The Study of Location of Mandibular Foramen in Dry Adult Human Mandible

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Abstract

Human mandible is only a movable bone forms lower jaw of the skull. It articulates with the temporal bone at the synovial temporomandibular joint, Mandible consists of a horizontal horse shoe shaped body and two broad rami projecting upward from the posterior end of body. Each ramus of mandible presents two surfaces, external and internal. The aim of the study is to identify the location of mandibular foramen in relation to the limits of mandibular ramus and to correlate the data with the other research works. In the present study 200 dry adult human mandibles of unknown sex and age were collected from the Dept. of Anatomy, J.N.M.C. Sawangi (M) Wardha, DMIMS (DU) and the students of first M.B.B.S of J.N.M.C. Sawangi (M), Wardha, Maharashtra and various measurements were noted. According to the results of the study, it is concluded that there is variability of the mandibular foramen of the two mandibular rami in the same person. There is variable difference between the locations of mandibular foramen in the dry human mandibles of the same zone. It may be due to differences in the age, sex and development in population. This study is mainly concentrated on finding the location of mandibular foramen by measuring its distance from various landmarks on mandibular ramus.

Keyword: *Mandible, Mandibular Foramen, Ramus of Mandible, Dry mandible.*

Introduction

In humans mandible is only a movable bone forms lower jaw of the skull. It articulates with the temporal bone at the synovial temporomandibular joint. Mandible consists of a horizontal horse shoe shaped body and two broad rami projecting upward from the posterior end of body. Each ramus of mandible presents two surfaces, external and internal.

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Near the centre of internal surface of each ramus presents mandibular foramen guarded bytongue like projection known as lingula. Mandibular foramen continuous as mandibular canal in the ramus of mandible and then in the body of mandible fora short distance. Mandibular canal conveys the inferior alveolar nerve and vessels. Inferior alveolar nerve is a branch of posterior division of mandibular nerve. Inferior alveolar nerve innervates the lower jaw, teeth and periodontal tissue. Inferior alveolar nerve also innervates soft tissue of the premolars, incisors, canines and skin of chin. Inferior alveolar nerve is blocked during anaesthesia in various dental surgeries and facial reconstruction.[1]

In dental surgeries technique failure during anaesthesia of inferior alveolar nerve is due to inappropriate setting of needle because of inaccurate location of mandibular foramen.[2] Anatomical variation of the location of the mandibular foramen may result in failure in dental and maxillofacial procedures and may lead to clinical complications if not properly identified.[3]

In advanced surgical techniques for the correction of craniofacial anomalies and pre –post operative procedures the knowledge of location of mandibular foramen is must.[4] For this purpose the qualitative and quantitative measurements are required.

It is now clear that facial reconstruction from the skull remnants in forensic medicine for medicolegal purpose is more accurate when the mandible is present. Measurements are equally important in the identification as well as facial reconstruction for medicolegal purpose in forensic medicine as well as in Anthropological study of different races. The study of various morphological features o mandible can be useful to determine age, sex and race of the individual in various medico-legal cases as well as in other anthropological studies.[5]

Despite numerous studies have been conducted on Morphometric measurements for location of the mandibular foramen in the various countries and the other regions of India, it is observed that there are differences in the data collected by various researchers. So it is important to study the location of the mandibular foramen in more no of mandibles of different regions to provide valuable and precise information to our clinician and dental professionals.[6]

The aim of the study is to identify the location of mandibular foramen in relation to the limits of mandibular ramus.

Aims and Objectives: To determine the location of mandibular foramen on dry adult human mandibles to provide informative data to be used for dental and other health professionals in various surgeries and procedures.

The aim of the study is to identify the location of mandibular foramen in relation to the limits of mandibular ramus.

To correlate the data with the other research works.

