Print ISSN: 2321-6379
Online ISSN: 2321-595X

Original Article

Morphometric Analysis of Mental Foramen by Cone-Beam Computed Tomography

Waseem Wani[1], Jyothi S Kumar[2], Henna Mir[3]

[1]3rd Year Post Graduate, Department of Oral Medicine and Radiology, Vyas Dental College and Hospital, Jodhpur, Rajasthan, India, [2]Professor and Head, Department of Oral Medicine and Radiology, Vyas Dental College and Hospital, Jodhpur, Rajasthan, India, [3]MDS, Public Health Dentist (General Practitioner)

Abstract

Introduction: Due to the increase in surgical procedures and increased risk of mental nerve damage, cone-beam computed tomography (CBCT) plays an important role to detect and evaluate the anatomical variations. Therefore, the goal of this research is the Morphometric Analysis of the Mental Foramen using the CBCT.

Materials and Methods: The CBCT images of 108 patients were collected from a CBCT center. Data were analyzed using descriptive statistics: mean, standard deviation, and range. Student's independent t-test was used to compare various parameters between the right and left mandibles.

Results: Out of 108 patients, 56 had a mental foramen of round shape. The most frequent position of the mental foramen was position IV-50% (In line with 2nd premolar).

Conclusion: Determining the shape, size, and location of the MF is important because many dental procedures are performed on the jaw. Therefore, further studies are recommended to analyze invariant landmarks such as inferior border of mandible to locate mental foramen.

Key words: Anatomy, Cone-beam computed tomography, Foramen, Mandible, Mental nerve

INTRODUCTION

The inferior alveolar nerve branches into the mental nerve and the incisive nerve in the mental foramen, which is located on the lateral section of the mandible.[1] The location of mental foramen varies in different age groups. In children before the eruption of teeth, it is located closer to the alveolar crest whereas in adults it is located midway between the alveolar crest and lower border of mandible. As the bone resorbs, it gets closer to the alveolar crest or even can be found over it.[2] Therefore for any surgical procedure like implant surgery, knowledge of the accurate mental foramen position is of utmost importance for any in the region of mental foramen.[3] Damage to the neurovascular bundles may cause serious complications such as paresthesia by any invasive procedure performed in this region. With different methods such as macroscopic investigations on dry skulls, plane radiographs, and computed tomography images.[4] The location and number of MF can be evaluated.[5]

An image that is three-dimensional in nature and has a very high spatial resolution at low exposures would be the ideal image for the planning of surgeries in the area of the mental foramen. These attributes can be achieved with cone beam computed tomography (CBCT), which not only make it an ideal form of imaging, but also allow for a precise understanding of the relationship between structures in ananatomically complex area.[6]

CBCT has proven to have an error of <0.6% when measuring mandibular anatomy.[7] It also has proven to be accurate when measuring simulated bone defects in acrylic blocks with a mean width accuracy of −0.01 mm and mean height difference of −0.03 mm.[8]

Hence, CBCT plays an important role to detect and evaluate the anatomical variations. Therefore the aim of this study is the Morphometric Analysis of the Mental Foramen using CBCT.

Access this article online

www.ijss-sn.com

Month of Submission : 08-2022
Month of Peer Review : 09-2022
Month of Acceptance : 10-2022
Month of Publishing : 10-2022

Corresponding Author: Waseem Wani, Department of Oral Medicine and Radiology Vyas Dental College and Hospital, Jodhpur, Rajasthan, India.

MATERIALS AND METHODS

This study has been reviewed and approved by the Ethical Committee of Vyas Dental College Jodhpur. Permission was obtained from the respective CBCT center authority. It was a Retrospective type of Study which was conducted in the Department of Oral Medicine and Radiology, Vyas Dental College Jodhpur. This study was conducted in the age group of 15 years and above with a sample size of 108. Patients with impacted teeth, radiolucent or radiopaque bony lesions, any surgical procedure or graft placed in the mandible, related syndromes or orthodontic treatments. From the list of CBCT centers, two CBCT centers were randomly selected by simple random sampling. Of the collected CBCT's who met the inclusion and exclusion criteria, 108 were selected. Daily three CBCT's were evaluated in the department of Oral Medicine and Radiology. This way it took 36 working days to evaluate 108 CBCT's. 108 patients' CBCT pictures were obtained from a CBCT center. CBCT images were taken using a New Tom VGi scanner (QR srl; Verona, Italy) in standard resolution mode [palatal plane parallel to the horizontal plane, allowing axial cuts parallel to the palatal plane with voxel size of 0.3 mm] with exposure parameters of kVp=110, 3.6 s, and FOV 808 cm, or 812 cm. Axial, Coronal, and Sagittal cross sections of 1mm thickness were produced at 0.5 mm intervals [Figures 1-3]. According to Tebo and Telford, the position of the mental foramen in reference to the lower teeth is represented as[45] [Figure 4]:

I. Mesial to the first premolar
II. Beneath the first premolar
III. Between the premolars
IV. Beneath the second premolar
V. Between the second premolar and first molar
VI. Beneath the mesial root of the first molar
VII. Edentulous, hence unable to determine the position.

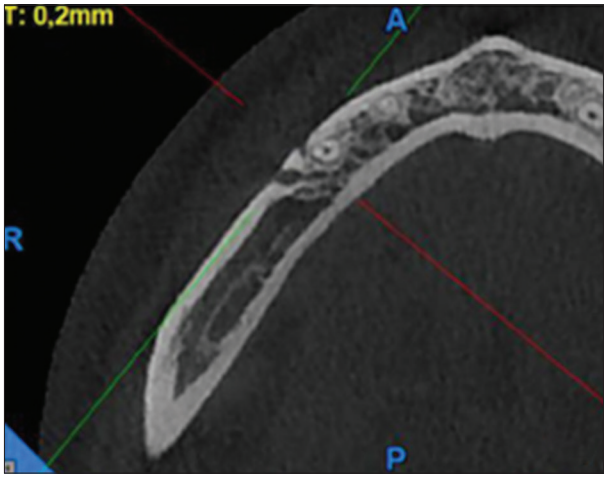


Figure 1: Cone-beam computed tomography image of axial section of MF

The shape of the mental foramen, whether oval or round, the number of mental foramina, the position of the mental foramen in relation to the roots of mandibular teeth, and the distance between the upper and lower cortical areas of the mental foramen to the alveolar crest and the inferior border of the mandible, respectively, were all recorded [Figures 5-8].

Statistical software SPSS (version 22.0) and Microsoft Excel (version 5.00) were used to carry out the statistical analysis of data. Descriptive statistics, such as means, standard deviations, and ranges, were used to analyze the data. For comparison of various parameters between right and left mandible, Student's independent *t*-test was employed.

RESULTS

Table 1 and Graph 1 show that the mean age of patients with right mandibular measurements was 34.07 years (SD = 12.31), whereas the mean age of patients with left

