

A MORPHOMETRIC STUDY OF MANDIBULAR FORAMEN IN DRY ADULT HUMAN MANDIBLES OF INDIAN POPULATION IN TELANGANA STATE

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ABSTRACT

Background: Mandibular foramen is an irregular foramen located just above the centre of the medial surface of the ramus of the mandible. Mandibular foramen is leading to mandibular canal through which inferior nerve and vessels will transmit and supply the teeth of lower jaw.

The Mandibular foramen is an important anatomical landmark for the inferior nerve blocks, mandibular osteotomies and implant treatment. The inferior nerve block is the commonest local anaesthetic technique which is used for anaesthetizing lower jaw in various surgical and dental procedures on mandible and mandibular teeth such as removal of impaction, reduction of fractures and tooth extraction. Inferior alveolar nerve block failure is not uncommon and it occurs even with experienced hands due to variations in position of mandibular foramen.

A thorough knowledge of anatomy of mandibular foramen is very essential hence aim of this study was to determine the exact position of mandibular foramen by studying dry adult human mandibles of telangana population.

Material and methods: The present study was conducted using 60 dry adult human mandibles obtained from anatomy department of Shadan institute of medical sciences, Hyderabad and VRK womens medical college, Hyderabad. The data was tabulated and statistically analysed.

Result: The mean distance of mandibular foramen to anterior border of ramus (MF-AB) was 16.67 ± 2.73 mm (R) and 16.56 ± 2.52 mm (L), to posterior border of ramus (MF-PB) was 12.67 ± 2.37 mm (R) and 13.03 ± 2.43 mm (L), to mandibular notch (MF-MN) 21.04 ± 2.95 mm (R) and 20.24 ± 2.94 mm (L), to angle of mandible was 23.005 ± 3.92 mm (R) and 22.36 ± 3.89 mm, base of mandible or inferior border (MF-MB) was 24.38 ± 3.86 mm (R) and 24.42 ± 4.44 mm (L), tip of coronoid process (MF-CrT) 35.68 ± 3.25 mm (R) and 35.19 ± 3.47 mm (L).

Conclusion: The present study gives a fair knowledge of the position of mandibular foramen and provides useful information for successful local anaesthesia (inferior nerve block), to the maxillofacial surgeons, radiologists and oncologists performing operations on the mandible to prevent complications and misinterpretations

KEY WORDS: Mandible, Mandibular Foramen, Inferior Alveolar Nerve Block, Ramus Of Mandible, Tip Of Coronoid Process.

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INTRODUCTION

Mandible is the strongest and largest bone of face which forms lower jaw. It has U shaped body anteriorly and a quadrilateral bony plate, ramus of mandible projecting postero-superiorly from body. Ramus of mandible has anterior, posterior, superior and inferior borders and lateral and medial surfaces[1].

The mandibular foramen is an irregular foramen located just above the centre of medial surface of ramus of mandible.

The mandibular foramen leads to mandibular canal which runs downwards and forwards into the body of mandible and opens at mental foramen[1].

The inferior alveolar nerves and vessels enters through mandibular foramen, passes through mandibular canal, supplies mandibular teeth and finally divides into incisive and mental branches, mental branch comes out through mental foramen[1].

Mandibular foramen is an anatomical landmark for surgical procedures like sagittal split osteotomies done to reposition the mandible in prognathism and retrognathia[2].

The assessment of mandibular foramen is of considerable importance for inferior alveolar nerve anaesthesia, dento alveolar surgery planning, endodontic treatments and lesion diagnosis. Incorrect estimation of its location might be an explanation to unsuccessful anaesthesia of inferior alveolar nerve[3].

It has been observed and reported by different researchers that the main complications encountered during sagittal split osteotomies are hemorrhage, injury to neurovascular bundle, undesired fractures and bone necrosis when the proper location of mandibular foramen is not clear. Hence a thorough knowledge of mandibular foramen and ramus is essential for orthodontic surgeries too [4].

