

ORIGINAL RESEARCH

Morphometric study of mandibular foramen and its clinical implications in inferior alveolar nerve block in western Rajasthan population

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ABSTRACT

Objective: The present study has been carried out on dry mandibles to determine the accurate position of mandibular foramen from various landmarks; anterior border of ramus, posterior border of ramus, mandibular notch, base of mandible with the suitable data. **Material and Methods:** The study was conducted in 50 adult dry human mandibles of unknown sex and age collected from the Department of Anatomy, Dr.S.N.Medical College Jodhpur and JNUIMSRC Jaipur for its position using Digital Vernier Caliper in mm. Mandibles with sockets for third molar teeth, those in regular shape, and devoid of deformities were selected. Measurements were recorded to the nearest millimeter. **Results:** The average distance of mandibular notch to mandibular foramen was 17.22 ± 0.732 mm(right side) and 17.19 ± 0.867 mm(left side); from the anterior border of ramus to mandibular foramen was 15.95 ± 0.506 mm(right side) and 16.29 ± 0.550 mm(left side); from the posterior border of ramus to mandibular foramen was 15.68 ± 0.400 mm(right side) and 15.93 ± 0.402 mm(left side); from the base of mandible to mandibular foramen was 31.02 ± 1.821 mm(right side) and 31.52 ± 1.773 mm(left side); respectively. Lingula is used as a key landmark to measure all the dimensions. **Conclusion:** These values tell us that mandibular foramen is situated almost at the same distance on both the sides. A prior knowledge of such variations will help the dentists and surgeons to locate the Mandibular foramen with more precision for successful Inferior Alveolar Nerve block.

Key words: Mandibular Foramen, Mandible, Lingula, Mandibular Notch

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INTRODUCTION

The Mandibular foramen (Mf) is an irregular foramen which is located just above the centre of the medial surface of the ramus of the mandible¹. The position of mandibular foramen and its knowledge is of paramount importance during dental procedures of lower jaw. Its location has been deliberated in relation to the anterior-posterior dimensions of the ramus of the mandible, the height of the ramus and changes of these dimensions with age, and also the foramen's position in relation to the occlusal plane². Mandibular foramen transmits inferior alveolar nerve and vessels into the mandibular canal. 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 gums³. The

mandible mainly uses block anesthesia instead of infiltration anesthesia due to close bone mineral density, limited access to the inferior alveolar nerve, and anatomical variation.

The asymmetrical mandibular foramen is seen slightly above the centre on the medial plane of the ramus of the mandible curving downwards and onward in the body as mandibular canal till it opens as mental foramen. Anaesthesia in the mandible might be associated with diverse complexities. To make inferior nerve block more effective the anaesthetic agent has to be infiltrated closer to the mandibular foramen⁵. However, the success rate of conventional inferior alveolar nerve block (IANB) is only 80-85%⁴. There is abundant literature present describing the anatomical structures significant in successful mandibular anesthesia, but failures are repeatedly

observed in performing this procedure. Some authors have estimated the failure rate of inferior alveolar nerve blocks to be approximately 20-25⁶. The dental professionals and surgeons understanding the position of mandibular foramen is essential in Inferior alveolar nerve block technique in various procedure like tooth extraction, implant placements and maxillofacial surgical corrections.

AIMS AND OBJECTIVES

The present study has been carried out on dry mandibles to determine the accurate position of mandibular foramen from various landmarks; anterior border of ramus, posterior border of ramus, mandibular notch, base of mandible with the suitable data to help the dentists and surgeons to locate the Mandibular foramen with more precision for successful Inferior Alveolar Nerve block.

MATERIAL AND METHOD

The position of mandibular foramen from various anatomical landmarks was measured and recorded on both right and left mandibular rami for each bone. The study was conducted in 50 adult dry human mandibles

of unknown sex and age collected from the Department of Anatomy, Dr. S. N. Medical College Jodhpur and JNUIMSRC Jaipur, for its position using Digital Vernier Caliper in mm. Mandibles with sockets for third molar teeth, those in regular shape, and devoid of deformities were selected. The damaged bones and those having pathological abnormalities were excluded. The MF cannot be palpated clinically; therefore, there are specific landmarks used to determine its location. To precisely locate the mandibular foramen, the following parameters were measured on both sides of the mandible. (Fig 1-4)

1. **MN-MF:** Distance of mandibular notch to mandibular foramen.
2. **AB-MF:** Distance from the midpoint of anterior margin of Mandibular foramen to the nearest point on the anterior border of the ramus of mandible.
3. **PB-MF:** Distance from the midpoint of posterior margin of mandibular foramen to the nearest point on the posterior border of the ramus of mandible.
4. **B-MF:** Distance from the base of mandible to mandibular foramen.