Material and Method

200 dry adult human mandibles of unknown sex and age from the Dept. of Anatomy, J.N.M.C.Sawangi (M) Wardha, DMIMS (DU) and from the students of first M.B.B.S ofJ.N.M.C.Sawangi (M), Wardha, Maharashtra were collected. The damaged bones and those, having pathological abnormalities, congenital anomalies were excluded. The mean distance of mandibular foramen from anterior border of ramus, posterior border of ramus, mandibular arch and the angle of the mandible (ramus). Both right and left sides are used for measurements. A digital vernier calliper of 0.001mm accuracy is used for taking measurements. Each distance measured thrice and mean is taken to avoid error. The measurements were recorded to the nearest millimetre. The mean and SD were calculated for left and right sides.

Fallowing measurements were noted:

1. MF- AB:A distance from the centre of the anterior limit of the mandibular foramen (MF)to the nearest point on anterior border of ramus (AB).
2. MF-PB: A distance from the centre of the anterior limit of the mandibular foramen (MF) to the nearest point on posterior border of ramus (PB).
3. MF-MN: A distance from the centre of the anterior limit of the mandibular foramen (MF) to the nearest point on mandibular notch (MN).
4. MF –AG: A distance from the centre of the anterior limit of the mandibular foramen (MF) to the nearest point on angle of mandible.

MF- Mandibular foramen

AB- Anterior border of ramus

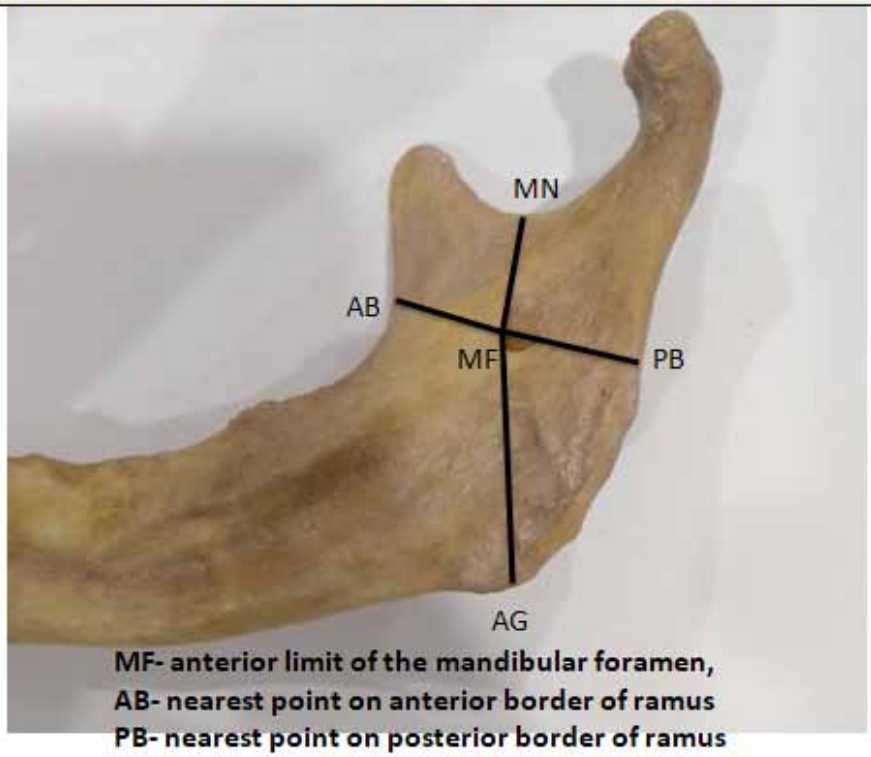
PB- Posterior border of ramus

MN- Mandibular notch

AG- Angle of mandible

Figure 1 showing various measurements from anterior limit of mandibular foramen

Image showing various measurements from anterior limit of mandibular foramen



MF- anterior limit of the mandibular foramen,
AB- nearest point on anterior border of ramus
PB- nearest point on posterior border of ramus
MN - nearest point on mandibular notch
AG - nearest point on angle of mandible

Observations:

Table 1: Measurement of the Mandibular foramen from anterior border.

