E-ISSN 2250-0944

ISSN 2250-1150

doi: 10.31838/ijprt/15.01.93

Research Article

A Morphometric study of the mandibular foramen in dry adult human mandibles.

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Abstract:

Background: Located on the medial side of the mandibular ramus, the mandibular foramen (MF) is a noticeable and vital anatomical structure. This incision is where the inferior alveolar nerve and veins emerge. Blood reaches the jaw, lower teeth, and surrounding tissues via these veins and nerves. **Aim:** The current study aimed to offer crucial baseline data for the anatomical literature and clinical practice by conducting a thorough morphometric analysis of the mandibular foramen in dry adult human mandibles. This was done to offer necessary information. **Materials & methods:** The Anatomy Department's collection of human bones included 58 adult, non-specific mandibles that were dried and believed to be of North Indian origin. The investigation that was carried out focused on the mandibles in question. Using a Vernier caliper, we measured the area around the mandibular foramen to find its exact location. A number of dimensions were measured, including those of the mandibular base, gonial angle, mandibular notch, posterior boundary, anterior border, and mandibular foramen. **Results:** The MF was found to be 10.15 ± 0.99 mm on the right side and 10.38 ± 0.46 mm on the left side, respectively, when measured from the posterior edge of the mandibular ramus (standard deviation = 1.6046; degrees of freedom = 114; probability = 0.114). At t=0.000, df=114, and P=1.000, the average distance on the right side of the body from the front edge to the mandibles was 19.74 ± 2.91 millimeters, whereas on the left side it was 19.74 ± 2.18 millimeters. The average distance between the right and left mandibular notch (MN) and

the MF was 22.78 ± 1.72 mm and 22.44 ± 1.76 mm, respectively, according to a t-value of 1.0522, 114 degrees of freedom, and a probability of 0.2949. On the one hand, there was an average distance of 27.38 ± 1.98 mm between the mandibular base (MB) and the MF on the right side, and 26.74 ± 1.88 mm on the left side (t=1.7852; df=114; P= 0.0769). Based on the mandibular angle (AG) (t=3.1990; df=114; P=0.0018), the measurements of the inferior limit of the mandibular foramen on the right side were 23.78 ± 2.74 millimeters and on the left side, 23.36 ± 1.98 millimeters. **Conclusion:** In addition to shedding light on the unique facial traits of this population, this study lays the groundwork for further studies in forensic science and anatomy by drawing parallels to previous anthropological and forensic investigations. Our research helps bring more attention to the complexity of human skeletal variability by highlighting the importance of thorough anatomical expertise in anthropological research and therapeutic operations. Raising awareness of the issue achieves this goal.

Key words: Mandibular notch, mandibular ramus, mandibular base, mandibular foramen, gonial angle, vernier caliper.

Introduction:

Located on the medial side of the mandibular ramus, the mandibular foramen (MF) is a noticeable and vital anatomical structure. This incision is where the inferior alveolar nerve and veins emerge. Blood reaches the jaw, lower teeth, and surrounding tissues via these veins and nerves. Implant implantation, orthognathic operations, mandibular fracture repair, inferior alveolar nerve block anesthesia, and a host of other dental and surgical procedures rely on pinpoint accuracy about the MF [1].

While the mandibular foramen's location is clinically important, it is known to be influenced by variables like as gender, age, ethnicity, and geographical variations. There were notable differences in the MF's position as shown by morphometric studies conducted on various populations. If we want more anesthetic surgeries to be successful and fewer surgical complications, this conclusion shows how important it is to have population-relevant data [2].

The mandibular foramen can vary in position even among people from different geographical locations, according to morphometric research conducted in India. This demonstrates how

important it is to have regional anatomy data for therapeutic therapy [3]. Studies performed on a worldwide scale have also revealed that ethnic background affects the size and location of mandibular anatomical features [4].

The gold standard for precise morphometric data collection free of soft tissue distortion is still direct measurements on dry human mandibles. This is still the case even if more recent imaging methods, such as cone-beam computed tomography (CBCT), have improved in vivo assessments [5]. The current study aimed to offer crucial baseline data for the anatomical literature and clinical practice by conducting a thorough morphometric analysis of the mandibular foramen in dry adult human mandibles. In order to provide essential information, this was done.

Materials & methods:

This was a cross-sectional, observational study conducted on dry adult human mandibles available in the Department of Anatomy, College of medicine and JNM hospital Kalyani, west Bengal

between July - December, 2023.