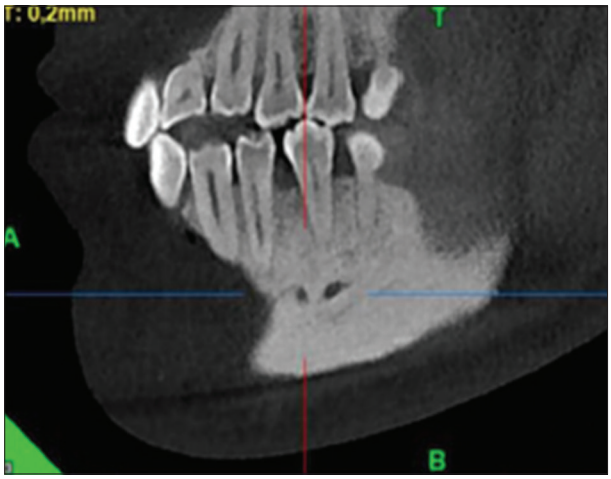


Figure 2: Cone-beam computed tomography image of sagittal section of MF

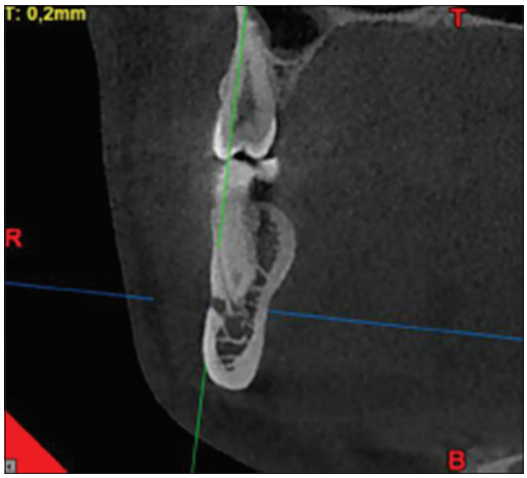


Figure 3: CBCT image of Coronal section of MF

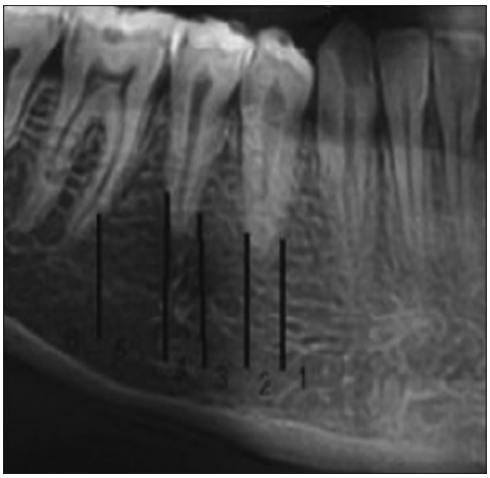


Figure 4: Position of MF

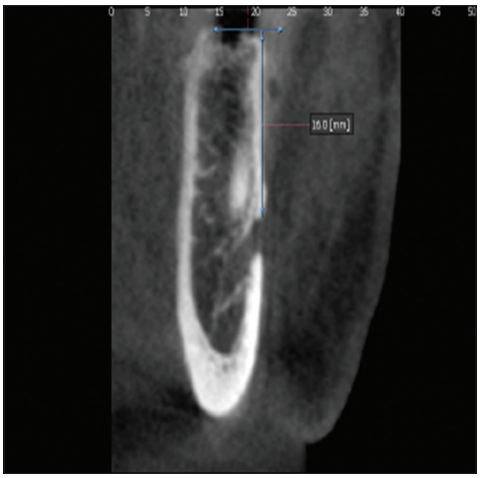


Figure 7: Measurement from the upper cortical area of foramen to alveolar crest

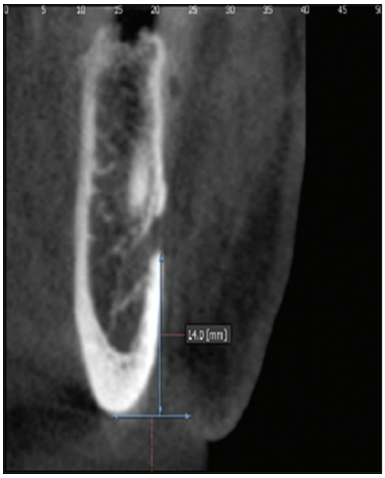


Figure 5: Measurement from base of foramen to inferior border of mandible

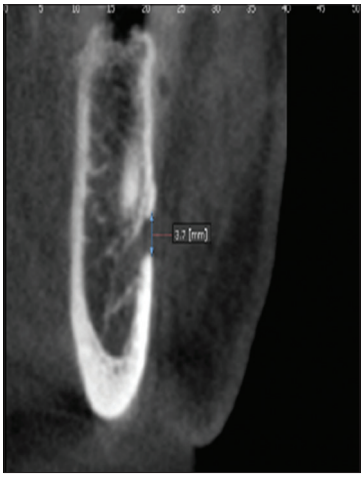


Figure 8: Size of mental foramen

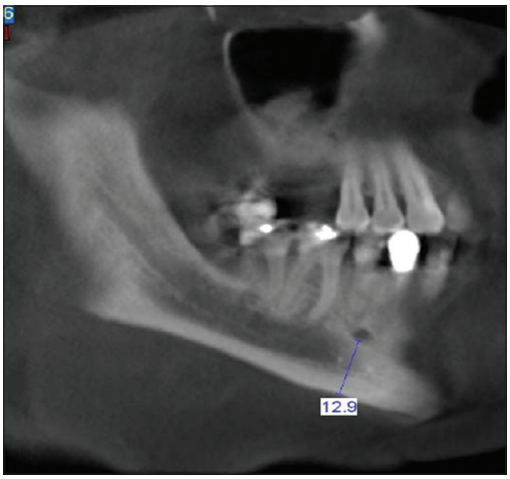
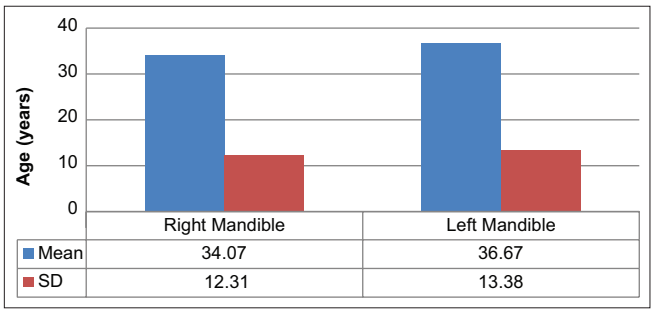


Figure 6: Measurement from base of foramen to inferior border of mandible



Graph 1: Mean age of patients with right mandibular measurements

mandibular measurements was 36.67 years (SD= 13.38), with no statistically significant difference ($P > 0.05$) between the right and left mandibles.

Table 2 and Graph 2 demonstrate that the most common shape in this sample was round, with no significant difference between right and left. Out of 108 patients, 56 had a mental foramen of round shape and 52 patients were found with a mental foramen of oval shape.

Table 3 and Graph 3 show that the most frequent position of the mental foramen was position IV-50% (In line with 2nd premolar) followed by positions III-39%

(Between 1st and 2nd premolars), Position V-8% (Between 2nd premolar and 1st molar) and position VI- 3% (In line with mesial root of 1st molar). No mental foramen was found in position I (Mesial to 1st premolar) and position II (In line with 1st premolar).

Table 4 and Graph 4 show that the distance from the upper cortical area of the mental foramen to the alveolar crest was measured. Mean distance from the upper cortical area to alveolar crest (mm) on the right side of mandible was found to be 12.91 (SD 1.92). Mean distance from the upper cortical area to alveolar crest (mm) on the left side of mandible was found to be 13.03 (SD 2.01). There was no statistically significant differences found between the right and left sides ($P = 0.081$).