Total no. of mandibles	Side	Mean (mm)	SD (mm)	P-Value
200	Right (200)	17.58	0.98	6.06 P=0.0001,S
	Left (200)	17.22	0.94	

Table 2: Measurement of the Mandibular foramen from posterior border.

Total no. of mandibles	Side	Mean (mm)	SD (mm)	P-Value
200	Right (200)	13.61	1.18	6.22 P=0.0001,S
	Left (200)	13.30	1.00	

Table 3: Measurement of the Mandibular foramen from mandibular notch.

Total no. of mandibles	Side	Mean (mm)	SD (mm)	P-Value
200	Right (200)	19.54	2.01	8.28 P=0.0001,S
	Left (200)	19.84	2.07	

Table 4: Measurements of mandibular foramen from angle of mandible.

Total no. of mandibles	Side	Mean (mm)	SD (mm)	P-Value
200	Right (200)	26.86	1.77	5.03 P=0.0001,S
	Left (200)	27.31	2.41	

Statistical analysis was done by using descriptive and inferential statistics using Student's paired t test and software used in the analysis was SPSS 24.0 version and $p<0.05$ is considered as level of significance.

Results:

In the present study, the position of the mandibular foramen in 200 dry human mandibles of unknown age and sex were located by measuring the distance between mandibular foramen from anterior border of ramus, posterior border of ramus, mandibular notch and angle of mandible. Measurements were taken on both the sides of mandible.

According to the study it is seen that, there is no symmetry between the location of mandibular foramen on right and left side of the same mandible.

In this study, the mean distance of MF from the anterior border is 17.58 mm on right side and 17.22 mm. on left side. The mean distance of MF from the posterior border is 13.61 mm on right side and 13.30 mm. on left side. So the mandibular foramen is more nearer to the posterior border than the anterior border of ramus. The mean distance of MF from the mandibular angle is 26.86 mm on right side and 27.31 mm. on left side. So the mandibular foramen is more nearer to the mandibular angle on right side than on the left side. The mean distance of MF from the mandibular notch is 19.54 mm on right side and 19.84 mm. on left side. So mandibular foramen is significantly nearer from mandibular notch on right side than on left side.

The location of mandibular foramen with reference to various landmarks varies mandible to mandible.

Discussion

The location of mandibular foramen is very important to achieve inferior alveolar nerve block in dental surgeries of lower jaw like osteotomy, orthognathic reconstruction and dental implant .[1]Morphometry of mandible vary from mandible to mandible and with age. Malka Ashkenazi et al, (2011) stated that, the distance of mandibular foramen from the anterior and posterior border of ramus increases significantly with age.[7]Variations in the number of canal can be explained because of early development.

It is stated that the mandibular foramen is located below occlusal plane by 6 years, at occlusal plane or slightly above by the age of 13 years.[8]

The distance from mandibular notch to the mandibular foramen is an important reference point for identifying the location of the mandibular foramen during orthognathic surgery.[9]

Some adult study show that the mandibular foramen is located posterior to the midline of ramus Hayward et.al 1977, Hetson et al 1988.[10,11] The other studies show that the location of mandibular foramen is located at the midline of the ramus Sweet 1947, Monheim 1969, Nicholson 1985). Mc Donald et.al (2004) recommended the injection of the mandibular block more posteriorly in children than adult.

In this study, the mean distance of MF from the anterior border is 17.58 mm on right side and 17.22 mm. on left side. The mean distance of MF from the posterior border is 13.61 mm on right side and 13.30 mm. on left side. So the mandibular foramen is more nearer to the posterior border than the anterior border of ramus. The mean distance of MF from the mandibular angle is 26.86 mm on right side and 27.31 mm. on left side. So the mandibular foramen is more nearer to the mandibular angle on right side than on the left side. The mean distance of MF from the mandibular notch is 19.54 mm on right side and 19.84 mm. on left side. So mandibular foramen is significantly nearer from mandibular notch on right side than on left side.