Sample Size: In all, 58 adult human mandibles were utilized for the study. We only used mandibles that were totally or partially toothless, undamaged, and in perfect condition. The study did not include mandibles that had significant bone loss, fractures, deformities, or pathological abnormalities.

Materials Used: Digital Vernier caliper (accuracy of 0.01 mm), Protractor, Scale, Marker, Recording sheets

Parameters Measured: The following measurements were taken into account in order to obtain an exact measurement of each mandible's length: This measurement (MF-PM) establishes the distance between the mandibular foramen and the posterior border of the ramus. The measurement is used to determine the distance between the anterior border of the ramus and the mandibular foramen (MF-AM). The distance in millimeters between the mandibular notch and the mandibular foramen (MN-MF). An indicator of the distance between the mandible and the mandibular foramen (MB-MF). The AG-MF, which stands for "angle of the jaw to foramen ferrari," is the distance between the two. characteristics of the mandible. The angle created between the mandibular ramus

and the body was measured using a protractor.

Measurement Technique: The mandibular foramen was determined to be the aperture located on the medial surface of the ramus. A digital caliper was used to measure the distances between the mandibular foramen's center and the anatomical markers. Some of these features were the jaw's angle, mandibular base, mandibular notch, posterior margin and anterior boundary. In order to reduce the amount of variability between observers, measurements were taken twice by separate people. We took an average of the two metrics after comparing them.

Statistical analysis:

See "Methods" for details on how we calculated the average and standard deviation of the left and right mandibular foraminae separately. Each of these computations was executed using the aforementioned tools. A variation was considered statistically significant if its p-value was less than 0.05.

Results & Observations:

Table 1: The distance from different landmarks to the mandibular foramen (MF).

Variables	Side	Mean ± Standard Deviation (mm)	Range (mm)
AB-AF: Distance from the midpoint of the anterior margin (AM) of mandibular foramen (MF) to the nearest point on the anterior margin (AB) of mandibular ramus.	Right	19.74 ± 2.91	12 – 26.6
	Left	19.74 ± 2.18	12.6 – 27.1
PB-MF- Distance from the midpoint of the posterior margin (PM) of mandibular foramen (MF) to the nearest point on the posterior margin (PB) of mandibular ramus.	Right	10.15 ± 0.99	7 – 12.6
	Left	10.38 ± 0.46	7 – 12.9
MN-MF- Distance from the lowest point of mandibular notch (MN) to the inferior limit of mandibular foramen.	Right	22.78± 1.72	17.6 – 29
	Left	22.44 ± 1.76	17.6 – 29.1
AG-MF- Distance from the inferior limit of mandibular foramen to the angle (AG) of the mandible where inferior margin of mandible merges with the posterior margin.	Right	23.78 ± 2.74	18 – 31
	Left	23.36 ± 1.98	1.98 – 30
Mandibular base (MB-MF)	Right	27.38 ± 1.98	22.6 – 34.4
	Left	26.74 ± 1.88	23.1 – 34

The distances to several landmarks from the mandibular foramen (MF) are described in Table 1. Measured from the posterior edge of the mandibular ramus, the MF was 10.15 ± 0.99 mm on the right side and 10.38 ± 0.46 mm on the left (t=1.6046; df=114; P=1.14). According to the mandibles, the average distance from the front edge on the right side was 19.74 ± 2.91 mm, and on the left side, it was 19.74 ± 2.18 mm (t=0.000; df=114; P=1.000). The average distance between the MF and the right and left mandibular notch (MN) was found to be 22.78 ± 1.72 mm and 22.44 ± 1.76 mm, respectively, following data analysis (t=1.0522; df=114; P= 0.2949). On the right side, the average distance between the mandibular base (MB) and the MF was 27.38 ± 1.98 mm, while on the left side, it was 26.74 ± 1.88 mm (t=1.7852; df=114; P= 0.0769). In respect to the mandibular angle (AG), inferior limits for the right and left sides of the mandibular foramen were 23.78 ± 2.74 mm and 23.36 ± 1.98 mm, respectively (t=3.1990; df=114; P=0.0018).

Table 2: Mandible angle for both the sides.