Table 5 and Graph 5 show the distance from the lower cortical area of the mental foramen to the mandibular base. Mean distance the lower cortical area of the mental foramen to the mandibular base (mm) on the right side of mandible was found to be 12.20 (SD 1.61). Mean distance the lower cortical area of the mental foramen to the mandibular base (mm) on the left side of mandible was found to be 13.40 (SD 1.95). There was no statistically significant differences found between the right and left sides ($P = 0.983$).

Table 6 and Graph 6 show that the size of the mental foramen was measured on both the right and left sides of the mandible, with a range of 0.8 mm to 6.0 mm. The mean size of mental foramen on the right side of mandible was found to be 3.17 mm (SD 1.41); however, on the left side of mandible the mean size was found to be 2.96 mm (SD 1.13). There was no significant difference observed between the two sides ($P = 0.413$).

Table 1: Mean age of patients

Age (years)	*n*	Mean	SD	Range	*P*
Right mandible	54	34.07	12.31	17–62	0.613
Left mandible	54	36.67	13.38	16–62	

SD: Standard deviation

Table 2: Shape of mental foramen

Shape	*n* (%)
Round	56 (52)
Oval	52 (48)
Total	108 (100)

Table 3: Location of mental foramen

Location	*n* (%)
Mesial to first premolar (position-1)	0
In line with first premolar (position-II)	0
Between first and second premolars (position-III)	42 (39)
In line with second premolar (position-IV)	54 (50)
Between second premolar and first molar (position-V)	9 (8)
In line with mesial root of 1stmolar (position-VI)	3 (3)
Total	108 (100)

Table 4: Distance from the upper cortical area to alveolar crest (mm) as per the right and left mandible

Parameter	Right mandible		Left mandible		*P*
	Mean	SD	Mean	SD	
Distance from upper cortical area to alveolar crest (mm)	12.91	1.92	13.03	2.01	0.081

SD: Standard deviation

DISCUSSION

For any surgical operation involving implant surgery in the mental foramen region, knowing the exact position of the mental foramen is essential. The position, shape, and size of the mental foramen, as well as the presence of accessory canals, can all be precisely determined by CBCT.[9]

