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ORIGINAL PAPER

Estimation of age by mental foramen using CBCT in central India

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ABSTRACT

Introduction and aim. This study aims to estimate the age of a population in Central India by analyzing the mental foramen using cone beam computed tomography (CBCT). The objectives of the study are to determine the parameters for age determination and study bilateral variations in mental foramen dimensions using CBCT.

Material and methods. One hundred and twenty CBCT scans, HD LED monitor, GALAXIS GALLIEOS viewer.

Results. Results from the study show significant values for various parameters such as the upper and lower borders of the mandible and mental foramen. Bilateral variations were also observed. The age regression model indicates a significant correlation between estimated and original ages for individuals aged between 31 to 50 years. While the study only analyzed five parameters of the mental foramen, it suggests that a more comprehensive assessment of mental foramen parameters with a larger sample size can yield more definitive results for age determination.

Conclusion. As only five parameters of mental foramen had been assessed in this retrospective study, so a comprehensive assessment of various other parameters of mental foramen with an increased sample size may be done for more definitive results for gender and age determination.

Keywords. cone-beam computed tomography, forensic science, mental foramina

Introduction

In the field of forensic dentistry, determining the age of severely deteriorated and obscure skeletal remains play an extremely significant role in the recognizable proof. Age can be resolved from various parts of the facial skeleton; mandible is one of them.[1-3] A more durable nature of this bone makes it a reasonable tool for age estimation. Mandible continues in an all-around protected state longer than some other bone because of the presence of a dense layer of cortical bone.[3-5] As a result, forensic anthropologists and criminological dental specialists primarily use the morphological features of the mandible to determine age. There are various mandibular criteria that can be used to determine the age of the obscure skeleton. Mental foramen is one of the mandibular components that can be quite helpful in determining age. Radiographs can be used to survey the morphological components of the mental foramen in both living and deceased people. Panoramic imaging, readily demonstrates the mental foramen.[4,5] Straight (linear), perpendicular, and anterior loop (AL) patterns have been observed in the mental foramen.[4-6] The existence of AL has been mentioned in the literature on rare occasions. CBCT is widely regarded as the gold standard in radiological imaging. Because CBCT can produce high-resolution three-dimensional images, it can detect accessory canals with small diameters and those that bifurcate in any direction.[6-8] Many researches have been published in panoramic imaging about age as-

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sessment using the mental foramen, and a lesser number of studies have been reported in CBCT, thus utilizing a 3D imaging approach will help to find the exact position of the mental foramen.[8,9] Therefore, there is a need for the forensic experts and anthropologists to have a thorough knowledge about the utilization of the CBCT and the accuracy it provides in determining the exact location of mental foramen. As a result, using CBCT, this study was carried out to determine age based on the location and size of mental foramen.[9,10]

Aim

This study aims to determine the age of a population in Central India by analyzing the mental foramen using CBCT.

Material and methods

The present study was conducted in the department of Oral Medicine, Diagnosis and Radiology, Rungta College of Dental Sciences and Research, Kohka Kurud, Bhilai, Chhattisgarh. Prior to the commencement of the study, ethical clearance was obtained from the institutional ethical committee (RCDSR/IEC/MDS/2018/01).

Source of data

For this retrospective study, a total of 120 CBCT scans were collected from the Oral Radiology Department, Rungta College of Dental Sciences and Research from November 2018 to December 2019.The sample size was determined using G-Power software (Version 3.1.9.7) with the power of the test kept at 80%. The scans of the subjects were randomly collected from the available data. The patient's identification number, sex, date of birth was kept confidential and a unique study case number was allotted. Analysis of the reformatted images was performed using SIDEXIS software using GALAXIS GALLIEOS viewer.

A CBCT scans of mandible were grouped under the following category:

- Group I comprising of age 21–30 years – 30 subjects
- Group II comprising of age 31–40 years –30 subjects
- Group III comprising of age 41–50 years –30 subjects
- Group IV comprising of age 51–60 years –30 subjects

Inclusion criteria

- the subjects should be of age from 21–60 years,
- all teeth may or may not present adjacent to mental foramen, from canine to first molar, on both sides.

