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Research Article

Study of Anatomical Variations of Mental Foramen in Dry Adult Human Mandibles and Its Clinical Importance

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Abstract: ***Background***: 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 ventage of the mandible and is an important mark of the face for carrying out many diagnostics and surgical processes along with anesthetic 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. ***Materials and methods:*** A total of 50 mandibles were measured bilaterally with a pachymeter for various dimensions, and a proportional calculation of each parameter was obtained, based on the size of the length of each mandibular base. In addition to the general descriptive morphology of the mandibles, considering that six mandibles presented duplicated foramina, they were divided into two groups, and the mandibles with no anatomical variation (normal group, N = 57) were compared to those with duplicated foramina (N = 6). Data ***Results***: The present study showed that the position of mental foramen from symphysis menti and posterior border of ramus of mandible was more from right side than left side and found to be insignificant while position of mental foramen from inferior border of body of mandible was more from left side than right side and found to be insignificant for right side while significant for left side. The shape of mental foramen from right side was found to be (Oval shape- 68.33% and round shape – 31.66%) while for left side was found to be (Oval shape- 71.66% and round shape – 28.33%). ***Conclusion***: The knowledge of the distances from surgically encountered anatomical landmarks in the present study provide valuable information to dental surgeons that will facilitate effective localization of the neurovascular bundle passing through mental foramen, thus avoiding complications from local anaesthetic, surgical and other invasive procedures. The study is also of forensic significance as the position of mental foramen also helps in determination of sex of an individual.

Keywords: Anatomical Variations Mental Foramen Adult Human Mandibles.

INTRODUCTION

Mandible is the largest, strongest and lower bone of the face having a curved body that is convex forwards with two broad ramus ascending posteriorly. Rami of the mandible carries coronoid & condylar processes.1 Mental foramen of mandible is situated in anterolateral aspect of the body. It lies below either the interval between the premolar tooth, midway between the upper and lower borders of the body of the mandible.2 On the inner surface of the body of mandible lies mandibular foramen that leads into the mandibular canal and opens on the outer surface of the mandible as mental foramen.3 Mental foramen transmits mental nerve, artery and vein through its canal.

Mental nerve is a branch of inferior alveolar nerve supplying sensations to lower lip, labial mucosa, lower canines and premolars.2 It has been seen that the shape of the mandible undergoes definitive variations from birth till the old age and with that the relative position/location of the mental foramen changes; thus, providing a clue to the age of an individual.

In infancy, the mental foramen is located relatively far posteriorly, below the first molar bud and with the eruption of permanent teeth, the mental foramen moves anteriorly, reaching its final destination that corresponds to the level of the second premolar tooth; Thus, accounting for its relative anteroposterior movement. With regard to its relative vertical movement, the mental foramen appears closer to the alveolar margin in neonates, and with eruption of teeth it descends between the alveolar and inferior border while in adult the mental foramen is nearer to the inferior border and moves upwards. As mental foramen moves upwards, it gets closer to the alveolar border representing an old age. Along with an increase in age it shows the loss of teeth and bone resorption in elderly people.4,5 Mental foramen is an anatomical landmark for mandible facilitating diagnostic, surgical, local anesthetic and other invasive procedure for dental surgeons performing periapical surgery in the mental region of mandible.6 Also, it is an important region for performing

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METHODOLOGY & MATERIALS

The mandibles which were used for our study were procured from the Department of Anatomy, Shadan Institute of Medical Sciences Teaching Hospital & Research Centre over a period of 6 years.

About 70 adult dry South Indian mandibles, irrespective of age and sex, with either all the teeth intact or with preserved alveolar margins, were used for our study. The bones with gross pathological deformities were excluded from our study. The number, shape and the orientation of

the MF were determined by a visual examination. The positions of the mental foramens were measured with respect to the teeth, for which we followed the Tebo and Telford [6] classification.

The positions of the mental foramens with respect to the borders were also measured with the help of a digital vernier calipers, at a measuring accuracy of 0.01mm. From the transverse and the vertical diameters which were obtained, the size of the MF was calculated.

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 the mandibles 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. Statistical analysis All the measurements were recorded by one of the authors to reduce bias. The SPSS, version 25 software were used for the statistical analysis, to find out the minimum and the maximum incidences, the mean and the standard deviation.

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 consideredsignificant.

In our study, the mean and standard deviation of the meanand standard deviation of position of mental foramen fromsymphysis menti was found to be (25.729±1.927) on rightside and (25.277±1.977) on left side. The distance from right side was more than the left side and was found insignificant (p>0.10 for both sides) (Table 1).

The mean and standard deviation of position of mental foramen from posterior border of ramus of mandible was found to be (62.333±5.045) on right side and(62.248±5.423) on left side. The distance from right side was more than the left side and was found insignificant (pvalue >0.10 for left side and p>0.0900 for right side) (Table 2).