When considering the mental incisive anesthetic block and surgery in the outer premolar mandibular region, the position of the MF is crucial.[10] However, there are significant differences reported among different ethnic groups in the location of MF.[11]

Shape

There are several studies reported whose results do not agree on the classification of shapes of mental foramen itself.[12] Round was the most frequent shape found in our

Table 5: Distance from lower cortical area to mandibular basal bone (mm) as per right and left mandible

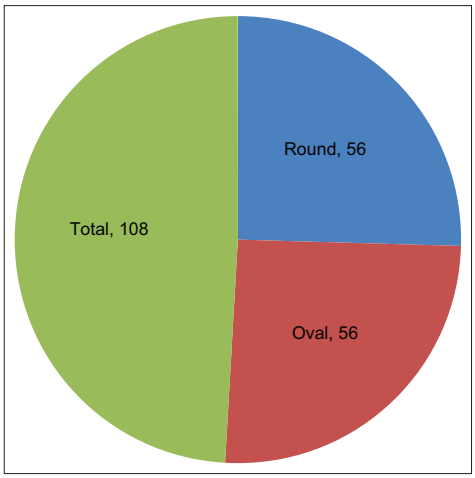
Parameter	Right mandible		Left mandible		*P*
	Mean	SD	Mean	SD	
Distance from lower cortical area to mandibular basal bone (mm)	12.20	1.61	13.40	1.95	0.983

SD: Standard deviation

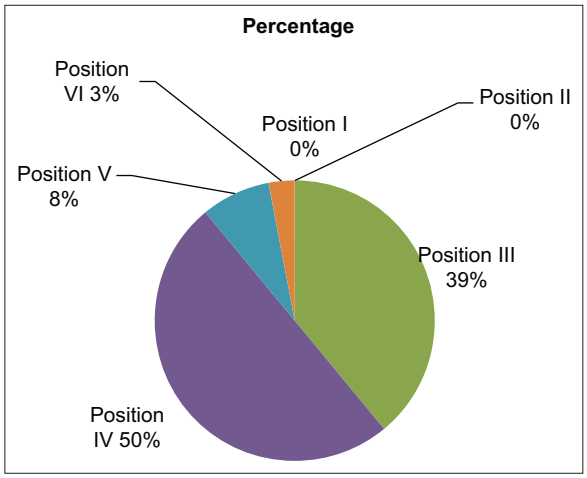
Table 6: Size of foramen

Size of foramen (mm)	*n*	Mean	SD	*P*
Right mandible	54	3.17	1.41	0.413
Left mandible	54	2.96	1.13	