According to Padmavathi G et.al .(2014) studied the mandibles from south Indian population found that the mean distance of MF from the anterior border is 16.9 mm on right side and 16.8 mm. on left side. The mean distance of MF from the posterior border is 12.10 mm on right side and 11.7 mm. on left side. The mean distance of MF from the mandibular angle is 22.20 mm on right side and 22.60mm on left side. The mean distance of MF from the mandibular notch is 22.30 mm on right side and 22.00 mm. on left side.[12]

According to Rajkumari K, et. al(2017)studied the mandibles from Imphal, Manipur population found that the mean distance of MF from the anterior border is 16.77mm on right side and 16.90mm. on left side. The mean distance of MF from the posterior border is 11.05mm on right side and 11.21 mm. on left side. The mean distance of MF from the mandibular angle is 21.02mm on right side and 21.80mm on left side. The mean distance of MF from the mandibular notch is 22.93mm on right side and 23.15mm. on left side.[13]

Table 5: Showing the location of mandibular foramen by different authors in different regions of India. (Mean distance in mm)

Author	Region	Side of mandible	MF-AB mm.	MF-PB mm.	MF-MN mm.	MF-AG mm.
Padmavathi G, et. al.(2014)	South India.	Right	16.90	12.10	22.30	22.20
		Left	16.80	11.70	22.00	22.60
Rajkumari K, et. al.(2017)	Imphal, Manipur.	Right	16.77	11.05	22.93	21.02
		Left	16.90	11.21	23.15	21.80
Amjad S.et. al.(2018)	Jalna, Maharashtra.	Right	15.6	12.0	17.70	23.0
		Left	15.3	11.10	17.0	24.0
Sandhya, et. al.(2019)	Ranchi, Jharkhand.	Right	16.00	10.21	20.48	-
		Left	16.27	10.28	20.15	-
Present study(2020)	Wardha, Maharashtra.	Right	17.58	13.61	19.54	26.86
		Left	17.22	13.30	19.84	27.31

According to Amjad S.et. al(2018), studied the mandibles from Jalna, Maharashtra and found out that, the mean distance of MF from the anterior border is 15.6mm on right side and 15.3mm on left side. The mean distance of MF from the posterior border is 12.0mm on right side and 11.10 mm. on left side. The mean distance of MF from the mandibular angle is 23.0mm on right side and 24.0mm on left side. The mean distance of MF from the mandibular notch is 17.70mm on right side and 17.0mm on left side.[14]

According to Sandhya, et. al.(2019)studied the mandibles from Ranchi, Jharkhand population found that the mean distance of MF from the anterior border is 16.00 mm on right side and 16.27mm. on left side. The mean distance of MF from the posterior border is 10.21mm on right side and 10.28mm on left side. The mean distance of MF from the mandibular notch is 20.48mm on right side and 20.15mm. on left side.[15]

So when the studies in table 5 correlates with the present study, the measurements of south Indian and Maharashtra population are showing some similarity than the population of Jharkhand and Manipur . Anatomic variations may be due to developmental perspective, racial discrepancies and craniofacial growth .[9]

Conclusion

The basic anatomy of the mandible and location of mandibular foramen is essential to medical and dental professionals for various surgeries as well as inferior alveolar nerve block.

According to the results of the study, it is concluded that there is variability of the mandibular foramen of the two mandibular rami in the same person. There is variable difference between the locations of mandibular foramen in the dry human mandibles of the same zone. It may be due to differences in the age, sex and development in population. This study is mainly concentrated on finding the location of mandibular foramen by measuring its distance from various landmarks on mandibular ramus.

Quantitative data analysisis an effective and reliable tool of demonstration and localisation of mandibular foramen in dry human mandibles. On the basis of present study it will be possible and helpful for monitoring and interpreting the maximum possible location of mandibular foramen.

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