

The Relationship between the Mandibular Foramen and Numerous Landmarks on the Ramus of the Mandible, as well as its Clinical Importance

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Abstract

Aim: The relationship between the mandibular foramen and numerous landmarks on the ramus of the mandible, as well as its clinical importance.

Material and methods: The present study was done in the Department of Anatomy, Nalanda Medical College, Patna, Bihar, India, for 15 months. The material for the present study consists of 120 adult dry human mandibles of unknown sex. All measurements were recorded using a sliding vernier caliper.

Results: A total of 120 adult human mandibles were studied for the location of mandibular foramen. The minimum, maximum, average and standard deviation values of the different parameters were studied on both the sides of the mandible. There was no significant difference statistically between the values obtained on the right and left sides ($P > 0.05$). The percentile of the distance from anterior border of ramus to midpoint of mandibular foramen in relation to the distance from anterior to posterior border of ramus on the right side is $57.66 \pm 3.67\%$ and on the left side it is $63.22 \pm 2.52\%$. The percentile of distance MF-MN in relation to MF - MN + MF-MB is $50.61 \pm 3.69\%$ on the right side and $47.51 \pm 5.30\%$ on the left side. There is no statistically significant difference in the location of mandibular foramen on the right and left sides according to value of $P > 0.05$ in both the anteroposterior axis and super inferior axis.

Conclusion: The present study gives knowledge of the position of mandibular foramen and provides useful information regarding site of inferior alveolar nerve block which is routinely used by dental surgeons in performing various procedures like tooth extraction, removal of ramus of mandible by maxillofacial surgeon.

Keywords: ramus, mandible, maxillofacial surgeon

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Introduction

Mandibular foramen (MF) is an opening on the internal surface of the ramus that leads into the mandibular canal. This canal curves downward and forward in the body to the mental foramen[1] The inferior alveolar

vessels and nerves enter through the MF, traverse the canal, providing branches to all teeth and exit through the mental foramen as mental nerve and vessel[1] MF is an important anatomical landmark not only for

oral maxillofacial surgery like sagittal split osteotomies done to reposition the mandible in prognathism and retrognathia[2] but it is also significant in connection with effective anesthesia in dentistry while doing the inferior alveolar nerve block (IANB)[3]

It has been observed and reported by different researchers that the main complications encountered during sagittal split osteotomies are hemorrhage, injury to the neurovascular bundle, undesired fractures, and bone necrosis when the proper location of MF is not clear. Hence, a thorough knowledge of the MF and ramus is essential for orthodontic surgeries too[4] A study conducted by Meechan[5] in 1999 and observed that the failures of anesthesia may stem from both the operator and patient dependent factors. Such factors range from a choice of technique to anatomical, pathological, and psychological reasons. There are many articles published in various scientific journals, describing the importance of the anatomical structures in relation to the MF relevant to successful mandibular anesthesia. A high failure rate still persists for this technique that has been reported by many workers like Potocnik and Bajrovic[6] have estimated the failure rate of IANBs to be approximately 30–45%.[6] While according to Shah et al[7] the failure rate of IANBs was found to be approximately 20–25%[7] Thangavelu et al[8] have described the significance of localization of MF in an IANB. Studies have shown the 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[9,10] There are significant differences reported on the location of MF among different racial groups[11,13]

Material and methods

The present study was done in the Department of Anatomy, Nalanda Medical College, Patna, Bihar, India, for 15 months. The material for the present study consists of 120 adult dry human mandibles of unknown sex. All measurements were recorded using a sliding vernier caliper. Measurements were taken using below mentioned bony landmarks on the mandible. Mandible with abnormalities were excluded.

1. Distance from the midpoint of anterior margin of mandibular foramen to the nearest point on the anterior border of the ramus of mandible is denoted by PQ-MF.
2. Distance from the midpoint of posterior margin of mandibular foramen to the nearest point on the posterior border of the ramus of mandible is denoted by RS-MF.
3. Distance from the lowest point of mandibular notch to the inferior limit of mandibular foramen is denoted by MF-MN.
4. Distance from inferior limit of mandibular foramen to the base of the mandible is denoted by MF-BM.

Medial surface of mandibular ramus showing measurements taken from different landmarks to determine the position of the mandibular foramen.

PQ-MF: distance from the midpoint of anterior margin of mandibular foramen to the nearest point on the anterior border of the ramus of mandible

BM -M F: distance from inferior limit of mandibular foramen to the base of the mandible

MF-MN: distance from the lowest point of mandibular r notch to the inferior limit of mandibular foramen.

RS-MF: distance from the midpoint of posterior margin of mandibular foramen to the nearest point on the posterior border of the ramus of mandible.

All the above parameters were carefully measured and statistically analysed in the department of anatomy. Student's t test was used as test of significance to compare the mean values of right and left sides. P-value less than 0.05 is statistically significant. The results of the present study were compared with the results of previous studies.

Results

A total of 120 adult human mandibles were studied for the location of mandibular foramen. The minimum, maximum, average and standard deviation values of the different parameters were studied on both the sides of the mandible and are shown in Table 1. There was no significant difference statistically between the values obtained on the right and left sides ($P>0.05$).

