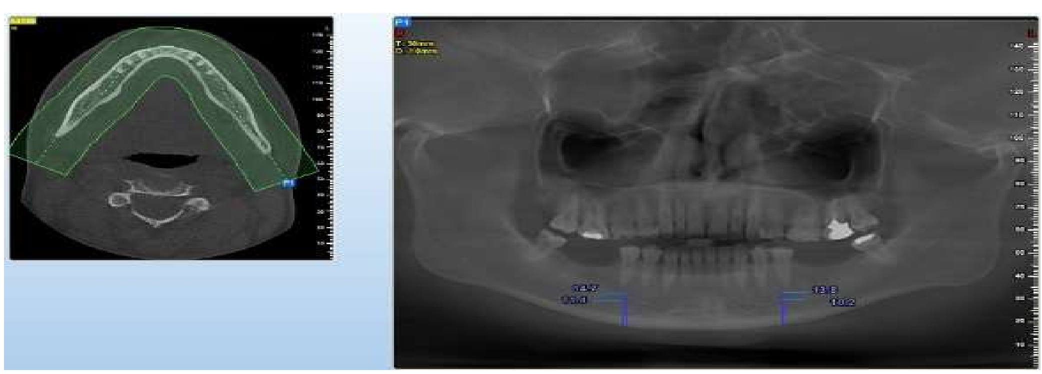

Fig. 1: Distance between the formation of mental inferior and superior borders (I-L and S-L)

RESULTS:

This research found that the average distance in millimeters, with SD, from the superior border foramen of the mental to the mandible lower border (S L) on the right-side was 16.44 ±1.28 for males and 14.13 ±1.37 for females. In males, the measurement on the left-side was 16.59±1.77, whereas in females it was 14.19±1.46. In males, the average distance from the foramen of the mental inferior border to the mandible lower border (I-L) on the right-side was 12.86±1.49, whereas in females, it was 11.01±1.59. In males, the measurement on the left-side was 12.804±1.56, whereas in females, it was 11.072±1.26 (Table 1,2).
Males had significant disparities in S-L and I-L between their left- and right- sides, with p = .000, and a non-significant variation in I-L, p = .884. The S-L and I-L differences between the left- and right-sides in females demonstrated a substantial variation (p = .013 and p = .001), as shown in Tables 3 and 4.
The S-L differences between men and females indicated a non-significant variation (P = 0.159) on the right-side and a very substantial variation (P = $1x10^{-3}$) on the left- side (refer to Table 5). The differences in the I-L between men and females indicated a non- substantial variation (P = $204x10^{-3}$) on the right-side and a substantial variation (P = $1x10^{-3}$) on the left-side (refer to Table 6).

Table 1: IL and SL in Males

	Right	Left
SL	16.448±1.28	16.59±1.77
IL	12.86±1.49	12.804±1.56

Table2: IL and SL in Females

	Right	Left
SL	14.136±1.37	14.19±1.46
IL	11.01±1.59	11.072±1.26

Table 3: The variations between Left and Right-sides in Males

	side	Average	SD	P magnitude
superior lower	right	16.545	1.3491	
	left	16.779	1.7761	.000
inferior lower	right	12.949	1.5125	.884
	left	12.916	1.5487	

Table 4: The variations between Left and Right-sides in Females

	Side	Average	SD	P magnitude
superior lower	right	14.265	1.3231	
	left	14.337	1.4390	.013
inferior lower	right	11.143	1.5336	
	left	11.170	1.2447	.001

Table 5: The variations between Females and Males on the Right-side

	Sex	Average	SD	P magnitude
superior lower	Male	16.54	1.3491	.159
	Female	14.26	1.3231	
inferior lower	Male	12.94	1.5125	.204
	Female	11.14	1.5336	

Table 6: The variations between Females and Males on the Left-side	Sex	Average	SD	P magnitude
superior lower	Male	16.77	1.7761	
	Female	14.33	1.4390	.000
inferior lower	Male	12.91	1.5487	
	Female	11.17	1.2447	.000

Discussion:

Forensic dentistry has employed several methods to identify humans, such as those employed by dentists. These include estimating racial, sexual, and age. The first stage in every legal investigation is to determine someone's status, whether they are alive or dead. In forensic medicine, sex identification is considered as a cornerstone since it fundamentally reduces the likelihood that the remains are human (17,18).

Several investigations were undertaken to determine the sex of unknown individuals (19,20). Because there is morphometric variety among different people around the world, the specific traits of each community must be investigated. The foramen of the mind is a fixed landmark on the mandible and one of the anatomical features of the human skull. Mental and basal bone foramen were selected as reference points for this experiment because of their stability (21).

In this work, CBCT has been utilized to ascertain sex based on the position of the mental foramen on both the left and right-sides. It has been detected that the dimensions of the mental foramen from the inferior and superior borders to the terminal border of the mandible (S-L) and (I-L).