Fig 1: MN-MF: Distance of Mandibular



Fig 2: AB-MF: Anterior border of the ramus notch to mandibular foramen to mandibular foramen



Fig 3: PB-MF: Posterior border of the ramus

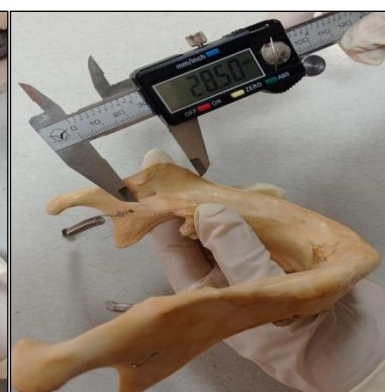


Fig 4: B-MF: Distance from the base of mandible to tomandibular foramen mandibular foramen

OBSERVATIONS AND RESULTS

A total of 50 dry human mandibles were taken and studied for the purpose of determining the precise location of the mandibular foramen. We calculated the mean and standard deviation for the above parameters on both sides and p value to assess any significant difference between the right and left side values shown in Table 1.

The average distance of mandibular notch to mandibular foramen was 17.22 ± 0.732 mm(right side) and 17.19 ± 0.867 mm (left side); from the anterior

border of ramus to mandibular foramen was 15.95 ± 0.506 mm (right side) and 16.29 ± 0.550 mm (left side); from the posterior border of ramus to mandibular foramen was 15.68 ± 0.400 mm (right side) and 15.93 ± 0.402 mm (left side); from the base of mandible to mandibular foramen was 31.02 ± 1.821 mm (right side) and 31.52 ± 1.773 mm (left side); respectively. Lingula is used as a key landmark to measure all the dimensions. These values tell us that mandibular foramen is situated almost at the same distance on both the sides.

Table 1: Showing the mean, standard deviation, values of the distance measured between the mandibular foramen and the various landmarks

Reference Points	Sides	N	Mean Distance in mm	Standard Error of Mean	P (2-Tailed)
Mn-Mf	Right	50	17.2224	0.732417	Non-significant
	Left	50	17.191	0.867508	
AbR-Mf	Right	50	15.9576	0.506637	Non-significant
	Left	50	16.2996	0.550866	
PbR-Mf	Right	50	15.688	0.400755	Non-significant
	Left	50	15.9312	0.402315	
B-Mf	Right	50	31.0274	1.821245	Non-significant
	Left	50	31.5278	1.77395	

For all the above parameters we calculated the p value which is more than 0.05, which means there was no difference when the values of the two sides were compared as shown in Table 1.

DISCUSSION

Awareness of the position of the MF is of great importance for many procedures in dentistry for mandibular surgeries like vertical ramus osteotomy, inverted L osteotomy and also esthetic surgeries for dentofacial deformities. Its definitive location enables more effective anesthesia. The inferior alveolar nerve is at a greater risk during these surgical procedures^{7,8}. The commonest reason for failure of the technique is the inappropriate location of the tip of the anesthetic needle due to inaccuratelocalization of the Foramen⁹.¹⁰.The surgeon has to select an appropriate needle to give the Inferior Alveolar Nerve Block. The average length of the long needles used should be 23 mm long and for short needles should be 21.5 mm long in consideration to the size of the patient's mandible especially while using the pterygomandibular technique of Inferior Alveolar Nerve Block. If a long needle is used in a patient with small mandible then there is a risk of perforating the capsule of Parotid gland thereby causing damage to the branches of the Facial Nerve. If a short needle is used in a patient with big mandible there may be chances of fracture of needle when it is completely introduced in the oral tissues^{9,11}.

One of the most common reason for the failure in the technique of inferior nerve block is due to the lack of the proximity between anaesthetic needle and mandibular foramen and thus the inaccurate localization of the structures of the mandibular foramen⁶.

Our study shows that the position of the mandibular foramen varies with individuals. The average distance of mandibular notch to mandibular foramen was 17.22 ± 0.732 mm (right side) and 17.19 ± 0.867 mm (left side); from the anterior border of ramus to mandibular foramen was 15.95 ± 0.506 mm(right side) and 16.29 ± 0.550 mm (left side); from the posterior border of ramus to mandibular foramen was 15.68 ± 0.400 mm (right side) and 15.93 ± 0.402 mm (left side); from the base of mandible to mandibular foramen was 31.02 ± 1.821 mm (right side) and 31.52 ± 1.773 mm (left side); respectively. Lingula is used as a key landmark to measure all the dimensions. The above findings are more or less similar to the findings of different studies carried out in different groups of Indian population.

