How to Cite:
Ravindranadh, G., Rao, S. B., & Kommanda, R. K. S. (2022). Study of mental foramen in dry human mandibles of adult and its significance: An anatomical study. *International Journal of Health Sciences*, *6*(S3), 2285–2292. https://doi.org/10.53730/ijhs.v6nS3.6000

Study of mental foramen in dry human mandibles of adult and its significance: An anatomical study

G. Ravindranadh
Associate Professor, Department of Anatomy, Manipal University College Malaysia (MUCM), Melaka, Malaysia

S. Babu Rao
Professor, Department of Anatomy, Santhiram Medical College, Nandyal, Andhra Pradesh, India

Radha Krishna Shetty Kommanda
Associate Professor, Department of Anatomy, Manipal University College Malaysia (MUCM), Melaka, Malaysia

***Abstract*---**Mandible also known as the largest and inferior, primary facial bone of the face giving a curved shape to it. It changes its shape and gives variations to the bony structure of the face from birth till older age. Mental foramen is known as the vintage of the mandible and is an important mark of the face for carrying out many diagnostics and surgical processes along with aesthetic procedures of the face. Thus, the present study is designed with an aim to get insight knowledge of position and shape of mental foramen in dry adult human mandible. The present study was designed as a comparative and descriptive study conducted in the Department of Anatomy at Tertiary Care Teaching Hospital. Total 70 bones were included in the study for consideration. Unknown mandibles with intact alveolar sockets removed from cadavers and unknown mandibles from storage room of dry adult mandibles were obtained in 2 years. The position of mental foramen was studied using an instrument known as digital Vernier Calliper (in mm) while shape was analysed visually. Position of mental foramen was calculated using Statistical package for social sciences (SPSS) software. In our study, the mean and standard deviation of the mean and standard deviation of position of mental foramen from symphysis menti was found to be (27.68±2.01) on right side and (26.92±2.12) on left side. The distance from right side was more than the left side and was found insignificant p>0.05 for both sides. The mean and standard deviation of position of mental foramen from posterior border of ramus of

International Journal of Health Sciences ISSN 2550-6978 E-ISSN 2550-696X © 2022.
***Corresponding author**: Ravindranadh, G.*
Manuscript submitted: 18 Nov 2021, Manuscript revised: 09 Feb 2022, Accepted for publication: 27 March 2022

mandible was found to be (62.23±6.15) on right side and (63.01±5.59) on left side. The distance from right side was more than the left side and was found insignificant (p value >0.05 for left side and p>0.05 for right side. The mean and standard deviation of position of mental foramen from inferior border of body of mandible was found to be, (13.63±2.76) on right side and (13.75±3.14) on left side. The distance from right side was less than the left side and was found insignificant for right side while significant for left side (p>0.10 for right side and p value 0.037 for left side and p>0.0900 for right side. Hence, mental foramen plays a pivotal role in performing major facial surgeries and is an important landmark for several facial procedures performed.

***Keywords*---**mental foramen, mandible, accessory mental foramen, mental nerve, ancestry.

Introduction

The mental foramen (MF) is an oval or circular opening on the body of the mandible where the mandibular canal terminates. It is an exit for the mental nerve and blood vessels, which are terminal branches of inferior alveolar nerve, artery, and vein. The mental nerve provides innervations of the lower teeth, lip, gingival, and lower face [2]. The MF is an important anatomical landmark during osteotomy procedures, anesthetic nerve blocks, and prevention of neurovascular complications after invasive procedures on the lower jaw. [2]. Its anatomy is also useful in evaluating the morphometric symmetry of the mental triangle, microscopic and macroscopic morphology, bone remodeling activity, and paleoanthropologic features of the facial skeleton in different populations [3].

The MF is usually located in the body of the mandible at an equal distance from the superior and inferior border below or between the apex of the first and second premolar [4]. The direction of opening of the foramen from the inferior alveolar has been shown to be pointing posteriorly outward and upward [5]. Variability in the location of MF has been documented in different literature with the tendency of being more posterior in blacks than in whites and between the second premolar and first molar [6]. A study on Tanzanian population revealed th1at the most frequent locations for MF were below the apex of the second premolar and between the 2nd premolar and 1st molar. The MF was asymmetrically located between the right and left sides and predominantly oval. The direction of opening was mostly superior and poster superior and rarely labial, mesial, or posterior [7].

