

## Harsukh Educational Charitable Society

### International Journal of Community Health and Medical Research

Journal home page: [www.ijchmr.com](http://www.ijchmr.com)

doi: 10.21276/ijchmr

Official Publication of "Harsukh Educational Charitable Society" [Regd.]

ISSN E: 2457-0117 ISSN P:2581-5040

Index Copernicus ICV 2017=57.10

## Original Research

### A MORPHOMETRIC ANALYSIS OF THE MANDIBULAR FORAMEN: CONSIDERATIONS FOR INFERIOR ALVEOLAR NERVE BLOCK

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#### ABSTRACT

**Background:** The mandibular foramen is an important anatomical landmark, known to transmit the inferior alveolar nerve to supply the lower jaw. Inferior alveolar nerve block is a common anesthetic procedure prior to dental surgeries on lower jaw. Failure in mandibular anesthesia may be resulted by inaccurate localization of mandibular foramen. Hence this study is aimed to locate the mandibular foramen and its distances from different bony landmarks on medial surface of ramus of mandible. **Material and Method** This descriptive study was done on 68 adult human mandibles of unknown sex and age. Distance of mandibular foramen were measured from the anterior border of the ramus of mandible, posterior border of the ramus of the mandible, base of the mandible, mandibular notch and retromolar fossa. The data was tabulated and statistically analyzed. **Results:** In the present study the mean distance of the mandibular foramen from the anterior border of the ramus was 18.30±2.01 mm and 18.43±2.30 mm on the right and left sides respectively and from the posterior border of the ramus was 15.03±1.83 mm and 14.56±1.76 mm on the right and left sides respectively. The mandibular foramen was situated at a mean distance of 23.81±3.86 mm on the right side and 24.10±3.81 mm on the left side from the mandibular base and at a mean distance of 21.36±3.50 mm on the right side and 21.30±3.19 mm on the left side from the mandibular notch. The mean distance of the mandibular foramen to retromolar fossa was 14.88±2.42 mm and 14.36±1.84 mm on the right and left sides respectively. **Conclusion:** The present study on the precise location of mandibular foramen will help the dental surgeons for more successful anesthesia and to avoid injury to the neurovascular bundles followed by complications.

**KEY WORDS:** Inferior alveolar nerve, mandibular foramen, ramus of mandible.

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**This article may be cited as:** Singh D, Patnaik P, Gupta N. A MORPHOMETRIC ANALYSIS OF THE MANDIBULAR FORAMEN: CONSIDERATIONS FOR INFERIOR ALVEOLAR NERVE BLOCK. HECS Int J Comm Health Med Res 2019; 5(1):14-17

#### INTRODUCTION

The mandibular foramen is an irregular foramen on the medial surface of the ramus of the mandible that leads into the mandibular canal. This foramen is guarded by a tongue shaped bony projection in its proximity called the lingula. The inferior alveolar nerve, a branch of mandibular nerve, after passing through the mandibular foramen, traverses the mandibular canal to supply the mandibular teeth<sup>1</sup>. The inferior alveolar nerve block is the most common type of nerve block used for dental procedures. This procedure anaesthetizes the inferior alveolar nerve before entering the mandibular foramen. The success of this procedure extremely depends on the proximity of the needle tip to the mandibular foramen at the time of the anesthetic injection<sup>2</sup>. To increase the effectiveness of the inferior alveolar nerve block, the local anesthetic solution should be injected as close as possible to

the mandibular foramen. Although it is a routine block injection administered regularly in dental practice, unfortunately failure rate of this technique is high and commonest cause being inaccurate localization of mandibular foramen<sup>3-5</sup>. According to Marzola et al<sup>6</sup> there is dearth of literature regarding the mandibular foramen location on the medial surface of the mandibular ramus, which might enable professionals to improve the anesthetic technique in the region. The objective of this study is to perform a morphometric evaluation of the mandibular foramen in dry mandibles in relation to the borders of the mandibular ramus in the horizontal and vertical directions to establish its more precise location. A thorough anatomical knowledge of the mandibular foramen not only helps increase the effectiveness of inferior alveolar nerve blocks, but also is of a considerable importance for surgical planning, especially in the function or esthetic restoration

of the dentofacial deformities<sup>7,8</sup>. Henzi D et al<sup>9</sup> have stated that a solid understanding of the anatomical basis for administering anesthetic injections correctly should be an important component of any dental curriculum.

