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An Anatomical Study and Clinical Correlations of Mandibular Foramen in Dry Adult Human Mandibles of North Indian Origin.

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ABSTRACT

Background: The mandibular foramen is located on the medial surface of ramus of mandible. It transmits inferior alveolar nerve. Inferior alveolar nerve block is a common procedure done by dental practitioners while doing various surgeries on mandible. The aim of this study is to determine the position of mandibular foramen in respect to various landmarks present on mandible. **Methods:** 30 adult human dry mandibles of north Indian origin were studied. The position of mandibular foramen from various landmarks was measured on both sides of mandibular ramus. **Results:** In our study we found the mean distance from the mandibular foramen to the anterior border of the ramus was 16.06±1.99 mm and 16.13±2.10 mm on the right and left sides respectively and from the mandibular foramen to the posterior border of the ramus was 12.02±1.99 mm and 11.10±1.95 mm on the right and left sides respectively. The mandibular foramen was situated at a mean distance of 1.36±0.77 mm on the right side and 1.47±0.72 mm on the left side, posterior to the midpoint of width of the ramus and at a mean distance of 3.37±1.37 mm on the right side and 3.10±1.41 mm on the left side, superior to the midpoint of vertical height of the ramus. **Conclusion:** In present study localization of mandibular foramen presented great variation. However if we keep these anatomical landmarks in our mind we can accurately locate the position of mandibular foramen and this will help us to create successful anesthesia and to perform good surgeries on mandible.

Keywords: Inferior alveolar nerve, mandible, mandibular foramen, ramus of mandible.

INTRODUCTION

The mandibular foramen is located on the medial surface of ramus of the mandible. It leads into the mandibular canal, which runs obliquely downward and forward within the ramus, and then horizontally forward within the body under the roots of the molar teeth, with which it communicates by small openings.[1] Mandibular canal opens on the anterior surface of body of the mandible as mental foramen. Mandibular foramen transmits inferior alveolar nerve and vessels into the mandibular canal.[2] Inferior alveolar nerve is the larger terminal branch of the posterior division of the mandibular nerve. It enters the Mandibular foramen and runs in the mandibular canal and gives branches that supply the lower teeth and gums.

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Inferior alveolar nerve block is one of the most common nerve block technique used in dental treatments. The most frequent technique failure in the inferior alveolar nerve block is inappropriate setting of the needle, due to the inaccurate judgment of location of mandible foramen. Variations in the position of the mandibular foramen and the presence of accessory mandibular foramina are other main reasons accounting for the failure rates of this technique.[3,4] Correct localization of mandibular foramen is needed for inferior alveolar nerve block during dentoalveolar surgeries, orthognathic and pre-prosthetic surgeries, endodontic treatments, mandibular fracture managements and treatment of benign and malignant tumours.[3]

There is no specific bony landmark present on the mandible for correct localization of the mandibular foramen. Along with absence of specific bony landmark there is also variations in the height and width of ramus of mandible and the position of mandibular foramen. These factors are responsible for failure of inferior alveolar nerve block. Some authors have estimated the failure rate of inferior alveolar nerve blocks to be as high as 20-25%.[4-6]

The triumph of dental treatment depends on achieving excellent local anaesthesia. There may be failure of inferior alveolar nerve block due to improper evaluation of location of mandibular foramen resulting in painful treatment procedures to the patient.[7] The location of mandibular foramen shows considerable variation among different populations, in different age groups in same population and even within the same individual on two sides. These variations occur due to racial differences, craniofacial growth and anatomical variability.[8,9] Hence, mandibular foramen should be accurately located before initiating any surgical procedure.

The aim of this study is to determine the position of the mandibular foramen from various anatomical landmarks in several dry adult human mandibles and provide valuable information to our students and dental practitioners.

MATERIALS AND METHODS

The study was designed and performed in department of Anatomy, Jawaharlal Nehru Medical College, AMU, Aligarh, (U.P.) India for a period of 3 months from January 2016 to March 2016. Thirty Indian dry human mandibles were selected from the skeletal collection of the department of Anatomy, Jawaharlal Nehru Medical College, AMU, Aligarh. All were adult mandibles and the exact ages of which were not known. Only those mandibles were selected which had first or second molars or canine tooth present on the same side. The edentulous, damaged mandibles and mandibles with tilted occlusal plane of the molars were excluded from the study.

The positions of the mandibular foramen from various landmarks were recorded on both the sides of the mandibular ramus, so total 60 measurements were taken from 30 mandibles. The measurements were taken with the help of a digital caliper (Aerospace, 0-150 mm) calibrated to measure up to 0.01 mm.