Inferior alveolar nerve block is one of the most common nerve block technique used in dental practice. The success of the procedure mainly depends on placing the needle tip close to the mandibular foramen. Variations in the position of mandibular foramen and the presence of accessory mandibular foramina are the main

reasons accounting for the failure rates of this technique[5].

The inferior alveolar nerve block is the commonest local anaesthetic technique which is used for anaesthetizing the lower jaw in various surgical and dental operations on the mandible and mandibular teeth such as removal of impaction, reduction of fractures and extraction of teeth. The failure rate of this technique is high and commonest cause being inaccurate localization of mandibular foramen[6].

The success of this technique highly depends on the proximity of the needle tip to the mandibular foramen at the time of the anaesthetic injection[7].

Inferior alveolar nerve block failure is not uncommon and it occurs even with experienced hands [8,9].

Failure of this procedure could be as high as 45%.

Studies have shown racial differences in the anatomy of the mandible. The literature contains conclusive evidence that significant metric, morphological and biological differences are present among the three major racial phenotypes, Caucasoid, Mongoloid and Negroid. The mandibular and mental foramen are often chosen as reference points because of their stable relation with base of mandible, in paleoanthropological studies of the facial skeleton in different populations and for identification of the human remains [10,11].

The risk of undesirable mandibular fractures might decrease when the mandibular foramen is taken as anatomical landmark for repair osteotomies performed for orthognathic purposes[12].

Imperfections in the attainment of the anaesthesia of the inferior alveolar nerve must be generally due to the lack of observance of the localisation of the mandibular foramen and also noticing its variations[13].

The aim of this study was to determine the precise location of the mandibular foramen in relation to the borders of the mandibular ramus, mandibular notch and tip of coronoid process and to determine whether bilateral symmetry existed for each of these landmarks with respect to position of mandibular foramen.

MATERIALS AND METHODS

The present study was conducted on 60 dry adult human mandibles procured from dept of anatomy of Shadan institute of medical sciences, Hyderabad and VRK Womens medical college, Hyderabad, India.

We selected only adult mandibles depending on presence of third molar tooth and excluded old and damaged mandibles.

All the measurements were taken with the help of vernier caliper in mm. The position of mandibular foramen from various anatomical landmarks was measured and recorded on both right & left mandibular rami for each bone [total 120 sides]

For morphometric analysis of mandibular foramen following parameters were studied

Distance

A. from midpoint of anterior border of mandibular foramen [MF] nearest point on the anterior border of the ramus [AB] [MF-AB].

B. from midpoint of posterior border of mandibular foramen to the nearest point on the posterior border of ramus [PB][MF-PB].

C. from mandibular foramen to farthest point on angle of mandible.[AG][MF-AG].

D. from inferior limit of mandibular foramen to base \inferior border of ramus[MB][MF-MB].

E. from mandibular foramen to lowest point of manbdibular notch.[MN][MF-MN].

F. from mandibular foramen to tip of coronoid process,highest point[CrT][MF-CrT].

The data collected was tabulated and statistically analysed.

We calculated mean.S.D.,P Value to exactly localize MF from defined anatomical land marks and to compare any difference between right and left sides.

RESULTS

Table 1: showing results of present study.

Position of mandibular foramen	Right side mean(mm)	Right side S.D	Left side mean(mm)	Left side S.D.	P value
MF-AB	16.67	2.73	16.56	2.52	0.822
MF-PB	12.67	2.37	13.03	2.43	0.407
MF-MN	21.04	2.95	20.24	2.94	0.14
MF-AG	23	3.92	22.36	3.89	0.374
MF-MB	24.38	3.86	24.42	4.44	0.963
MF-CrT	35.68	3.25	35.19	3.47	0.425

A total of 60 adult dry human mandibles were studied for the precise location of mandibular foramen.we calculated mean and S.D for all parameters on both sides and P value to assess any significant difference between right and left side values.shown in table-1.