**MATERIAL & METHODS**

The study was conducted on 68 dry human adult mandibles obtained from Jamia Millia Islamia University, Delhi, and Sudha Rustagi College of Dental Science & Research Institute, Faridabad (Haryana). Only complete mandibles with presence of third molar either dentate or edentate were selected for the measurement. Damaged, mutilated, extensive attrition and deformed mandibles were excluded from the present study. The following measurements were taken bilaterally in all the mandibles using vernier caliper and divider. The V-shaped depression located above the mandibular foramen, called mandibular foramen fossa by Minarelli&Ramalho<sup>10</sup>, presents clear margins and limits that converge inferiorly to one apex point MF, which was considered as mandibular foramen. The following distances were measured from point MF (Figure 1.):

- 1) The shortest distance between the mandibular foramen and anterior border of mandibular ramus: (MF-A)
- 2) The shortest distance between the mandibular foramen and posterior border of mandibular ramus: (MF-P)
- 3) The shortest distance between the mandibular foramen and the mandibular base: (MF-B)
- 4) The shortest distance between the mandibular foramen and the lowest point of the mandibular notch: (MF-N)
- 5) The distance between the mandibular foramen and apex of the retromolar fossa :( MF-RF)

All the measurements were made using a divider with two fine tip ends and then transferred to a sliding caliper. The distance of the mandibular foramen from various landmarks were recorded as an average of two measurements which were measured independently by two different people.

The mean and standard deviation for each distance were calculated individually for right and left sides. The mean, standard deviation (SD) and the minimum and maximum values of various parameters will be assessed using student’s t-test.

**RESULT**

A total of 68 adult dry human mandibles were studied for the position of mandibular foramen. Results are presented in Table I. Table display the mean, standard deviation and the minimum and maximum values of various parameters which were studied on either sides of the mandible. It was found that there was no statistical significant difference in the values on the right and left sides (Figure 2.). The mean distance of the mandibular foramen from anterior border of mandibular ramus was 18.30±2.01 mm on the right side and 18.43±2.30 mm on the left side, and from posterior border it was 15.03±1.83 mm and 14.56±1.76 mm on right and left side respectively. The mandibular foramen was positioned from mandibular base at a distance of 23.81±3.86 mm

on the right side and 24.10±3.81mm on left side, likewise mandibular foramen from mandibular notch was 21.36±3.50 mm on Right side and 21.30±3.19 mm on left side. The distance of mandibular foramen from apex of the retromolar fossa was found to be 14.88±2.42mm on right side and 14.36±1.84mm on left side.

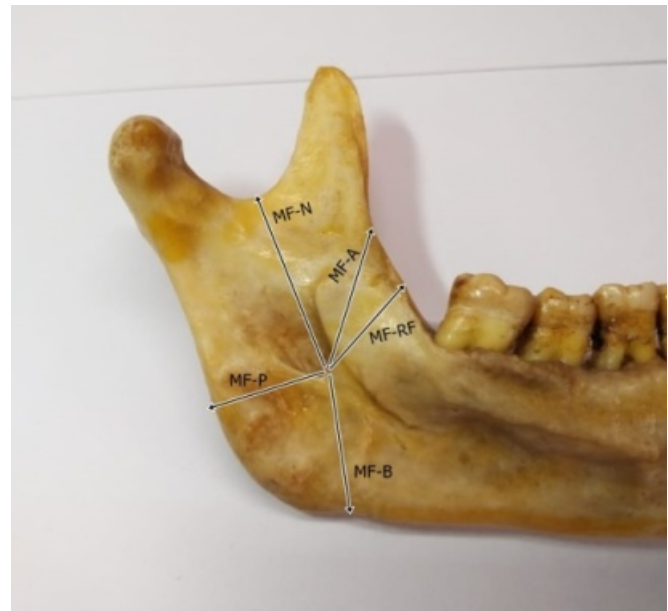


Figure 1. Photograph showing measurement of mandibular foramen (MF) from various mandibular landmarks, (a) Anterior border (MF-A), (b) Posterior border (MF-P), Mandibular base (MF-B), (c) Mandibular notch (MF-N) and (d) Retromolar fossa (MF-RF).

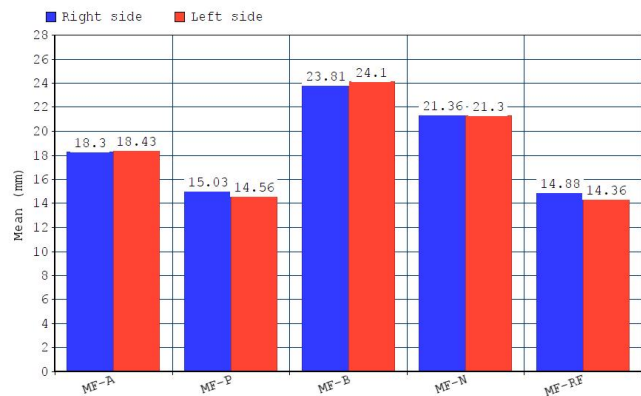


Figure2. Bar diagram showing the distance of mandibular foramen (MF) from various mandibular landmarks on right and left sides of mandible.