Table 1: Distance of mandibular foramen (MF) from different mandibular landmarks on the right and left sides

| Measurement | Right side (mm) | Left side (mm) |
|-------------|-----------------|----------------|
| PQ-MF | 17.25 ± 2.90 | 17.55±3.20 |
| RS-MF | 10.61±2.33 | 9.92±2.26 |
| PQ-RS | 31.86±3.97 | 31.53±3.98 |
| BM-MF | 22.22±3.48 | 25.50±4.40 |
| MF-MN | 21.70±2.91 | 21.88±3.51 |

Values are presented as mean±SD.

PQ-MF: distance from midpoint of anterior margin of mandibular foramen to the nearest point on anterior border of ramus.

RS-MF: distance from midpoint of posterior margin of mandibular foramen to the nearest point on posterior border of ramus.

BM-MF: mandibular notch to inferior limit of mandibular foramen.

MF-MN: distance from Mandibular Base to inferior limit of mandibular foramen.

MF-MN: The sum of the distances PQ-MF and RS-MF. Location of mandibular foramen in relation anteroposterior and super inferior axis of the ramus of mandible:

The percentile of the distance from anterior border of ramus to midpoint of mandibular foramen in relation to the distance from anterior to posterior border of ramus on the right side is $57.66 \pm 3.67\%$ and on the left side it is $63.22 \pm 2.52\%$. The percentile of distance MF-MN in relation to MF - MN+ MF-MB is $50.61 \pm 3.69\%$ on the right side and $47.51 \pm 5.30\%$ on the left side. There is no statistically significant difference in the location of mandibular foramen on the right and left sides according to value of $P>0.05$ in both the anteroposterior axis and super inferior axis.

Table 2: Percentile of the distance from anterior border of ramus to midpoint of mandibular foramen in relation to the PQ-RS, percentile of distance BM-MN in relation to MF-MN+ BM-MF on anteroposterior and super inferior axis of mandibular ramus on both sides

| Side | Anteroposterior localization% | Supero-inferior localization % |
|-------|-------------------------------|--------------------------------|
| Right | 57.66±3.67 | 50.61±3.69 |
| Left | 63.22±2.52 | 47.51±5.30 |

Discussion

The knowledge of position of mandibular foramen is of a great importance for many procedures in dentistry. Mandibular foramen is a key landmark which lies on the inner aspect of the ramus of mandible. It is intimately related with inferior alveolar nerve which is branch of posterior division of mandibular nerve passing through same foramen. Many clinical conditions mentioned above in the study requires nerve block. So, its exact location on medial aspect in relation to various landmarks need to carry out study. In present study mandibular foramen is studied in relation to distance from anterior, posterior border of ramus, distance from mandibular notch and mandibular base. Variations in anatomical position of mandibular foramen may result in failure of inferior nerve block anesthesia. Several studies have been done to locate its position with the same aims.

According to K. Thangavedu et al the mandibular foramen is located $19\text{mm} + 2.34$ from coronoid notch of ramus, 2.75mm posterior to the midpoint of anteroposterior width of ramus, 5mm inferior to midpoint of condyle to the inferior border distance.[8]

According to Shalini et al mean distance of mandibular foramen from anterior border of ramus is $17.11 + 2.74\text{mm}$ on right and $17.41 + 3.05\text{mm}$ on left, from posterior is $10.47 + 2.74\text{mm}$ on right and $9.68 + 2.03\text{mm}$ on left side. In her study author has also found accessory mandibular foramen in 32.36% of mandibles. According to her study knowledge of mandibular foramen is useful to many clinicians like dental surgeons, or maxillofacial surgeons.[14]

Seema Gupta et al studied to find out accessory lingual foramen to avoid injury to inferior alveolar nerve while operating dental surgeries and procedures.

Shaikh Amjad has mentioned the mean of MF-AB distance 15.6mm on right and 15.3mm on left sides. Mean of MF-PB distance is 12.0mm on right and 11.60mm

on left side. In his study he has taken MF-MB distance which was 23.4mm and 22.9mm on right and left side respectively.

Rajkumari K et al has studied the morphology of MF with the same aim to avoid complication of mandibular nerve block. The result obtained by her study is very close to that of the present study.

Kilarkaji et al[15] in his study on middle east Asian mandibles found that the distance from mandibular foramen to anterior border of ramus was $18.5 \pm 1.9\text{mm}$ on right side and $18.5 \pm 2.0\text{mm}$ on left side.

Varsha Shenoy et al[16] 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 The present study distance from mandibular foramen to anterior border of ramus was 17.25mm on right side and 17.55mm on left side, no significant difference between right and left side and thus result is similar to result of study by Oguz et al[12] Varsha Shenoy et al but differs from Kilarkaji et al[15] and Prado et al.

In the present study distance between mandibular foramen to posterior border was 10.61mm on right and 9.92mm on left, no significant difference between sides. Distance from mandibular notch to mandibular foramen was 21.70mm on right side and 21.98mm on left side without any significant side difference.

In the present study distance from mandibular foramen to base of mandible or inferior border was 22.22mm on right side and 25.50mm on left side which is comparable with Dr. Amita Sarkar 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.

Conclusion

The data may also be useful in reconstructive surgery and anthropological assessments. The present study gives

knowledge of the position of mandibular foramen and provides useful information regarding site of inferior alveolar nerve block which is routinely used by dental surgeons in performing various procedures like tooth extraction, removal of ramus of mandible by maxillofacial surgeon

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