Exclusion criteria

- presence of any imaging artifact of mandible,
- presence of any radiolucent or radio-opaque lesion, obscuring the MF region,
- presence of any fracture in the parasympyseal region.

A CBCT apparatus, the SIRONA ORTHOPHOS XG 3D (Dentsply Sirona, Germany) was used with the following parameters: a tube voltage of 85 kV, a tube current of 6 mA and an exposure cycle of 14.4s of 8X5 FOV. Contiguous sectional images in three directions, parallel section (parallel to the dental arch), cross-section (perpendicular to the dental arch) and horizontal section images, were reconstructed from the projection data with a slice width of 1 mm. Viewing the contiguous sectional images using dedicated SIDEXIS software (GALAXIS GALLIEOS viewer), the images were evaluated in each section on a high-definition light emitting diode (HD LED) monitor.

Evaluation of scans

Two subject experts from the Department of Oral Medicine and Radiology, Rungta College of Dental Sciences and Research, with an experience of 10 years and 7 years respectively calibrated the principal investigator for the evaluation of various parameters required in the study. The Kappa (k) value obtained was 0.86. The required measurement (Fig. 1) of CBCT scan were done in SIDEXIS Software by a single observer on these following parameters:

- upper border of crest of mandible to upper border of mental foramen (Fig. 2),
- upper border to lower border of mandible (Fig. 3),
- upper border of mental foramen to lower border of mandible (Fig. 4),
- lower border of mandible to lower border of mental foramen (Fig. 5).

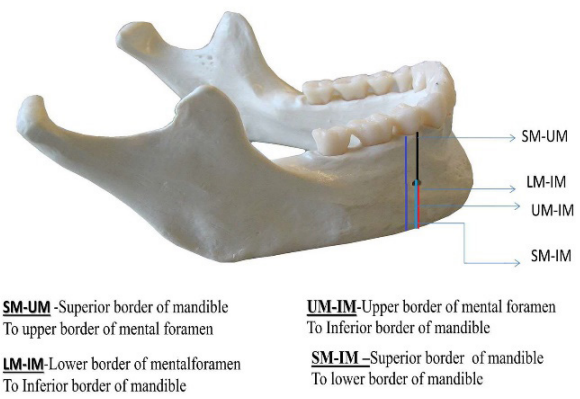

Fig. 1. Graphic representation of the measurements done for the mental foramen

Statistical analysis

The data so collected was entered into the MICROSOFT OFFICE EXCEL SPREAD SHEET which was then transferred to SPSS version 16.0 IBMT for statistical analysis. Descriptive statistics with mean and standard deviation was calculated for various parameters. Student unpaired t- test and Chi square test was used to

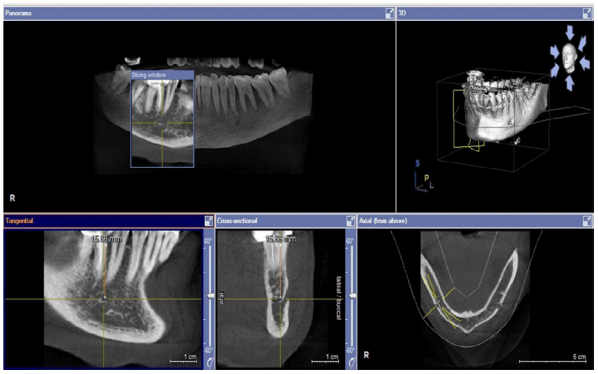

Fig. 2. Measurement from the crest of alveolar ridge to upper border of mental foramen

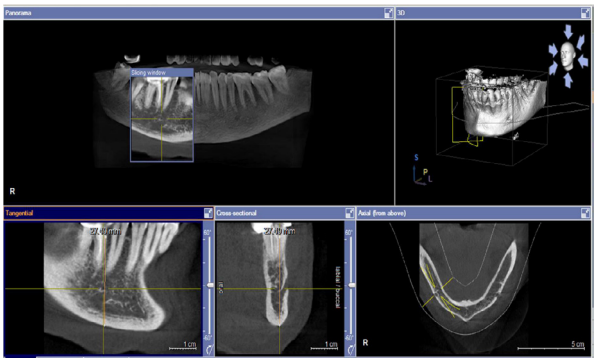

Fig. 3. Measurement from the upper border of mandible to lower border of mandible