For anatomical study of the mandibular foramen, the measurement were taken from the anterior border of the mandibular foramen to the anterior border of the ramus of mandible and designated as (MF-AB) and from the posterior border of the mandibular foramen to the posterior border of the ramus (MF-PB). Similarly, distance from the superior border of the mandibular foramen to the mandibular notch (MF-MN), mandibular foramen to the angle of mandible (MF-AG) and distance from the superior border of the mandibular foramen to the base of the mandible (MF-MB) were measured and recorded [Figure 1].

The distances from the mandibular foramen to various landmarks were calculated as a mean of two measurements recorded independently by two people. All the measurements were recorded in millimeters with accuracy of 0.01 mm.

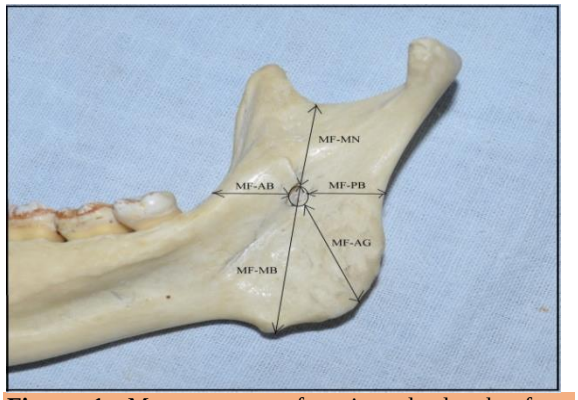

Figure 1: Measurements of various landmarks from mandibular foramen.

The height of ramus was calculated by adding the (MF-MB) and (MF-MN) distances and the horizontal width of ramus was measured from the anterior border of the ramus of mandible to the posterior border of the ramus passing through the middle of the mandibular foramen (AB-PB). The width of the mandibular foramen was calculated by subtracting, the sum of the distances of (MF-AB) and (MF-PB) from the distance between anterior border of ramus to the posterior border of ramus of the mandible (AB-PB).

The midpoint of horizontal width and vertical height of the ramus was calculated and the position of mandibular foramen with respect to the midpoint of horizontal width and vertical height was calculated.

RESULTS

The mean distance for each measurement of both sides of the mandible, range and the standard deviation (SD) is tabulated in [Table 1]. Measurements of ramus of mandible and mandibular foramen are summarized in [Table 2].

The mean distance from the mandibular foramen to the anterior border of the ramus was 16.06 ± 1.99 mm and 16.13 ± 2.10 mm on the right and left sides respectively and from the mandibular foramen to the posterior border of the ramus was 12.02 ± 1.99 mm and 11.10 ± 1.95 mm on the right and left sides respectively. The Mandibular foramen is positioned at a mean distance of 18.79 ± 2.79 mm on the right side and 18.71 ± 2.77 mm on the left side, from the mandibular notch. Likewise, the mean distance between superior border of the mandibular foramen and mandibular base is 25.46 ± 3.75 mm on the right side and 24.91 ± 3.81 mm on the left side. The mean distance from mandibular foramen and angle of the mandible was found to be 19.64 ± 4.03 mm on the right side and 19.49 ± 4.19 mm on the left side [Table 1].

Table 1: Distances (in mm) from the mandibular foramen to various landmarks of the mandible

Measurements	Side	Range	Mean	Standard deviation (SD)
MF-AB	Right	12.85-19.28	16.06	1.99
	Left	12.58-19.66	16.13	2.10
MF-PB	Right	9.52-16.45	12.02	1.99
	Left	9.54-15.88	11.10	1.95
MF-MN	Right	14.18-24.41	18.79	2.79
	Left	14.40-23.88	18.71	2.77
MF-MB	Right	16.28-30.96	25.46	3.75
	Left	16.07-30.64	24.91	3.81
MF-AG	Right	13.14-27.60	19.64	4.03
	Left	12.43-28.04	19.49	4.19

The average height of the mandibular ramus was found to be 44.25 ± 6.02 mm of right side and 43.62 ± 6.04 mm of left side. Likewise average width of the ramus was found to be 30.68 ± 2.75 mm of right side and 30.50 ± 2.71 mm of left side. The diameter (width) of mandibular foramen is calculated by subtracting, the sum of the distances of (MF-AB) and (MF-PB) from the distance between anterior and posterior borders of ramus of the mandible (AB-PB) and its mean was 2.60 ± 1.10 mm on right side and 2.38 ± 0.98 mm on left side [Table 2].

The mandibular foramen was situated at a mean distance of 1.36 ± 0.77 mm on the right side and 1.47 ± 0.72 mm on the left side, posterior to the midpoint of width of the ramus and at the mean distance of 3.37 ± 1.37 mm on the right side and 3.10 ± 1.41 mm on the left side, superior to the midpoint of vertical height of the ramus.