The distances (S-L and I-L) between an individual's right- and left- sides revealed a substantial difference in average magnitudes for both male and female groups, except for the I-L measurement in males, which was non-significant. This aligns with the findings of Seidu et al., who detected an asymmetrical positioning of the foramen mind on the left and right-sides among the same people (22). Research conducted by Chkoura and El Wady identified asymmetrical mental foramina in 51.3% of instances. In comparison, symmetrical mental foramina were seen in 48.7% of cases (23), and the research by Alok et al. (24). The average magnitudes of the left-sides of men and females exceed those of the right-side, corroborating Ilker's findings. Asymmetric linear distances were seen between the two parts of the face. Ilker said that the left-side of the face is primarily asymmetrical in both sexes (25).

Our data indicate that men have a much greater average S-L and I-LF on the left-side. The left-side of the foramen of the mental landmark may be utilized for sex identification, which may be associated with the disparity in bone development rates across sexes. Male growth rates exceed those of females by 5 to 9%. Moreover, muscle strain stimulates bone development. Men, on average, possess more robust masticatory muscles than females (26).

Our results aligned with Indian research, which revealed that men had higher magnitudes for both measures. In a study of cadaveric skulls conducted in America, Cutright et al. (27) identified a slight but significant variation in the positioning of the cerebral foramen between females and males.

The findings of this study diverged from the Uppal investigation, which examined an Indian inhabitant to assess the significance of the foramen of the mental and mandibular canal in sex identification via CBCT. In the following investigation, no substantial variation in the I-L was seen.

Conversely, several investigations conducted in Taiwan (29), Thailand (30), Elmekkawy et al. (31), and Mamta Malik et al. (32) revealed that both S-L and I-L were markedly elevated in men.

Diversity across groups may arise from food preferences, lifestyle choices, and genetic factors that result in distinct anatomical characteristics. Besides, considering that most prior research utilized cadavers and panoramic imaging, discrepancies in the imaging modalities employed in these studies might add to this variance (33).

Conclusion

The study findings indicate that the distances from the lower mandible border to the foramen mental inferior and superior borders vary between male and female inhabitants in Iraq.

The suggested measures may be efficiently conducted utilizing CBCT radiography, a viable method for determining sex from skeletal remains. In the event of a large-scale tragedy when only fragments of the jaws are accessible, the methodology becomes vital. More significant research populations and a comprehensive assessment of supplementary variables connected to the foramen of mental are needed to validate the findings.

References

1. Saini V, Srivastava R, Rai RK, Shamal SN, Singh TB, Tripathi SK. Mandibular ramus: an indicator for sex in fragmentary mandible. J forensic sci. 2011;56.
2. Indira AP, Markande A, David MP. Mandibular ramus: An indicator for sex determination-A digital radiographic study. J forensic dent sci. 2012;4:58.
3. Scheuer L. Application of osteology to forensic medicine. Clinical Anat. 2002;15:297-312
4. Gamba TdO, Alves MC, Haiter-Neto F. Analysis of sexual dimorphism by locating the mandibular canal in images of cone-beam computed tomography. J Forensic Rad and Imag. 2014;2:72-6.
5. Hu KS, Koh KS, Han SH, Shin KJ, Kim HJ. Sex determination using nonmetric characteristics of the mandible in Koreans. J forensic sci. 2006;51:1376-82.
6. Singal K, Sharma S. Sex Determination by Mental Foramen Using Linear Measurements on Radiographs: A Study in Haryana Population. Indian J Forensic Med & Tox. 2016;10:44-9.
7. Haghanifar S, Rokouei M. Radiographic evaluation of the mental foramen in a selected Iranian population Indian JDent Res, 20(2),2009.