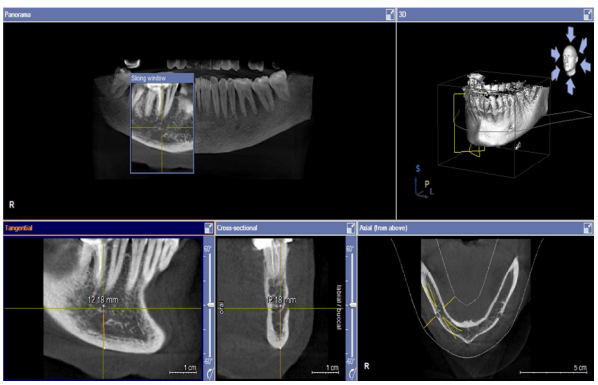

Fig. 4. Measurement from the upper border of mental foramen to lower border of mandible

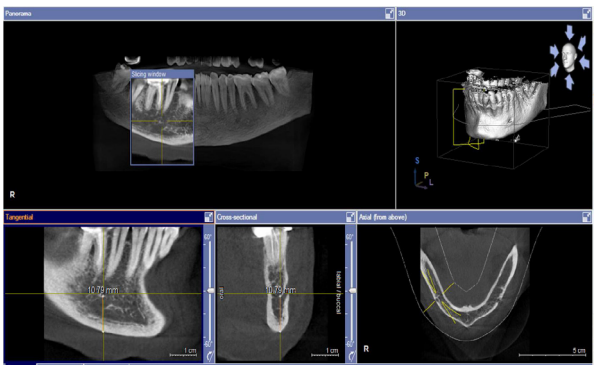

Fig. 5. Measurement from the lower border of mental foramen to lower border of mandible

analyze the data. The confidence Interval (CI) was kept at 95% and p value < 0.05 was statistically significant.

Results

The mean measurement recorded for the right side for 31–40 years the mean measurement among males and females were 29.95±1.75 and 27.01±2.41 with a mean difference of 2.94, which was statistically significant (p≤0.05) whereas for the left side it was 30.3±2.1 among males and 27.64±2.02 with a mean difference of 2.65 which was highly significant. The age group of 41-50 years the mean measured among males and females was 29.05±0.96 and 27.33±0.71 with a mean difference of 1.72 and found to be statistically significant (p≤0.05) whereas for the left side it was 28.99±0.93 among males and 27.28±0.71 with a mean difference of 1.71 (p≤0.05). The final age group of 51–60 years the mean measurement among males and females recorded were 28.69±2.44 and 27.02±1.62 respectively with a mean difference of 1.66 and found to be statistically significant (p≤0.05) whereas for the left side it was 28.27±2.21 among males and 26.35±2.15 with a mean difference of 1.91 also found to be significant as shown in Table 1.

Table 1. Mean comparison of measurement of right and left side upper border to lower border of mandible: among male and female

Age	Gender	n	Mean±SD		Mean Difference		T value		p	
			Right	Left	Right	Left	Right	Left	Right	Left
21–30	Male	15	26.49±1.68	26.81±1.87	0.41	-0.127	0.643	-0.193	0.52	0.849
	Female	15	26.90±1.81	26.94±1.74						
31–40	Male	15	29.95±1.75	30.30±2.10	2.94	2.65	3.805	3.51	0.001	0.002
	Female	15	27.01±2.41	27.64±2.02						
41–50	Male	15	29.05±0.96	28.99±0.93	1.72	1.71	5.48	5.62	0.001	0.001
	Female	15	27.33±0.71	27.28±0.71						
51–60	Male	15	28.69±2.44	28.27±2.21	1.66	1.91	2.19	2.40	0.03	0.023
	Female	15	27.02±1.62	26.35±2.15						

Table 2. Mean comparison of measurement for right and left upper border of crest of mandible to upper border of mental foramen