Table 2: Measurements (in mm) of ramus of the mandible and mandibular foramen

Measurements	Side	Range	Mean	Standard deviation (SD)
Height of ramus	Right	30.65-54.76	44.25	6.02
	Left	30.47-53.92	43.62	6.04
Width of ramus	Right	26.66-36.41	30.68	2.75
	Left	26.79-36.17	30.50	2.71
Diameter of MF	Right	1.60-5.40	2.60	1.10
	Left	1.86-4.51	2.38	0.98

DISCUSSION

The knowledge of accurate anatomical location of mandibular foramen is essential in various dental procedures. The correct localization of mandibular foramen and in turn effective inferior alveolar nerve block results in painless treatment of patients and confidence to practitioner. The mandibular foramen cannot be palpated intraorally, so various anatomical landmarks and distance of mandibular foramen from these landmarks helps us in better localization of the mandibular foramen.

Our study clearly shows that the position of the mandibular foramen is highly individualistic. Mandibular foramen on an average lies at a distance of 16.06 ± 1.99 mm on right side and 16.13 ± 2.10 mm on the left side from anterior border of ramus of the mandible. The average distance from posterior border of ramus was found to be 12.02 ± 1.99 mm and 11.10 ± 1.95 mm on the right and left sides respectively. The above findings are more or less similar to the findings of different studies carried out in different groups of Indian population. Padmavathi G et al. studied the position of mandibular foramen in South Indian origin of population.[4] In their study they found that the mandibular foramen was situated at a mean distance of 16.9 ± 2.7 mm from anterior border and 11.9 ± 2.2 mm from posterior border. The mean distance of the mandibular foramen to the mandibular notch was 22.2 ± 3.2 mm and to the mandibular base was 24.9 ± 3.3 mm. In our study we found that the mean distance of the mandibular foramen to the mandibular notch is 18.79 ± 2.79 mm on right side and 18.71 ± 2.77 mm on the left side and to the mandibular base is 25.46 ± 3.75 mm on right side and 24.91 ± 3.81 mm on the left side.

93 edentulous mandibles of Indian origin were studied by K. Thangavelu et al. in 2011.[3] According to them the mandibular foramen was located at a mean distance of 18.9 ± 2.14 mm on right side and 18.88 ± 2.34 mm on the left side from the anterior border of ramus of the mandible. The mean distance from posterior border of the ramus was found to be 14.31 ± 1.82 mm and 14.39 ± 1.79 mm on right and left sides respectively. The mean distance of mandibular foramen from mandibular notch was 20.80 mm on right side and 20.54 mm on left side and from mandibular base was 27.62 ± 4.2 mm on right side and 27.30 ± 4.19 mm on left side.

Karthikeya Patil et al. studied 25 Indian dry human adult mandibles and found that average mandibular ramus width was 30.2 mm.[8] In our study average mandibular ramus width was found to be 30.68 ± 2.75 mm on the right side and 30.50 ± 2.71 mm on the left side. Distance between mandibular foramen

and anterior border of ramus was found to be 16.93 ± 1.54 mm and between mandibular foramen and posterior border of ramus was found to be 13.33 ± 1.57 mm by Karthikeya Patil et al., which is close to the results of our study.

In another study conducted by Ennes, J. P. and Medeiros, R. M. the average mandibular ramus width was found to be 28.77 mm.[10] Distances between mandibular foramen and various landmarks found by Ennes, J. P. and Medeiros, R. M. are quite different from our study. They found (MF-AB) distance 14.9 ± 3 mm, (MF-PB) distance 12.3 ± 2.2 mm, (MN-MF) distance 23.5 ± 2.8 mm and (MF-MB) distance 21 ± 4.1 mm. These differences may be attributed to racial variations. However, the results can vary if the study is performed on a larger sample size.

There is another study conducted on adult black Zimbabweans by Mbajiorgu EF.[11] He found the mean distance between mandibular foramen and anterior border of ramus 18.95 ± 0.41 mm and between mandibular foramen and posterior border of ramus 14.30 ± 0.35 mm. Mandibular foramen was located at the distance of 22.50 ± 0.50 mm from mandibular notch and 28.44 ± 0.65 mm from mandibular base in his study. Mbajiorgu EF found that mandibular foramen lies at about 2.56 mm (right) and 2.08 mm (left) behind the midpoint of rameal width and at approximately 3 mm superior to the midpoint of rameal height on both sides. In our study we found that mandibular foramen is situated at a mean distance of 1.36 ± 0.77 mm (right) and 1.47 ± 0.72 mm (left) behind the midpoint of rameal width and 3.37 ± 1.37 mm (right) and 3.10 ± 1.41 mm (left) superior to the midpoint of rameal height.

CONCLUSION

In the present study the localization of the mandibular foramen presented great variation. However if we keep these anatomical landmarks in our mind we can accurately locate the position of mandibular foramen and this will help us to create successful anesthesia and to perform good surgeries on the mandible.

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