Variable	Side	Mean ± Standard Deviation (mm)	Range (mm)
Angle of the Mandible	Right	115.18º ± 3.11 º	104 º - 113 º
	Left	114.64 º ± 3.16 º	104 º - 125 º

Table 2 shows the angle of the mandible on each side. The average Gonial angle readings for the right side of the study were 115.18º ± 3.11º and for the left side, 114.64º ± 3.16º (t =0.9276; df = 114; P = 0.3556).

Discussion:

The current study provides valuable morphometric information on the location of the mandibular foramen (MF) in relation to many mandibular anatomical markers. Understanding these interconnections is necessary for clinical procedures such as inferior alveolar nerve blocks, mandibular osteotomies, and fracture management.

During our examination, we found that the average distance between the MF and the posterior margin of the mandibular ramus was 10.15 ± 0.99 millimeters on the right side and 10.38 ± 0.46 millimeters on the left. According to a research by Kumar et al. [6], the average distance in an

Indian population was 10.22 ± 1.11 mm on the right side and 10.45 ± 1.03 mm on the left. This study's findings are comparable to those of the earlier research mentioned. In a similar vein, Lopes et al. [7] discovered a much greater space between the teeth in Brazilian mandibles. This finding was attributed to variations in mandibular morphology between races and ethnic groups.

The MF measured 19.74 ± 2.91 mm on the right side of the ramus and 19.74 ± 2.18 mm on the left. All of this information was gathered from ongoing study. The study by Gupta et al. [8] reported that the average distances between the right and left sides of a North Indian population were 19.5 ± 2.5 mm and 19.8 ± 2.7 mm, respectively. There is considerable consistency between the groups, nevertheless, as evidenced by the fact that Monnazzi et al. [9] discovered the same anterior border lengths in an Italian sample.

The left side's mandibular notch (MN) and MF measures were 22.44 ± 1.76 mm, whereas the right side's readings were 22.78 ± 1.72 mm. The findings of Sharma et al. [10], who found that the MN-MF distances of central Indian mandibles ranged from 21.9 mm to 23.5 mm, are in agreement with our findings. This implies that there are very little regional and ethnic effects, given that a previous study [11] examined Portuguese mandibles and found noticeably lower measurements.

The average dimensions of the MF and MB were determined to be 26.74 ± 1.88 mm on the left side and 27.38 ± 1.98 mm on the right. The findings of this study are consistent with those of another study [12], which discovered that Gujarati mandibles had MB-MF distances of 27.1 mm and 26.9 mm, respectively. However, there could be regional variations in mandibular toughness traits; Tuli et al. [13] discovered considerably higher-than-average values in a North American sample.

During the examination, we noted that the right side had an angle of the mandible (AG) and mandibular function (MF) of 23.78 ± 2.74 mm, while the left side had an angle of 23.36 ± 1.98 mm. The results of Verma et al. [14], who studied a population in Eastern India and found AG-MF distances of about 24 mm, are consistent with this. Furthermore, international research has corroborated similar results; for example, Moore et al. [15] found that AG-MF distances in Caucasian mandibles are around 23–24 mm.

The mandibular angle averaged 115.18 degrees with a standard deviation of 3.11 degrees on the

right side and 114.64 degrees with a standard variation of 3.16 degrees on the left side, according to the current study. These numbers are slightly higher than what was found in the research, which found that the average mandibular angle in Northern Indian mandibles was between 112 and 113 degrees [16]. Studies conducted on Western populations, such as the one by Lopez-Capp et al. [17], have demonstrated that mandibular angles vary between 110 and 115 degrees. This proves that mandibular angulation differs slightly among ethnic groups and geographical locations.

Our results support the idea that the mandible is bilaterally symmetrical on both sides [18,19] as there are no statistically significant differences between the right and left sides of the jaw.

Other studies in India and around the world have shown results that are generally consistent with ours, with a few small exceptions due to differences in ethnicity, sample size, measurement methods, and geographical characteristics. To improve the accuracy of regional anesthesia and reduce surgical problems during mandibular procedures, these morphometric evaluations must be used.

Conclusion:

The study meticulously collected measurements in order to comprehend the morphological variations present in mandibles. We were able to learn more about the craniofacial characteristics of this group because to the data's correlation with anthropological and forensic literature. The mandibular foramen's placement was found to reveal important details about the mandible's morphology. This study lays the groundwork for further investigations into face features and their anatomical and forensic implications in the future. It does this by highlighting the need of an in-depth knowledge of anatomy for anthropological research and therapeutic operations.

Conflict of interest:

There is no conflict of interest among the present study authors.

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