Any foramen in addition to MF in the body of mandible is known as accessory mental foramen (AMF) and it tends to exist in the apical area of the first molar and posterior or inferior area of the mental foramen. As AMF is due to branching of mental nerve before passing through MF, its shape, size, and verification of its existence would prevent accessory nerve injury during periapical surgery [8]. The potential severe complication of injury of the accessory mental foramen (AMF) is sensory disturbance of the lower lip [9]. Absent AMF are a more common variation than MF absence in humans and the frequent reasons for absence may range

from atrophy, posttraumatic fibrosis, osteoblastic hyperplasia, geriatric bony resorption, or congenital agenesis [10].

Material and Methods

The present study was designed as a comparative and descriptive study conducted in the Department of Anatomy at Tertiary Care Teaching Hospital. Total 70 bones were included in the study for consideration. Unknown mandibles with intact alveolar sockets removed from cadavers and unknown mandibles from storage room of dry adult mandibles were obtained in 2 years.

Inclusion criteria

Normal adult human mandibles with intact alveolar processes and without any apparent damage or congenital anomaly was included in the study.

Exclusion criteria

Abnormal human mandible with incomplete alveolar processes, with congenital or Pathological anomalies, damaged specimen, pediatric mandibles were excluded from the study.

Methodology followed during study

For measurement of various parameters of our study, mandible was placed on the horizontal plane and the lower border of mandible interact with greatest force as vertical pressure is applied to the second molar teeth. The shape of mental foramen in dry human adults was analyzed by visual examination of the both sides of the mandible. For measuring position of mental foramen in mandible of both sides following are the considerations in our study: position of mental foramen from symphysis menti, position of mental foramen from posterior border of ramus of mandible and position of mental foramen from inferior border of the body of mandible. Position was measured using Digital Vernier Calliper (in mm).

Statistical analysis

Mean and standard deviation of the position of mental foramen was calculated using Statistical package for social sciences (SPSS) software for comparison.

Result

In the present study, the statistical analysis was evaluated as mean and standard deviation. The mean and standard deviation of mental foramen (left and right side) were calculated. It was done using SPSS software and $p>0.05$ was considered insignificant while $p<0.05$ was considered significant.

Table 1
Comparison of mean and SD of position of mental foramen from symphysis menti (right and left side)

Side	No	Position of MF from symphysis menti		P value	Remark
		Mean	SD		
Right	70	27.68	2.01	>0.05	Insignificant
Left	70	26.92	2.12	>0.05	Insignificant

In our study, the mean and standard deviation of the mean and standard deviation of position of mental foramen from symphysis menti was found to be (27.68±2.01) on right side and (26.92±2.12) on left side. The distance from right side was more than the left side and was found insignificant (p>0.05 for both sides in Table 1.

Table 2
Comparison of mean and SD of position of mental foramen from posterior border of ramus of mandible (right and left side)

Side	No	Position of MF from posterior border of ramus of mandible		P value	Remark
		Mean	SD		
Right	70	63.23	6.15	0.011	Insignificant
Left	70	63.01	5.59	>0.10	Insignificant

The mean and standard deviation of position of mental foramen from posterior border of ramus of mandible was found to be (62.23±6.15) on right side and (63.01±5.59) on left side. The distance from right side was more than the left side and was found insignificant (p value >0.05 for left side and p>0.05 for right side in Table 2.

Table 3
Comparison of mean and SD of position of mental foramen from inferior border of ramus of mandible (right and left side)

Side	No	Position of MF from inferior border of ramus of mandible		P value	Remark
		Mean	SD		
Right	70	13.63	2.76	>0.05	Insignificant
Right	70	13.75	3.14	0.037	Significant

The mean and standard deviation of position of mental foramen from inferior border of body of mandible was found to be, (13.63±2.76) on right side and (13.75±3.14) on left side. The distance from right side was less than the left side and was found insignificant for right side while significant for left side (p>0.10 for right side and p value 0.037 for left side and p>0.0900 for right side in table 3.

Table 4
Comparison of shape of mental foreman

Shape	Right side N (no. of mandibles)	Percent (%)	Left side N (no. of mandibles)	Percent (%)
Round	24	33.42%	22	29.41%
Oval	46	66.58%	48	73.42%
Total	70	100%	70	100%

The shape round and oval of mental foramen was also compared for both the sides and the results for right side (Oval shape – 66.58% and round shape – 33.42%) while for left side (Oval shape – 73.42% and round shape –29.41% in Table 4.