8. Shah P P, Parikh K K, Shah M J, Khan F. Radiographic Study of Mental Foramen in a Selected Indian Population in Kheda District, Gujarat. Journal of Indian Academy of Oral Medicine and Radiology, January-March 2013;25(1):1317.
9. Naroor N, Shenai P, Chatra L, Veena K.M, Rao P K, Shetty P. Sex determination using the mental foramen. Journal of Cranio-Maxillary Diseases / Vol 4 /Issue 2 / July 2015.
10. Malik M, Laller S, Saini RS, Mishra RK, Hora I, Dahiya N. Mental foramen: An Indicator for Sex Determination-A Radiographic Study. J Health Sci.2013;2:124.
11. Miracle A, Mukherji S. Cone beam CT of the head and neck, part 2: clinical applications. American j neurorad. 2009;30:1285-92.
12. Mowafey B, Van de Casteele E, Youssef J, Zaher A, Omar H, Politis C, et al. Can mandibular lingual canals be used as a forensic fingerprint? J forensic odonto-stomat. 2014;2:26-35.
13. Marmulla R, Wörtche R, Mühling J, Hassfeld S. Geometric accuracy of the NewTom 9000 Cone Beam CT. Dentomaxillofac. Rad. 2005;34:28-31.
14. Biwasaka H, Aoki Y, Tanijiri T, Sato K, Fujita S, Yoshioka K, et al. Analyses of sexual dimorphism of contemporary Japanese using reconstructed three-dimensional CT images. Leg Med.2009;11:S260-S2.
15. Sheikhi M, Karbasi Kheir M, Hekmatian E. Cone-Beam Computed Tomography Evaluation of Mental Foramen Variations: A Preliminary Study. Radiology research and practice. 2015;2015.
16. Moshfeghi M, Amin Tavakoli M, Tavakoli Hosseini E, Tavakoli Hosseini A, Tavakoli Hosseini I. Analysis of linear measurement accuracy obtained by cone beam computed tomography Dent res J. 2013;1:57-62.
17. Kanchan T, Krishan K, Sharma A, Menezes RG. A study of correlation of and foot dimensions for personal identification in mass disasters. Forensic sci intern. 2010 2010/06;199:112.e1-.e6.
18. Krishan K, Kanchan T, Sharma A. Sex Determination from and Foot Dimensions in a North Indian Population. J Forensic Sci. 2011 2011/01/31;56:453-9.
19. El Morsi DA, Al Hawary AA. Sex determination by the length of metacarpals and phalanges: X-ray study on Egyptian population. J Forensic and Leg Med. 2013
20. 2013/01;20:6-13.
21. 20.Kharoshah MAA, Almadani O, Ghaleb SS, Zaki MK, Fattah YAA. Sexual dimorphism of the mandible in a modern Egyptian population. J Forensic and Leg Med. 2010 2010/05;17:213-5.
22. Cra A, Singh A, Badni M, Jaiswal R, Agnihotri A. Determination of sex by radiographic analysis of mental foramen in North Indian population. J forensic dent sci. 2013;5:52.
23. Seidu Adebayo Bello, John Ademola, Nosa Ighile, and Nathan Ukuoghene Ikimi: Mental Foramen Size, Position and Symmetry in a Multi-Ethnic, Urban Black Population: Radiographic Evidence. J Oral Maxillofac Res. 2018 Oct-Dec; 9(4): e2.
24. Ahmed Chkoura and Wafaa El Wady: Position of the mental foramen in a Moroccan population: A radiographic study. Imaging Sci Dent. 2013 Jun; 43(2): 71–75.
25. Alok A, Singh ID, Panat SR, Singh S, Kishore M, Jha A. Position and symmetry of mental foramen: A radiographic study in Bareilly population. J Indian Acad Oral Med Radiol 2017;29:16-9.
26. Ercan I, Ozdemir ST, Etoz A, et al. Facial asymmetry in young, healthy subjects evaluated by statistical shape analysis. J Anat. 2008;213(6):663–669.
27. 26.Uppal MK, Iyengar AR, Patil S, Vasudev SB, Kotni RM, Joshi RK. Radiomorphometric localization of mental foramen and mandibular canal using cone beam computed tomography as an aid to sex

determination-A retrospective study. Int Healthcare Res J (IHRJ). 2018;2:115-20

28. Cutright B, Quillopa N, Schubert W. An anthropometric analysis of the key foramina for maxillofacial surgery. J oral and maxillofac surg. 2003;61:354-7
29. Lo L-J, Wong F-H, Chen Y-R. The Position of the Inferior Alveolar Nerve at the Mandibular Angle. Annals of plastic surgery. 2004 2004/07;53:50-5.
30. Agthong S, Huanmanop T, Chentanez V. Anatomical variations of the supraorbital, infraorbital, and mental foramina related to sex and side. J oral and maxillofac surg. 2005;63:800-4
31. Esraa A. Elmekkawy BDS, Yousria S. Gaweesh Phd, Rania A. Fahmy Phd, Wael M. Safwat Phd. CONE BEAM COMPUTED TOMOGRAPHY (CBCT) IN SEX DETERMINATION THROUGH MENTAL FORAMEN POSITION IN AN EGYPTIAN POPULATION SAMPLE (A RETROSPECTIVE STUDY). Alexandria Dental Journal. Volume 45 Issue 2
32. Mamta Malik, Sanjeev Laller, Ravinder S Saini, Rakesh Kumar Mishra, Indu Hora, Nisha Dahiya. Mental foramen: An Indicator for Sex Determination - A Radiographic Study. Santosh University Journal of Health Sciences 2016;2(1):12-14
33. 32.de Oliveira Gamba T, Alves MC, Haiter-Neto F. Analysis of sexual dimorphism by locating the mandibular canal in images of cone-beam computed tomography. J Forensic Rad and Imag. 2014;2:72-6.