Morphometric Analysis of the Mandibular Foramen from Different Bony Landmarks in Dry Human Mandibles

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Abstract

Introduction: Mandibular foramen is an irregular foramen located just above the center of the medial surface of the ramus of the mandible leading to mandibular canal through which inferior alveolar nerve and vessels will transmit. Aim: The aim of the study was to find exact location of mandibular foramen from different anatomical landmark. Subjects and Methods: The present study evaluated 60 dry human mandibles & all the distances were measured from center of mandible to different landmark on both sides. Results: The mean of MF-AB distance on right side is 15.6mm & on left side is 15.3mm. Mean of MF-PB distance are 12.0mm & 11.0mm on right side and left side respectively. MF-MB distance 23.4 mm and 22.9 mm are the mean of MF-MN on right and left side respectively. The mean of MF-AG is 23.2mm on right side & 24.2mm on left side. Conclusion: There is great variation found in the position of MF in previous studies. The present study helps in dental anaesthesia and also would help dental surgeons to avoid complications.

Keywords: Mandibular foramen, Landmark, Inferior alveolar nerve distance.

Introduction

The mandible is the strongest and largest bone of the face which forms the lower jaw. It has a ‘U’ shaped anterior part, the body of the mandible and a quadrilateral bony plate which is known as the ramus. The mandibular foramen is an irregular foramen which is located just above the center of the medial surface of the ramus of the mandible.[¹] The inferior alveolar nerve and the vessels enter through the mandibular foramen to reach the mandibular body and give fine branches that supply the mandibular teeth, gums and the lower lip.[²] The mandibular foramen leads into the mandibular canal, a canal which traverses the body of the mandible. The inferior alveolar nerve block is the commonest local anesthetic technique which is used for anaesthetizing the lower jaw in various surgical & dental operations on the mandible and mandibular teeth such as removal of impaction, reductions of fractures and extraction of teeth. Unfortunately the failure rate of this technique is high and commonest cause being inaccurate localization of mandibular foramen.[³] The success of this technique highly depends on the proximity of the needle tip to the mandibular foramen (MF) at the time of the anesthetic injection.[⁴] Inferior alveolar nerve block failure is not uncommon and it occurs even with experienced hands.[⁵,⁶] Failure with this procedure could be as high as 45%. Variations in the location of the mandibular foramen have been suggested in various studies. Some studies of adult mandibles in different races have given varied results regarding the location of the mandibular foramen from the anterior and posterior borders, angle of the mandible and the lowest point on the mandibular notch.[³,⁸-¹⁰] 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 clinician and dental practitioners.

Subjects and Methods

The study was designed and performed in department of Anatomy, at ANMMCH, Gaya. The study was approved by institutional research committee. 60 dry human mandibles were selected from the skeletal collection of the department of Anatomy. All were adult mandibles and the exact age and sex 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 120 measurements were taken from 60 mandibles. The measurements were taken with the help of a venire calliper. 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), from posterior inferior border 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. 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 15.6 ± 1.66 mm and 15.3 ± 1.99 mm on the right and left sides respectively and from the mandibular foramen to the posterior border of the ramus was 12.0 ± 1.65 mm and 11.0 ± 1.82 mm on the right and left sides respectively. The Mandibular foramen is positioned at a mean distance of 17.70 ± 2.56 mm on the right side and 17.0 ±2.17 mm on the left side, from the mandibular notch. Likewise, the mean distance between superior border of the mandibular foramen and mandibular base is 23.4 ± 3.25 mm on the right side and 22.9 ± 3.05 mm on the left side. The mean distance from mandibular foramen and angle of the mandible was found to be 23.2 ± 3.80 mm on the right side and 24.2 ± 3.17 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| 12.75-19.18 | 15.6     | 1.66                    |
|              | Left | 12.48-19.44 | 15.3     | 1.99                    |
| MF-PB        | Right| 09.40-15.60 | 12.0     | 1.65                    |
|              | Left | 09.30-15.00 | 11.0     | 1.82                    |
| MF-MN        | Right| 13.80-20.14 | 17.7     | 2.56                    |
|              | Left | 13.40-21.30 | 17.0     | 2.17                    |
| MF-MB        | Right| 15.14-26.60 | 23.4     | 3.25                    |
|              | Left | 15.20-25.90 | 22.9     | 3.50                    |
| MF-AG        | Right| 13.00-26.60 | 23.2     | 3.80                    |
|              | Left | 12.60-27.20 | 24.2     | 3.17                    |

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

| Measurements  | Side | Range       | Mean     | Standard deviation (SD) |
|---------------|------|-------------|----------|-------------------------|
| Height of ramus| Right| 30.06-54.0  | 43.15    | 5.85                    |
|               | Left | 30.0-53.2   | 42.70    | 5.78                    |
| Width of ramus| Right| 25.88-35.4  | 30.23    | 2.15                    |
|               | Left | 25.79-35.8  | 30.02    | 2.05                    |
| Diameter of MF| Right| 1.50-4.89   | 2.5      | 1.00                    |
|               | Left | 1.75-3.8    | 2.2      | 0.75                    |

The average height of the mandibular ramus was found to be 43.15 ± 5.85 mm of right side and 42.70 ± 5.78 mm of left side. Likewise average width of the ramus was found to be 30.23 ± 2.15 mm of right side and 30.02 ± 2.0 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 2.5 ±1.0 mm on right side and 2.2 ± 0.75 mm on left side [Table 2].

Discussion

Anatomic variations of the mandible may result in clinical complications if not properly identified, revealing the importance of studying the incidence of these variations.\[9\] Restoration of form and function without violating important anatomic structures is a fundamental goal in the surgical management of patient.\[10\]

From an embryological perspective variations of number in the mandibular canal can be explained because in the early development, the inferior alveolar nerve innervate in the mandibular canal can be explained because in the first year of life. In adults, when these foramina remain, it is considered as an anatomical variation.\[12\]

Greatest variation are found in the position of MF with different landmark. The variability of the position of MF varies from its first description with the proximity to the mandibular foramen in the inferior alveolar nerve block. Anesthetic technique for the inferior alveolar nerve block: exploring the alternatives. J. Am. Dent. Assoc. 133: 843-846.

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Conclusion

Precise localization of mandibular foramen is clinically very important to achieve effective inferior alveolar nerve block, prior to dental surgeries in the lower jaw like osteotomy, orthognathic reconstruction surgeries of the mandible and dental implant procedures and to avoid injury to the neurovascular contents passing through it. Accessory mandibular foramina will serve as a route for spread of infection and tumor cells. The present study concludes that the pinpoint knowledge on the position of mandibular foramen with its normality and laterrity is important for planning and conducting dental surgeries, which will help for effective management, better result and prognosis. Since some investigators have stated that anesthesia is essential for both the patients and the dentists, quoting that the opinion of the patients about their dentists was strictly based on their experience with local anaesthesia, it was preferred to infiltrate the anesthetic solution in close proximity to the mandibular foramen in the inferior alveolar nerve block.

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