Discussion

The MF is often involved in certain steps of maxillofacial surgeries. It is especially important to identify its boundaries and to preserve it during surgery, trauma, and local anesthesia according to Budhiraja *et al.* [11] The location and appearance of the MF are often determined by assessing some variables using panoramic radiography. Although it is recommended to cautiously use panoramic radiography for exact measurements and comparisons, previous studies have shown that there is a close relationship between the radiographic position of the MF and the skull Hasan *et al.*). [12]

The position of the MF in relation to the mandibular body is probably more precise, and is not affected by factors such as malocclusion, mesiodistal width of the tooth, race, nutrition, and age (Scheid, 2012). [13] Additionally, MF position and position symmetry are important anatomical landmarks, critical in forensic or medico legal cases because of the established racial variation among different population groups. Significant differences exist in the position, shape and symmetry of the MF among various ethnic groups and populations Udhaya *et al.*; because of this, the variation in the position of MF has been documented either according to the age, sex and race or in combinations, in different geographical regions and within the inhabitants of the same geographical area (Hasan). [12] However, in most studies, the position of this foramen is assessed in relation to the teeth, as this is simpler to use in clinical applications (Tebo & Telford). [14]

In maxillofacial surgical man oeuvres, knowledge of the precise position of MF is critical for accurate local anesthesia essential in dental procedures and as well safeguard against mental neurovascular bundle damage during oral surgical procedures. The lack of consistent anatomic landmarks and inability to clinically palpate the mental foramen during clinical man oeuvres may explain the intense attention the subject has received from researchers using either advanced radiographic imaging techniques Currie *et al.*, 2016, cadaveric or dry human materials Sankar *et al.* [15,16] Consequently, variation in the anthropological parameters is important in identification of skeletal remains in forensic and/or medico legal cases. Besides, success of surgical procedures requiring mental nerve block for the different subpopulation groups is contingent on accurate

knowledge of the MF position, shape and number and position symmetry existing in these subpopulation groups. [17]

In the present study, we found clear ancestry- and sex-specific differences in the position of the MF not previously reported. Position IV of the MF is shown as the most prevalent in South African subpopulations. [18] Positions III and IV were commonly observed in males and females respectively. However, in terms of ancestry and sex, position II was commonly observed in the males of ED while position III was observed in AD and MD males and ED female subpopulations; signifying differences in MF position between the South African males AD and MD and their ED counterparts as well as among the females of the various subpopulation groups. [19] These variations may be the result of varying degrees of genetic admixture between ancestral groups. However, globally, previous studies have shown that PIII and IV are the commonly reported MF positions. Position III is common among Bosnian and Herzegovinians and Brazilians; while PIV is common among South Indians (Udhaya *et al.*). [20]

As anatomical landmarks, MF position and position symmetry are important and helpful in forensic or medico legal cases population groups. The distinct in symmetry and asymmetry identified amongst the AD sub population group (as against MD and ED subpopulations) suggests genetic influence on these parameters which is very important in clinical practice for successful mental nerve block. Nevertheless, there was no significant difference in the symmetric analysis of MF amongst male and female ($p = 0.059$) and between ancestry ($p = 0.455$). [21]

In this study, an oval shape of MF was the most common across population groups and ancestry and is in line with most international previous reports. The high frequency of occurrence of the oval shape is similar to what was reported by Udhaya *et al.* [20] Factors responsible for predominant oval shape of MF are not clearly known, but may be unrelated to the embryonic factors operating during the development of the mandible and feeding patterns. [22] Naturally, an AMF occurs from the branching of the inferior alveolar nerve prior to the formation of the mental canal by Naitoh *et al.*, 2009. [23]

Conclusion

Knowledge of the position of the mental foramen and the number of accessory mental foramen in a heterogeneous Indian population will prevent mental nerve damage during surgery. This study is the first comprehensive description of the mental foramen in the Indian population and its ancestry subgroups. The observations in this study could also be very useful in forensic anthropology in the Indian population. However, the morphometric analysis of the vertical and horizontal position of mental foramen and the relative positions of the accessory mental foramen in the mandible of Indian populations warrant further research.

References

1. Fuakami, K.; Shiozaki, K.; Mishima, A.; Shimoda, S.; Hamada, Y. & Kobayashi, K. Detection of buccal perimandibular neurovascularisation