Age	Gender	n	Mean±SD		Mean Difference		T value		p	
			Right	Left	Right	Left	Right	Left	Right	Left
21–30	Male	15	13.89±1.34	13.91±0.82	-0.74	-0.47	-1.44	-0.998	0.157	0.327
	Female	15	14.63±1.45	14.38±1.60						
31–40	Male	15	15.91±1.96	15.75±1.70	1.86	0.63	2.15	0.864	0.018	0.395
	Female	15	14.05±2.09	15.12±2.26						
41–50	Male	15	13.49±0.88	13.56±0.84	-1.42	1.08	-4.46	-3.421	0.001	0.002
	Female	15	14.91±0.86	14.65±0.89						
51–60	Male	15	15.43±1.91	14.66±1.63	0.71	0.44	1.19	0.621	0.256	0.540
	Female	15	14.71±1.47	14.23±2.81						

For 31–40 years the mean measurement among males and females were 15.91±1.96 and 14.05±2.09

respectively with a mean difference of 1.86, which was statistically significant (p≤0.05) whereas for the left side it was 15.75±1.70 among males and 15.12±2.26 with a mean difference of 0.63 (p≤0.05). The age group of 51–60 years the mean measurement among males and females recorded was 15.43±1.91 and 14.71±1.47 respectively with a mean difference of 0.71 this was found to be statistically significant (p≤0.05), whereas for the left side it was 14.66±1.63 among males and 14.23±2.81 with a mean difference of 0.44 also found to be significant as shown in Table 2.

The mean comparison of measurement of right and left lower border of mandible to lower border of mental foramen; of both male and female. For 31–40 years the mean measurement among males and females were 12.63±1.38 and 11.25±1.15 respectively with a mean difference of 1.37600, which was statistically significant (p≤0.05), whereas for the left side it was 12.55±1.33 among males and 11.06±1.23 with a mean difference of 1.58933 which was highly significant. The age group of 41–50 years the mean measured among males and females was 13.86±1.53 and 10.56±0.41respectively with a mean difference of 3.29800, this was found to be statistically significant (p≤0.05) whereas for the left side it was 14.01±1.52 among males and 10.81±0.69 with a mean difference of 3.19 (p≤0.05) as shown in Table 3.

Table 3. Mean comparison of measurement of right and left lower border of mandible to lower border of mental foramen

Age	Gender	n	Mean±SD		Mean Difference		T value		p	
			Right	Left	Right	Left	Right	Left	Right	Left
21–30	Male	15	10.45±1.08	10.55±0.97	-0.16	-0.41	-0.370	-1.181	0.755	0.248
	Female	15	10.60±1.22	10.95±0.91						
31–40	Male	15	12.63±1.38	12.55±1.33	1.37	1.49	2.952	3.17	0.006	0.004
	Female	15	11.25±1.15	11.06±1.23						
41–50	Male	15	13.86±1.53	14.01±1.52	3.29	3.19	8.059	7.39	0.001	0.001
	Female	15	10.56±0.41	10.81±0.69						
51–60	Male	15	11.07±1.31	10.89±1.13	0.17	0.22	0.377	0.535	0.709	0.597
	Female	15	10.90±1.21	10.67±1.07						

The mean comparison of the measurement of right and left upper border of mental foramen to lower border of mandible of both male and female among all age groups were determined. For 31–40 years the mean measurement among males and females was 16.29±1.58 and 13.54±0.87 with a mean difference of 2.747, this was statistically significant (p≤0.05). whereas for the left side it was 16.25±1.85 among males and 13.76±1.1 with a mean difference of 2.48 (p≤0.05). The age group of 41–50 years the mean measured among males and females was 15.97±1.49 and 12.86±0.82 with a mean difference of 3.105, this was found to be statistically significant (p≤0.05) whereas for the left side it was 15.96±1.54 among males and 13.6±1.09 with a mean difference of 2.79 (p≤0.05) as shown in Table 4.