**Table I. Table showing Mean, Standard Deviation (SD), minimum (Min) and maximum (Max) values of various parameters studied.**

Measurement	Side	Mean (mm)	(SD)	Min-Max
MF-A	Right side	18.30	2.01	15.12 - 22.4
	Left side	18.43	2.30	14.12 - 22.8
MF-P	Right side	15.03	1.83	11.66 - 17.6
	Left side	14.56	1.76	10 - 17.16
MF-B	Right side	23.81	3.86	16 - 32.36
	Left side	24.10	3.81	17.38 - 31.78
MF-N	Right side	21.36	3.50	14 - 25.6
	Left side	21.30	3.19	12.66 - 26.48
MF-RF	Right side	14.88	2.42	11.18 - 20.82
	Left side	14.36	1.84	11.18 - 19.24

MF-A =Mandibular foramen to anterior border of ramus, MF-P =Mandibular foramen to posterior border of ramus, MF-B =Mandibular foramen to the base of mandible, MF-N =Mandibular foramen to the mandibular Notch, MF-RF =Mandibular foramen to the retromolar fossa.

**DISCUSSION**

The mandibular foramen is known to transmit the inferior alveolar nerve to supply the lower jaw, which is at a greater risk of injury during the surgical procedures. The morphological knowledge of the position of this foramen is clinically crucial in achieving inferior alveolar block. It is used to anesthetize mandibular teeth, gingiva of the mandible and lower lip to carry out many surgical procedures. The present study was conducted on the mandibles to identify the location of the mandibular foramen and its distances from different bony landmarks on mandibles. In this study, mandibular foramen on an average lies at a distance of 18.30 mm on right side and 18.43 mm on left side from the anterior border of the mandibular ramus and that from posterior border was 15.03 mm and 14.56 mm on the right and left side respectively. The above findings are very much similar to the findings of Thangavelu K et al<sup>11</sup>. Thangavelu K et al studied 102 dry mandibles and observed that the distance of mandibular foramen from the anterior border of the mandibular ramus was 18.90 mm on right side and 18.88 mm on left side, whereas from posterior border of ramus it was 14.31 mm on the right side and 14.39 mm on the left side. According to Monnazzi M S et al<sup>12</sup> mandibular foramen was

located at the distance of 17.67 mm from the anterior border and 14.35 mm from the posterior border of the ramus of mandible.

In the study of Monnazzi M S et al mandibular foramen was situated at a mean distance of 20.96 mm from the base of mandible and 21.89 mm from the mandibular notch. Thangavelu K et al reported that the mean distance of mandibular foramen from mandible base was 27.62 mm on right side and 27.30 mm on left side and from mandibular notch was 20.84 mm on right side and 20.54 mm on left side. In the present study the mandibular foramen was situated from base of the mandible at an average distance of 23.81 mm on the right side and 24.01 mm on the left side and from mandibular notch was 21.36 mm and 21.30 mm on right and left side respectively. Slight variations in the findings were observed, probably due to the standardization of the location of the mandibular foramen, which was the lowest point in the mandibular foramen fossa. Besides the variability in the methodology, it may be due to the variation in size and form of the studied mandibles. The retromolar fossa is a permanent structure of the mandible. It is described as a triangular shaped region bordered by the two bifurcation lips of the temporal ridge and the distal surface of the last molar tooth<sup>13, 14</sup>. Shalini R et al<sup>15</sup> studied 204 Indian dry human adult mandibles and found that the average distance of mandibular foramen from the apex of retromolar fossa was 12.27 mm on the right side and 12.13 mm on the left side. There is another study conducted on 35 mandibles by Valente VB et al<sup>16</sup> and reported that the mean distance of mandibular foramen from retromolar fossa was 14.23 mm and 14.40 mm on right and left side of mandible respectively. In the present study, the measurements were 14.88 mm on the right side and 14.36 mm on the left side.

**CONCLUSION**

To make a success of inferior alveolar nerve block it is essential to find the distance of mandibular foramen from the anterior border and posterior border of ramus. Additionally the position of mandibular foramen in vertical plane supero-inferiorly from the mandibular notch to inferior border is essential to make oral block effective. The precise location of the mandibular foramen will facilitate dental surgeons to avoid injury to the neurovascular bundles followed by complications like paresthesia and trauma and it will additionally increase the success rate of dental anesthesia.

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