associated with accessory foramina using limited cone-beam computed tomography and gross anatomy. *Surg. Radiol. Anat., 33(2)*:141-6, 2011.
2. Kqiku, L.; Weiglein, A.; Kamberi, B.; Hoxha, V.; Meqa, K. & Städtler, P. Position of the mental foramen in Kosovarian population. *Coll. Antropol., 37(2)*:545-9, 2013.
3. 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., 44(1)*:31-8, 2015.
4. Orhan, A. I.; Orhan, K.; Aksoy, S.; Ozgül, O.; Horasan, S.; Arslan, A. & Kocyigit, D. Evaluation of perimandibular neurovascularization with accessory mental foramina using cone-beam computed tomography in children. *J. Craniofac. Surg., 24(4)*:e365-9, 2013.
5. Chu, R.A.; Nahas, F. X.; Di Martino, M.; Soares, F. A.; Novo, N. F.; Smith, R. L. & Ferreira, L. M. The enigma of the mental foramen as it relates to plastic surgery. *J. Craniofac. Surg., 25(1)*:238-42, 2014.
6. Eboh, D. E. & Oliseh, E. I. Analysis of mental foramen in dry human mandibles of adult Nigerians. *Afr. J. Med. Med. Sci., 43(2)*:107-13, 2014.
7. J. Rajkohila, P. Daniel, S. Ambikaipakan, and S. Rabi, "Morphological and morphometric analysis of accessory mental foramen in dry human mandibles of south indian population," Indian Journal of Dental Research, vol. 29, no. 1, p. 56, 2018.
8. D. R. Agarwal and S. B. Gupta, "Morphometric analysis of mental foramen in human mandibles of South Gujarat," People's Journal Of Scientif c Research, vol. 4, no. 1, pp. 15–18, 2011.
9. M. Kadel, B. P. Sedhain, and P. M. Dangol, "Morphometric analysis of mental foramen in human dry mandibles of Nepalese population," Asian Journal of Medical Sciences, vol. 7, no. 6, pp. 82–86, 2016.
10. V. Budhiraja, R. Rastogi, R. Lalwani, P. Goel, and S. C. Bose, "Study of position, shape, and size of mental foramen utilizing various parameters in dry adult human mandibles from north," ISRN Anatomy, vol. 2013, Article ID 961429, 5 pages, 2013.
11. Budhiraja, V.; Rastogi, R.; Lalwani, R.; Goel, P. & Bose, S. C. Study of position, shape, and size of mental foramen utilizing various parameters in dry adult human mandibles from north India. ISRN Anat., 2013:961429, 2013.
12. Hasan, T. Characteristics of the Mental Foramen in Different Populations. Internet J. Biol. Anthropol., 4(2), 2011.
13. Scheid, R. C. Woelfel's Dental Anatomy. 8th ed. Philadelphia, Lippincott Williams & Wilkins. 2012. pp.255-6.
14. Tebo, H. G. & Telford, I. R. An analysis of the variations in position of the mental foramen. Anat. Rec., 107(1):61-6, 1950
15. Currie, C. C.; Meechan, J. G.; Whitworth, J. M.; Carr, A. & Corbett, I. P. Determination of the mental foramen position in dental radiographs in 18-30 year olds. Dentomaxillofac. Radiol., 45(1):20150195, 2016.
16. Sankar, D. K.; Bhanu, S. P. & Susan, P. J. Morphometrical and morphological study of mental foramen in dry dentulous mandibles of South Andhra population of India. Indian J. Dent. Res., 22(4):542-6, 2011.
17. Currie, C. C.; Meechan, J. G.; Whitworth, J. M.; Carr, A. & Corbett, I. P. Determination of the mental foramen position in dental radiographs in 18-30 year olds. *Dentomaxillofac. Radiol, 45(1)*:20150195, 2016.

18. Samanta, Paramita P, Kharb P. Morphometric analysis of mandibular foramen and incidence of accessory mandibular foramina in adult human mandibles of an Indian population 2013; 5(2):60-6.
19. M Lipski, IM Tomaszewska, W Lipska, GJ Lis, KA Tomaszewski. The mandible and its foramen: anatomy, anthropology, embryology and resulting clinical implications. 2013; 72(4):285-92.
20. Udhaya K., Saraladevi K.V., Sridhar J. The Morphometric analysis of mental foramen in dry human mandible: a case report journal of clinical and Diagnostic Research. 2013; (8):1547-551.
21. Parmar A, Shah K, Patel B, Jadav J, Trivedi B. Morphological and Morphometric Analysis of Mental Foramen in dry Human Mandibles. Int J Med Sci Public Health. 2013; 2:640-44.
22. Balakrishnan Y.A., S.Vikram, Rao C.P., RevankarS.K. Position of mental foramen in dry human mandibles and its significance. International journal of Anatomy and Research 2018; (6):5228-32.
23. Shukla R.K., Gupta P, Hussain M, Hussain F, Singh A.B. Morphometric Measurement of Foramen in Dry Human Mandible in North India population. Int J Anet Res. 2015; 3(1); 899-05.