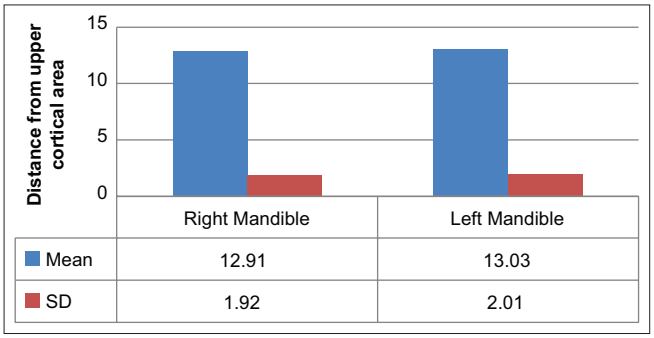
SD: Standard deviation



Graph 2: Most common shape

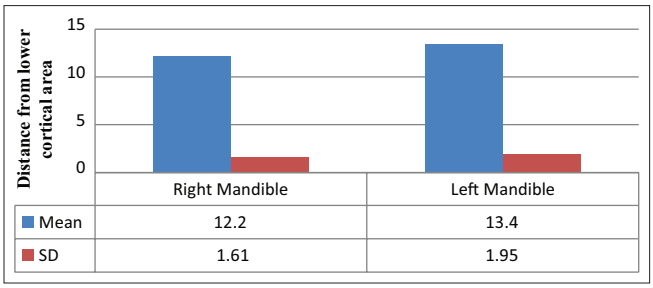


Graph 3: Most frequent position of the mental foramen

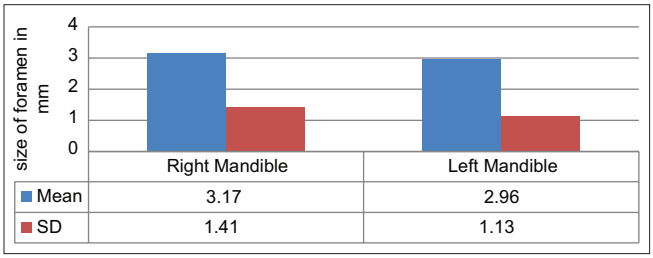


Graph 4: Distance from the upper cortical area of the mental foramen to the alveolar crest

study with no significant difference observed between right and left. This was in consistent with the studies conducted by Gupta and Soni[13] and Córdova,[14] Singh and Srivastav[15] and Sekerci.[16] However, the studies by Chalkoo *et al.*,[17] Padilla *et al.*,[18] Igbigbi and Lesbona[1] Budhiraja *et al.*,[19] Agarwal and Gupta[12] Oliveira *et al.*,[20] Ilayperuma *et al.*,[21] and Hasan.[22] have reported the oval shape as the most frequent one. These results were not in accordance with the present study. This variation may be because of the fact



Graph 5: Distance from the lower cortical area of the mental foramen to the mandibular base



Graph 6: Size of the mental foramen

that these studies were conducted on dry skulls or because of the different races and ethnic groups selected.

Frequent Position of the Mental Foramen

In the literature, there is a lot of disagreement over where the mental foramen is located in different ethnic groups. Position IV (In line with 2nd premolar) was the most frequent position of the mental foramen in our study (that was 50%). In position I (Mesial to 1st premolar) and position II (In line with 1st premolar) no mental foramen was found. Similar results were observed by Igbigbi and Lesbona,[1] Amorin *et al.*,[23] and Chalkoo *et al.*[17] where as Haghanifar and Rokouei[24] Oliveira *et al.*,[20] Rupesh *et al.*,[25] and Gungor *et al.*[26] showed that the most frequent locate on of the mental foramen was position III. The different feeding habits subsequently affecting the mandible development may be the reason related to the variability in the position of mental foramen.

Distance of Mental Foramen from Upper Cortical Plate and the lower Cortical area to the Mandibular Basal Bone

The findings of our study were in accordance with the studies conducted by Igbigbi and Lesbona and Agarwal and Gupta[1] Oliveira *et al.*[20] and Budhiraja *et al.*[19] They observed measurements on dry mandibles and reported shorter distances as compared to this study.

SUMMARY AND CONCLUSION

Following conclusions can me made:

i. Round was the most frequent shape found in this study with no significant difference observed between right and left

ii. The most frequent position of the mental foramen was position IV-50% (In line with 2nd premolar).

Thus, further studies are recommended to analyze the invariable landmarks like the inferior border of mandible to locate mental foramen. However, variations do exist in the position, shape and size of mental foramen in different population groups. It is essential to be aware of the possibility of these anatomical variations while planning surgery in that region to avoid nerve damage and also to enable effective mental nerve block anesthesia.