The mean and standard deviation of position of mental foramen from inferior border of body of mandible was found to be, (12.531±1.994) on right side and (12.684±2.273) 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 0.024 for left side) (Table 3).

The shape round and oval of mental foramen was also compared for both the sides and the results for right side (Oval shape – 68.33% and round shape – 31.66%) while for left side (Oval shape – 71.66% and round shape – 28.33%) (Table 4).

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

Side	No.	Range		Position of MF from symphysis menti		P value	Remark
		Minimum	Maximum	Mean	SD		
Right	50	18.900	29.320	25.7293	1.927	>0.10	Insignificant
Left	50	19.800	28.480	25.2771	1.977	>0.10	Insignificant

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.	Range		Position of MF from posterior border of ramus of mandible		P value	Remark
		Minimum	Maximum	Mean	SD		
Right	50	49.330	75.970	62.3335	5.044	0.090	Insignificant
Left	50	49.330	75.970	62.2487	5.422	>0.10	Insignificant

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

Side	No.	Range		Position of MF from inferior border of body of mandible		P value	Remark
Minimum		Maximum		Mean	SD		
Right	50	5.639	16.439	12.5315	1.993	>0.10	Insignificant
Left	50	7.009	22.219	12.6842	2.272	0.023	Significant

Table 4: Comparison of shape of mental foramen.

	Right side N (no. of mandibles)	Percentage (%)	Left side N (no. of mandibles)	Percentage (%)
Round	19	38.00%	12	24.00%
Oval	31	62.00%	38	76.00%
Total	50	100%	50	100%

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 . 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 [1]. 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 [3]. 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 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. 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 [6]. In maxillofacial surgical manoeuvres, knowledge of the precise position of MF is critical for accurate local anaesthesia 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 manoeuvres may explain the intense attention the subject has received from researchers using either advanced radiographic imaging techniques, cadaveric or dry human materials [20]. In India, due to inherited admixed ancestry arising from colonization, there is a diverse genetic constitution of the population implying a great variability in the skeletal stature and structure of the different racial groups. 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. The importance of this study among the heterogeneous South African population therefore cannot be over emphasized. In the present study, we found clear ancestryand sex-specific differences in the position of the MF not previously reported. Position IV of the MF is shown as the most prevalent in Indian populations. 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. Thesevariations may be the result of varying degrees of genetic admixture between ancestral groups. 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 subpopulation 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) [23]. 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 [7]. The high frequency of occurrence of the oval shape is similar to what was reported in Bosnia and Herzegovina, North India and South India [8]. 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. About 23.84 % of the studied population presented with multiple MF reaching a maximum of 3 AMFs in AD and MD populations. But, the presence of 1 AMF was frequent across the subpopulation groups. Unlike earlier reports [9], this study shows that there are 2 (2 %) and 3 (0.46 %) AMFs present in the South African population. Naturally, an AMF occurs from the branching of the inferior alveolar nerve prior to the formation of the mental canal [27]. Ignorance of its existence may result in unforeseen damage to the neurovascular bundles or unsuccessful men- tal nerve block. Consequently, the application of Champy techniques in maxillofacial surgery in the South African population will more likely affect the mental nerve. Furthermore, the high prevalence of one AMF in AD and MD populations is consistent with an earlier report on African population by Eboh & Oliseh probably suggesting genetic influence from African ancestry in this case. The results were compared with similar studies in the last decade as presented in Table III. In the last decade various reports on the position of MF (Table IV) have mostly utilized radiographic imaging techniques. Very few of these authors reported the frequency of MF position and position symmetry in the different studied populations [10]. The most common shape of the foramen reported was oval similar to our study, still, the only study that reported the frequency of position symmetry presented a very high frequency (85 %) compared to our study [11]. The results from studies of MF using radiographic imaging techniques are consistent with the results of our present study, confirming that there is a relationship between the radiographic position of the MF and the skull [12]. Actually, the results from these studies on the frequency of AMF occurrence was limited to only 1 AMF, with no similarity in the frequency of occurrence of 1 AMF in our studied population. This discrepancy may be due to the poor visualization of AMF on 2-dimensional imaging techniques, especially when the diameter of AMF is less than 1.5 mm [14].

Conclusion

The present study of the mental foramen and the incidence of accessory mental foramen will provide helpful information to the oral and maxillofacial surgeon, oncosurgeon for performing procedure on the mandible. Which prevents complications, misinterpretations. also helps to plan and develop newer techniques for nerve blocks for surgery on mandible. Therefore, identification of mental foramen in its various positions and its morphometric analysis is important for dental surgeons in nerve block and surgical procedures like apical curettage of mandibular premolars and periodontal surgery, to avoid injury to neurovascular bundle. In a majority of mandibles, we have found oval-shaped foramina lying in position IV. 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

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