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

Israr *et al.*³ studied the position of the mandibular foramen in North Indian population. In their study they found that the mandibular foramen was situated at a mean distance of 16.06 ± 1.99 mm from the anterior border and 12.02 ± 1.99 mm from the posterior border respectively. 93 edentulous mandibles of Indian origin were studied by Thangavelu *et al.*¹³ in 2011 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. A study carried out by Gopalakrishna.K *et al.*¹⁴ on mandibles found that the distance from mandibular foramen to anterior border of ramus was 14.63 ± 3.16 mm on right side and 15.31 ± 3.11 mm on left side, this study corresponds with the present study, in the present study the distance of the mandibular foramen to the anterior border of ramus was 15.95 ± 0.506 mm on the right side and 16.29 ± 0.550 mm on the left side. A study carried out by Oguz *et al.*¹⁵ on mandibles found that the distance from mandibular foramen to the base of the mandible was 30.97 mm on right side and 29.75 mm on left side, this study corresponds with the present study, in the present

study the distance of the mandibular foramen to the base of the mandible was 31.02 ± 1.821 mm on the right side and 31.52 ± 1.773 mm on the left side, respectively.

Our findings are more or less similar to the findings of different studies carried out in different groups of Indian populations, like Oguz *et al.*,¹⁵ Thangavela *et al.*,¹³ Israr *et al.*,³ Sakshi Mathur *et al.*,¹ Gopalakrishna.K *et al.*¹⁴.

CONCLUSION

These values tell us that mandibular foramen is situated almost at the same distance on both the sides. A prior knowledge of such variations will help the dentists and surgeons to locate the Mandibular foramen with more precision for successful Inferior Alveolar Nerve block.

Table 2: Comparison of studies on mandibular foramen (MF) by various authors

Author	Side	MF-AB	MF-PB	MF-MN	MF-Base
Oguz <i>et al.</i> ¹⁵	Right	16.9mm	14.09mm	22.37mm	30.97mm
	Left	16.78mm	14.37mm	22.17mm	29.75mm
Israr <i>et al.</i> ³	Right	16.09 ± 1.99 mm	12.02 ± 1.99 mm	18.26 ± 2.79 mm	25.46 ± 3.75 mm
	Left	16.13 ± 2.10 mm	11.1 ± 1.95 mm	18.7 ± 2.9 mm	24.9 ± 3.8 mm
Thangavelu <i>et al.</i> ¹³	Right	18.9 ± 2.14 mm	14.31 ± 1.02 mm		27.62 ± 4.2 mm
	Left	18.88 ± 2.34 mm	14.39 ± 1.79 mm		27.30 ± 4.19 mm
Kilarkaji <i>et al.</i> ¹²	Right	18.5 ± 1.9 mm		21.6 ± 3.1 mm	25.1 ± 4.2 mm
	Left	18.5 ± 2.0 mm		21.6 ± 3.4 mm	24.7 ± 4.4 mm
Gopalakrishna.K <i>et al.</i> ¹⁴	Right	14.63 ± 3.16 mm	12.34 ± 3.10 mm	21.23 ± 4.56 mm	
	Left	15.31 ± 3.11 mm	13.51 ± 3.92 mm	21.16 ± 3.12 mm	
Prado <i>et al.</i> ¹⁶	Right	19.2 ± 3.6 mm	14.2 ± 2.4 mm	23.6 ± 3.0 mm	
	Left	18.8 ± 3.8 mm	13.9 ± 2.6 mm	23.1 ± 3.0 mm	
Sakshi Mathur <i>et al.</i> ¹	Right	15.78 ± 2.72 mm	11.29 ± 1.99 mm	22.91 ± 3.88 mm	
	Left	16.09 ± 2.30 mm	11.48 ± 2.03 mm	22.95 ± 3.50 mm	
Saify SI <i>et al.</i> ¹⁷	Right	18.1 ± 2.4 mm	13.6 ± 1.16 mm	20.06 ± 2.25 mm	26.5 ± 3.0 mm
	Left	18.2 ± 1.77 mm	13.5 ± 1.92 mm	19.9 ± 1.5 mm	26.8 ± 2.8 mm
Sultana <i>et al.</i> ¹⁸	Right	16.67 ± 2.73 mm	12.67 ± 2.37 mm	21.04 ± 2.95 mm	24.38 ± 3.86 mm
	Left	16.56 ± 2.52 mm	13.03 ± 2.43 mm	20.24 ± 2.94 mm	24.42 ± 4.44 mm
Present study	Right	15.95 ± 0.506 mm	15.68 ± 0.400 mm	17.22 ± 0.732 mm	31.02 ± 1.821 mm
	Left	16.29 ± 0.550 mm	15.93 ± 0.402 mm	17.19 ± 0.867 mm	31.52 ± 1.773 mm

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