Table 4. Mean comparison of measurement of right and left upper border of mental foramen to lower border of mandible among male and female

Age	Gender	n	Mean±SD		Mean Difference		T value		p	
			Right	Left	Right	Left	Right	Left	Right	Left
21–30	Male	15	14.15±1.03	14.19±0.76	0.41	0.04	0.99	0.085	0.327	0.93
	Female	15	13.74±1.21	14.15±1.52						
31–40	Male	15	16.29±1.58	16.25±1.85	2.75	2.48	5.88	4.455	0.001	0.001
	Female	15	13.54±0.87	13.76±1.10						
41–50	Male	15	15.97±1.49	15.96±1.54	3.11	2.79	7.064	5.705	0.001	0.001
	Female	15	12.86±0.82	13.16±1.09						
51–60	Male	15	13.54±1.86	13.85±1.50	0.31	1.29	0.437	2.218	0.665	0.03
	Female	15	13.23±1.96	12.56±1.67						

The mean comparison of measurement for right and left dimension of mental foramen of both male and female among all age. For 31-40 years the mean measurement for the left side it was 3.70±0.930 among males and 2.70±0.878 with a mean difference of 0.99667 which was highly significant. The age group of 41-50 years the mean measured for the left side was 1.95±1.560 among males and 2.35±1.252 among females with a mean difference of -0.40133 (p≤0.05) The final age group of 51-60 years the mean measurement among males and females recorded was 2.46±1.008 and 2.33±1.482 respectively with a mean difference of 0.13133 this was found to be statistically significant (p≤0.05). whereas for the left side it was 2.96±0.934 among males and 1.89±1.396 with a mean difference of 1.07400 also found to be significant as shown in Table 5.

Table 5. Mean comparison of measurement for right and left dimension of mental foramen among male and female

Age	Gender	n	Mean±SD		Mean Difference		T value		p	
			Right	Left	Right	Left	Right	Left	Right	Left
21–30	Male	15	3.70±1.146	3.64±0.737	0.57	0.45	1.253	1.191	0.221	0.244
	Female	15	3.13±1.329	3.19±1.248						
31–40	Male	15	3.66±0.905	3.70±0.930	1.37	0.99	4.342	3.018	0.001	0.005
	Female	15	2.29±0.822	2.70±0.878						
41–50	Male	15	2.10±1.130	1.95±1.560	-0.19	-0.40	-0.473	-0.777	0.640	0.444
	Female	15	2.30±1.102	2.35±1.252						
51–60	Male	15	2.46±1.008	2.96±0.934	0.13	1.07	0.284	2.476	0.779	0.020
	Female	15	2.33±1.482	1.89±1.396						

Using all the measurement of all the five parameters of the mandible and mental foramen formula for estimation of age was derived using simple linear regression model (p<0.05, CI= 95%).

Age estimate equation for right side= 24.030+ (1.763* UB.to.LB.right) +(-0.933* UBCM.To. UBMF. Right) + (-0.819* LBM.to.LBMF. Right) + (-3.447* Dimension.MF.Right)

Age estimate equation for left side = 45.988+ (2.617* UB.to.LB.Left) +(-2.880* UBCM.To. UBMF.Left) +(-2.200*LBM.to.LBMF. Left) +(-4.002* Dimension. MF.Left)

Discussion

Forensic odonatologists can play a role in the identification of gender using facial bones especially mandible, which is a stronger bone.[9] Mental foramen is one of the stable landmarks of mandible.[10] It is located on lateral surface of body of mandible below the apices of first and second premolars. Wical and Swoope reported that there is no effect of alveolar bone resorption on the distance between mental foramen and lower border of the mandible. It remains relatively constant throughout life.[11] Lindh et al. and Guler et al. also agreed with the results suggested by Wical and Swoope.[12,13] All these studies demonstrated that linear measurements on radiographs can be a sound indicator of the alveolar bone resorption with age. CBCT is a relatively accurate technology, introduced to dentistry in 1998, which is used for the three-dimensional imaging. Currently, high resolution CBCT is the most promising and accurate technology available for quantitatively determining the position of MF.[14,15] The vertical measures computed from the superior edge of the mental foramen to the crest of the alveolar ridge were found to be larger in edentulous males than in women in this study. Ajmal et al. reported similar findings, noting that the measurement dropped considerably with age.[16] Bhardwaj et al. studied 300 digital panoramic radiographs for predicting age in various age groups and were divided into 3 groups of 25–34 years, 35–44 years, and 45–54 years using five parameters collectively, which were: gonial angle, ante gonial angle, mental foramen, mandibular canal, mandibular foramen.[17] Among all the data studied, changes in the mandibular canal and mandibular foramen were shown to be very significant (p=0.05) as age progressed, however in our study, the analysis was limited to the factors linked to the mental foramen using CBCT.[18-20]