REFERENCES

1. Igbigbi PS, Lesbona S. The position and dimensions of the mental foramen in adult Malawian mandibles. West Afr J Med 2005;24:184-9.
2. Hassan T, Fauzi M, Hassan D. Bilateral absence of mental foramen: A rare variation. Int J Anat Var 2010;3:187-9.
3. Al-Juboori MJ, Al-Wakeel HA, Yun CM, Wen FS. Location of mental foramen among Malaysia populations: Retrospective study by using orthopantomogram. World J Med Sci Res 213;1:85-90.
4. Amorim MM, Borini CB, Lopes SL, Neto HF, Caria PH. Morphological description of mandibular canal in panoramic radiographs of Brazilian subjects: Association between anatomic characteristic and clinical procedures. Int J Morphol 2009;27:154-9.
5. Voljevica A, Talovic E, Hasanovic A. Morphological and morphometric analysis of the shape, position, number and size of mental foramen on human mandibles. Acta Med Acad 2015;44:31-8.
6. Rigolone M, Pasqualini D, Bianchi L, Berutti E, Bianchi SD. Vestibular surgical access to the palatine root of the superior first molar: Low-dose cone-beam CT analysis of the pathway and its anatomic variations. J Endod 2003;29:773-5.
7. Ludlow JB, Laster WS, See M, Bailey LJ, Hershey HG. Accuracy of measurements of mandibular anatomy in cone beam computed tomography images. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007;103:534-42.
8. Pinsky HM, Dyda S, Pinsky RW, Misch KA, Sarment DP. Accuracy of three dimensional measurements using cone-beam CT. Dentomaxillofac Radiol 2006;35:410-6.
9. Mbajiorgu EF, Mawera G, Asala SA, Zivanovic S. Position of the mental foramen in adult Black Zimbabweanc mandibles: A clinical anatomical study. Cen Afr J Med 1988;44:24-30.
10. Mwaniki DL, Hassanali J. The position of mandibular and mental foramina in Kenyan African mandibles. East Afr Med J 1992;69:210-3.
11. Ngeow WC, Yuzawati Y. The location of the mental foramen in a selected Malay population. J Oral Sci 2003;45:171-5.
12. Agarwal D, Gupta S. Morphometric analysis of mental foramen in human mandibles of South Gujarat. Peoples J Sci Res 2011;15:1-5.
13. Gupta S, Soni JS. Study of anatomical variations and incidence of mental foramen and accessory mental foramen in dry human mandibles. Natl J Med Res 2012;2:28-30.
14. Córdova L. Características Radiográficas del Foramen Mentoniano en Pacientes del Instituto de Salud Oral de la FAP del 2000 al 2008 [Thesis] Lima, Perú. Universidad Nacional Federico Villarreal; 2009.
15. Singh R, Srivastav A. Study of position, shape, size and incidence of mental foramen and accessory mental foramen in Indian adult human skulls. Int J Morphol 2010;28:1141-6.
16. Sekerci AE, Sahman H, Sisman Y, Aksu Y. Morphometric analysis of the mental foramen in a Turkish population based on multi-slice computed tomography. J Oral Maxillofac Radiol 2013;1:2-7.
17. Chalkoo HA, Wani AB, Sheikh AR, Maqbool S. Morphometric analysis of the mental foramen using cone-beam computed tomography. J Med Sci Clin Res 2018;6:766-71.
18. Padilla C, Juan, Cahuana Q, Eduardo. Morphological and morphometric study of the mental foramen using cone-beam CT in dentate adult patients. 2014;16:4-12.
19. Budhiraja V, Rastogi R, Lalwani R, Goel P, Bose CS. Study of position, shape, and size of mental foramen utilizing various parameters in dry adult human mandibles from North India. ISRN Anat 2013;3:1-5.
20. Oliveira J, Araujo A, Da Silva C, Sousa R, Lima F. Morphological and morphometric study of the mental foramen on the M-CP. 18 Jianchenjiang point. Int J Morpho 2009;27:231-8.
21. Ilayperuma I, Nanayakkara G, Palahepitiya N. Morphometric analysis of the mental foramen in adult Sri Lankan mandibles. Int J Morphol 2009;27:1019-24.
22. Hasan T. Mental foramen morphology: A must know in clinical dentistry. J Pak Dent Assoc 2012;21:167-72.
23. Amorin M, Prado F, Borini C, Bittar T, Volpato M, Groppo F, *et al*. The mental foramen position in dentate and edentulous Brazilian's mandible. Int J Morphol 2008;26:981-7.
24. Haghanifar S, Rokouei M. Radiographic evaluation of the mental foramen in a selected Iranian population. Indian J Dent Res 2009;20:150-2.
25. Rupesh S, Winnier JJ, John SA, Joy T, Rao AP, Reddy V. Radiographic study of the location of mental foramen in a randomly selected Asian Indian population on digital panoramic radiographs. J Med Sci 2011;11:90-5.
26. Gungor K, Ozturk M, Semiz M, Brooks SL. Location of mental foramen in Turkish population. Coll Antropol 2006;30:801-5.

How to cite this article: Wani W, Kumar JS, Mir H. Morphometric Analysis of Mental Foramen by Cone-Beam Computed Tomography. Int J Sci Stud 2022;10(7):14-19.

Source of Support: Nil, **Conflicts of Interest:** None declared.