The mean distance of mandibular foramen from,

1. Anterior border of ramus is 16.67mm on right side and 16.56mm on left side.

2. Posterior border of ramus is 12.67mm on right side and 13.03mm on left side.

3. Mandibular notch is 21.04mm on right side and 20.24mm on left side.

4. Angle of mandible is 23.005 on right side and 22.36mm on left side.

5. Mandibular base \inferior border of ramus is 24.38mm on right side and 24.42mm on left side.

6. Tip of coronoid process is 35.68mm on right side and 35.19mm on left side.

For all parameters we calculated P value which is more than 0.05,means there was no difference when we compare two sides for location of mandibular foramen,shown in table -1.

DISCUSSION

Anatomical variations of mandible may result in clinical implications if not properly identified revealing the importance of studying the incidence of these variations[8].

Great variations are found in the position of mandibular foramen with different landmarks. The variability of the position of mandibular foramen makes it difficult to anaesthetize the inferior alveolar nerve[3,11].

The location of mandibular foramen is clinically crucial in achieving inferior nerve block. Failure to locate neurovascular bundle will result due to inaccurate localization of mandibular foramen[3].

In the present study the location of mandibular foramen and its distances from different bony landmarks on mandibles of Indian population from Telangana state was done and compared with previous studies.

According to Samanta P P et al[13] who studied 60 mandibles from north part of india,the mandibular foramen was located 15.75+-2.92 mm(R) and16.23+-2.88mm (L) from

Table 2: Showing Comparison of studies on Mandibular Foramen (MF) by various authors.

author	Side	MF-AB	MF-PB	MF-MN	MF-AG	MF-MB	MF-CrT
Oguz et al [6]	Right	16.9	14.09	22.37		30.97	
	Left	16.78	14.37	22.17		29.75	
Padmavati G et al [18]	Right	16.9±2.5	12.1±2.4	22.3±3.4	22.2±2.9	24.8±3.3	
	Left	16.8±2.8	11.7±2.0	22.0±3.0	22.6±3.4	25.0±3.2	
Samanta p et al [13]	Right	15.72±2.92	13.29±1.74	22.70±3	21.54±2.92		
	Left	16.23±2.88	12.73±2.04	22.27±2.92	21.13±3.43		
Prado et al [19]	Right	19.2±3.6	14.2±8.4	23.6±3.1			
	Left	18.8±3.8	13.0±2.6	23.1±3.0			
Qudusia sultana et al.[20]	Right	17.69±2.7	11.39±1.9	23.87±4.5	17.9±3.5		
	Left	17.94±2.72	22.39±3.1	23.66±4.3	17.6±3.7		
Gopalakrishna.K et al [21]	Right	14.63±3.16	12.34±3.10	21.23±4.56	22.14±3.18		
	Left	15.31±3.11	13.51±3.92	21.16±3.12	22.1±4.12		
Sakshi mathur et al [22]	Right	15.78±2.72	11.29±1.99	22.91±3.88	21.10±3.28		
	Left	16.09±2.30	11.48±2.03	22.95±3.50	21.18±2.96		
Present study	Right	16.67±2.73	12.67±2.37	21.04±2.95	23.0±3.92	24.38±3.86	35.68±3.25
	Left	16.56±2.52	13.03±2.43	20.24±2.94	22.36±3.89	24.42±4.44	35.19±3.47

anterior border, 13.29±1.74mm(R) and 12.73±2.04mm(L) from posterior border. It was positioned 22.7±3.0mm (R) and 22.27±2.62mm (L) from mandibular notch from angle of mandible to mandibular foramen the distance was 21.54mm on right side and 21.13mm on left side.

Karan Shah et al [17] studied 100 human mandibles from Ahmadabad and found the average distance of mandibular foramen was 23-25mm from mandibular notch (in present study it was 21.04mm on right side and 20.24mm on left side), 16-18mm from anterior border of ramus (present study it was 16.67mm on right side and 16.56mm on left side), 12-13mm from posterior border (present study 12.67mm on right and 13.03mm on left side), 27-30mm from angle of mandible (present study it was 23mm on right side and 22.36mm on left side).