Similar to our study Gungor et al. studied the locations of mental foramen (MF) from age 10-70 years using CBCT found that the vertical size of the MF was similar on right and left side (p=0.785) whereas in our study it was only similar and highly significant in the age group of 41–50 years i.e., 0.001,0.005 (p<0.05).[21] According to the study's findings, the vertical position of the MF changes with age. In younger age groups, it is closer to the lower border of the mandible; in middle age groups, it is equidistant from the alveolar crest and the lower border of the mandible; and in older age groups, it is closer to the alveolar crest. These findings agreed with those of Ahmed et al., who found that only the distance between the inferior edge and the lower border of the mandible is statistically significant (p=0.01).[22] The position of the mental foramen also influences the distance between the superior edge of the foramen and the alveolar crest.

Conclusion

Mental foramen is one of the most important anatomical landmarks present in the mandible. As CBCT is considered a gold standard in radiological imaging, so the mandibular foramen was assessed using the 3D imaging technique which helped to determine the exact parameters of the mental foramen without any radiological errors. The current study concluded that the distance between the upper border of the body of the mandible and the upper border of the mental foramen, the height from the superior border of the mandible to the lower border of the mandible, and the distance from the lower border of the mental foramen to the lower border of the mandible all play an important role in determining age. This study demonstrated that mental foramen could potentially serve as a useful forensic criterion due to its clinical importance. The age assessment was found to be highly significant for the age groups of 31–40 years and 41–50 years (p<0.05). Same was also noticed in case for gender estimation for the same age groups. Least significance was found in the age group of 51–60 years. The dimensions of the right and left sides of the mental foramen varied bilaterally. Using the obtained parameters, the predicted age using the age regression formula was shown to be very significant in the age groups 21–30, 31–40, and 41–50 years. This study can also serve as a guide for orthognathic operations, implant placement, and pre-prosthetic surgery, as well as help in more accurate identification of the dead and deceased, which is critical in forensic investigations.

Declarations

Funding

No funding has been received for the study.

Author contributions

Conceptualization, S.B. and J.S.; Methodology, S.B.; Software, S.B.; Validation, J.S., F.K. and D.D.; Formal Analysis, J.S.; Investigation, S.B.; Resources, S.P.; Data Curation, S.B.; Writing – Original Draft Preparation, S.P.; Writing – Review & Editing, E.S.; Visualization, A.R.; Supervision, J.S.; Project Administration, F.K.; Funding Acquisition, D.D.

Conflicts of interest

The authors declare no competing interests.

Data availability

The datasets used and/or analyzed during the current study are open from the corresponding author on reasonable request.

Ethics approval

Research protocols and procedures were approved according to the ethical standards of the Helsinki Declaration 2013 and by the Ethics Committee of Rungta College of Dental Sciences & Research (ethical approval RCDSR/IEC/MDS/2018/01).

References

1. Standring S, Neil R Borley H. *Gray's Anatomy: The Anatomical Basis of Clinical Practice*. USA: Elsevier; 2008.
2. Chaurasia BD. *BD Chaurasia's Human Anatomy Regional and Applied Dissection and Clinical: Vol. 3: Head-Neck Brain*. CBS Publishers & Distributors; 2013.
3. Phulari RGS, Dave EJ. Evolution of dental age estimation methods in adults over the years from occlusal wear to more sophisticated recent techniques. *Egypt J Forensic Sci*. 2021;11(1):36. doi: 10.1186/s41935-021-00250-6
4. Sujatha S, Azmi SR, Devi B, Shwetha V, Kumar TP. CBCT--the newfangled in forensic radiology. *Journal of Dental and Orofacial Research*. 2017;13(2):47-55.
5. Ghali S, Katti G, Shahbaz S, Katti C. Cone beam computed tomography: A boon for maxillofacial imaging. *J Indian Acad Oral Med Radiol*. 2017;29(1):30. doi: 10.4103/jiaomr.jiaomr_89_16
6. Pelé A, Berry PA, Evanno C, Jordana F. Evaluation of mental foramen with cone beam computed tomography: A systematic review of literature. *Radiol Res Pract*. 2021;2021:8897275. doi: 10.1155/2021/8897275
7. Santos Oliveira D, Coutinho R, Panzarella K. Morphometric Analysis of the Mental Foramen Using Cone-Beam Computed Tomography. *Int J Dent*. 2018.
8. Breeland G, Aktar A, Patel BC. Anatomy, Head and Neck, Mandible. In: *StatPearls*. Treasure Island (FL): StatPearls Publishing; June 11, 2022.
9. Saxena S, Sharma P, Gupta N. Experimental studies of forensic odontology to aid in the identification process. *J Forensic Dent Sci*. 2010;2(2):69-76. doi: 10.4103/0975-1475.81285
10. Shah J, Asrani V. Mental foramen: A predictor of age and gender and guide for various procedures. *J Forens Sci Med*. 2018;4(2):76. doi: 10.4103/jfsm.jfsm_2_18.
11. Wical KE, Swoope CC. Studies of residual ridge resorption. Part 1. Use of panoramic radiographs for evaluation and classification of mandibular resorption. *J Prosthet Dent*. 1974;32:7-12.
12. Lindh C, Petersson A, Klinge B. Measurements of distances related to the mandibular canal in radiographs. *Clin Oral Implants Res*. 1995;6(2):96-103. doi: 10.1034/j.1600--0501.1995.060205.x
13. Güler AU, Sumer M, Sumer P, Biçer I. The evaluation of vertical heights of maxillary and mandibular bones and the location of anatomic landmarks in panoramic radiographs of edentulous patients for implant dentistry. *J Oral Rehabil*. 2005;32(10):741-746. doi: 10.1111/j.1365--2842.2005.01499.x
14. Raju G, Sairam V, Vikas S. Evaluation of mental foramen - A CBCT assessment. *IP Int J Maxillofac Imaging*. 2018;4(1):23-26.
15. Sheikhi M, Kheir MK. CBCT assessment of mental foramen position relative to anatomical landmarks. *Int J Dent*. 2016;2016:5821048. doi: 10.1155/2016/5821048.
16. Ajmal M. Evaluation of mental foramen position from panoramic dental radiographs. *J Contemp Dent Pract*. 2014;15(4):399-402. doi: 10.5005/jp-journals-10024-1551
17. Bhardwaj D, Kumar JS, Mohan V. Radiographic evaluation of mandible to predict the gender and age. *J Clin Diagn Res*. 2014;8(10):ZC66-9. doi: 10.7860/JCDR/2014/9497.5045
18. Sheikhi M, Karbasi Kheir M, Hekmatian E. Cone-beam computed tomography evaluation of mental foramen variations: A preliminary study. *Radiol Res Pract*. 2015;2015:124635. doi: 10.1155/2015/124635
19. Lee YH, Auh QS, Chun YH, An JS. Age-related radiomorphometric changes on panoramic radiographs. *Clin Exp Dent Res*. 2021;7(4):539-551. doi: 10.1002/cre2.375
20. Shalash M, Khallaf ME, Ali AR. Position and dimensions of the mental foramen and presence of the anterior loop in the Egyptian population: a retrospective CBCT study. *Bull Natl Res Cent*. 2020;44(1):110. doi: 10.1186/s42269-020-00364-2
21. Guven S, Gungor E, Aglarci OS, Unal M, Dogan MS. Evaluation of mental foramen location in the 10–70 years age range using cone-beam computed tomography. *Niger J Clin Pract*. 2017;20(1):88. doi: 10.4103/1119-3077.178915
22. Ahmed AA, Ahmed RM, Jamleh A, Spagnuolo G. Morphometric analysis of the mandibular canal, anterior loop, and mental foramen: A cone-beam computed tomography evaluation. *Int J Environ Res Public Health*. 2021;18(7):3365. doi: 10.3390/ijerph18073365