According to study conducted by Oguz et al [6] on west Indian mandibles, the mandibular foramen was positioned at 16.09mm on right side and 16.78mm on left side from anterior border of mandibular ramus.

Kilarkaji et al [23] in his study on middle east Asian mandibles found that the distance from mandibular foramen to anterior border of ramus was 18.5±1.9mm on right side and 18.5±2.0mm on left side.

Varsha shenoy et al [24] in her study on mandibles of south Indian origin found that mandibular foramen was located at a distance of 16.1mm on right side and 16.3mm on left side

from anterior border of ramus of mandible.

In the present study distance from mandibular foramen to anterior border of ramus was 16.67mm on right side and 16.56mm on left side ,no significant difference between right and left side and thus it is in conformity with Oguz et al [6] Varsha Shenoy et al [24] but differs from Kilarkaji et al [23] and Prado et al [19].

Varsha Shenoy et al [24] in her study on south Indian mandibles found that mandibular foramen was located at a distance of 11.7mm on right side and 11.3mm on left side from posterior border of ramus of mandible.

Oguz et al [6] reported the distance from mandibular foramen to posterior border of ramus as 14.09mm on right side and 14.37mm on left side.

In the present study distance between mandibular foramen to posterior border was 12.67mm on right and 13.03mm on left ,no significant difference between sides.

Our study differs from Oguz et al [6] and prado et al [19] and corresponds with varsha shenoy et al [24] and samanta p et al [13].

In the present study distance from mandibular notch to mandibular foramen was 21.04mm on right side and 20.24mm on left side, without any significant side difference and it is in conformity with studies of kilarkaji et al with values of 21.6 ±3.1mm on right side and 21.6 ±3.4mm on left side .

In the present study distance from mandibular

foramen to angle of mandible was 23.00mm on right side and 22.36mm on left side ,no significant side difference,it corresponds with study of Gopalakrishna K et al [21] with 22.14 mm on right side and 22.1mm on left side and Padmavati g et al [18] with 22.6mm on right side and 22.2mm on left side. But it differs from Kilarkaji et al [23] with 25.1mm on right side and 24.7mm on left side,Anil sastyal et al with 26.45mm on right side and 26.04mm on left side.it also differs from Qudusiya sultana et al[20].

In the present study distance from mandibular foramen to base of mandible or inferior border was 24.38mm on right side and 24.42mm on left side which is comparable with Dr.Amita Sarkar [25] who studied 50 dry adult human mandibles and the distance of mandibular foramen to base of mandible was 24.80 ± 3.00 on right side and 24.60 ± 3.10 on left side.present study differs from K.Thangavelu et al [26] studied 102 mandibles and distance from mandibular foramen to base was 27.62 ± 4.20 on right side and 27.30 ± 4.19 mm on left side.

Koketso T Shite [27] in his research work on 253 mandibles mentioned the distance from base to mandibular foramen as 22.9mm on right side and 22.7mm on left side which corresponds to present study.

In the present study distance from mandibular foramen to tip of coronoid process was 35.68mm on right side and 35.19mm on left side ,no significant difference on comparing two sides these values are in conformity with the research work done by Koketso Tshite [27] on 253 bones ,the distance from mandibular foramen to tip of coronoid process was 35.3 ± 3.4 mm on right side and 35 ± 3.6 mm on left side but significant difference between right and left side. Compared to other landmark this parameter ,distance from mandibular foramen to tip of coronoid process needs further studies.

CONCLUSION

The present study gives a fair knowledge of the position of mandibular foramen and provides useful information regarding the success rate of dental anaesthesia and to maxillofacial surgeons, radiologists and oncologists performing operations on mandible to prevent complications, misinterpretations and to plan

and develop newer techniques for nerve blocks and mandibular surgeries. The data may also be useful in reconstructive surgery and anthropological assessments.

Conflicts of Interests: None

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