



## Original Research Article

# POSITIONAL VARIATIONS AND MORPHOMETRY OF MANDIBULAR FORAMEN IN ADULT DRY HUMAN MANDIBLES

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### ABSTRACT

**Background:** The mandible is a U – shaped and the only movable bone of the skull. It is the strongest and the largest bone of the face which forms the lower jaw. During routine dental practice all over the world, inferior alveolar nerve block is the commonest procedure done for effective anaesthesia during dental procedures like tooth extraction or placing dental implants onto the lower jaw. Hence the knowledge about the location of the mandibular foramen through which the nerve supplying the teeth of lower jaw passes through is very important to dentists & maxillofacial surgeons.

**Material and Methods:** A total number of 70 dry mandibles were utilized from the department of Anatomy for the study. All the mandibles were cleaned properly for better visualization of features. With the help of digital calipers the morphometric values of mandibular foramen were noted. The position and number of accessory mandibular foramina was also observed. The findings were tabulated and analysed.

**Results:** The present study revealed the presence of accessory mandibular foramina in 10 mandibles. One mandible presented with two accessory foramina on one side of the mandible. The location of mandibular foramen is correlating with the review except from the posterior border. In the posterior border there is a significant difference in the location of the mandible foramen from right side to left side of mandibles.

**Conclusion:** Morphometric anatomical knowledge of mandibular foramen from various nearby anatomical landmarks and number of accessory mandibular foramina is useful to the dental surgeons in their routine practice to do their procedures on the lower jaw with minimal inconvenience to the patients if inferior nerve block done is completely successful.

**Keywords:** Mandibular foramen (MF), accessory mandibular foramen (AMF), lingula.

## INTRODUCTION

The mandible is a U-shaped and the only movable bone of the skull. It is the strongest and the largest bone of the face which forms the lower jaw. It consists of 2 rami and a body which bears sockets for the teeth of lower jaw. Ramus of the mandible is a quadrilateral vertical plate of bone with a condylar process and a coronoid process. On the medial surface of ramus, is present an irregular foramen

called as mandibular foramen or inferior alveolar foramen, a recently coined term. The mandibular foramen in turn leads to a mandibular canal which passes through the ramus of the mandible downwards and then forwards into the body of the mandible. The structures passing through the mandibular foramen are inferior alveolar vessels and nerve.<sup>[1]</sup>

Inferior alveolar nerve is a branch of posterior division of mandibular nerve which in turns is a branch of trigeminal nerve. It provides sensory

innervation to the gum, dental sockets and teeth of lower jaw. During routine dental practice all over the world inferior alveolar nerve block is the commonest procedure done for effective anaesthesia during dental procedures like tooth extraction or placing dental implants. For doing inferior alveolar nerve block most commonly used landmarks are coronoid process, anterior and posterior borders of mandible and pterygomandibular raphe.

Usually there is a single mandibular foramina on the inner aspect of ramus of mandible. Sometimes it could be more than one foramen through which a part of the neurovascular bundle could be passing through. Such accessory foramen are named as accessory mandibular foramen [AMF]. In the embryonic period there were 3 inferior alveolar nerve groups and later all of them fuse together forms one single nerve. This gives us the best explanation for the presence of accessory mandibular foramina.<sup>[2]</sup> The incidence of AMF could be unilateral or bilateral side of mandible . Their number could be single or double or triple. Failure to notice the presence of accessory foramina could lead to achievement of incomplete anaesthesia which will be very painful for the patient during any procedure being done over the teeth of lower jaw.

In the previous studies done, it was reported that there are 20% chances of failure of inferior alveolar nerve block. Hence a precise knowledge of position of mandibular foramen through which inferior alveolar nerve shall be passing, presence or absence of accessory mandibular foramina is a must for dentists or maxillofacial surgeons to achieve complete anaesthesia of ipsilateral jaw for the intended procedures.<sup>[3]</sup>

## MATERIAL AND METHODS

The present study was a cross-sectional observational study. The study was undertaken in the department of Anatomy, Sri Venkateswara medical college, Tirupati after taking the institutional scientific and ethics committee approvals. A total number of 70 adult human mandibles available in the department of Anatomy were utilized for this study. All the mandibles were cleaned properly with brush to identify the mandibular foramen and accessory mandibular foramen. The morphometric measurements were taken with the help of digital vernier calipers. The presence or absence of accessory mandibular foramen was observed with the help of a magnifying lens. A flexible wire was used to look for the patency of accessory foramen & presence of accessory mandibular canal.

### Inclusion Criteria

- Dry adult mandibles with sockets for third molar teeth & those which were with regular shape irrespective of age and sex are considered for the study.

### Exclusion Criteria

- Damaged mandibles and those having pathological abnormalities were excluded from the study.

For assessing the location of mandibular foramen [MF]-- the following parameters were considered & noted down.

1. MF-Mandibular notch/ superior border - distance from the middle of mandibular notch to upper limit of MF.
2. MF- Anterior border - distance from just above to the 3rd molar socket to anterior limit of MF.
3. MF- Posterior border - distance from posterior border of MF to posterior border of ramus of mandible.
4. MF- Inferior border - distance from lower border of MF to base of the mandible
5. MF-Symphysis menti - distance of anterior border of MF to outer margin of symphysis menti.

### Data Analysis

The data collected is shown in suitable tables and graphs wherever necessary. The data is categorized in percentage. The mean and standard deviations were calculated. The results are analysed by using Epi info 7.2.1 CDC Atlanta (version). Student's t-test was used to test the significance to compare the mean values on right Vs left sides and a P-value less than 0.005 was taken as statistically significant.

## RESULTS

All the mandibles considered for the study presented with a mandibular foramen (MF). The location of mandibular foramen as told earlier is calculated by measuring the distance from nearby anatomical landmarks. The mean and standard deviations of the location of mandibular foramen from anterior border to the midpoint of mandibular foremen was  $17.23 \pm 2.29$ , from the posterior border to MF was  $13.47 \pm 2.38$ , from the superior border to MF was  $20.1 \pm 3.47$ , from the inferior border to MF was  $25.38 \pm 4.16$  and from the symphysis menti to MF was  $80.36 \pm 5.56$  respectively. There was no significance in P value in the distance of MF from all four borders of mandible except from the posterior border.



Figure 1: Showing the position of mandibular foramen from nearby anatomical landmarks



Figure 2: Showing the measuring the morphometric values using digital calipers

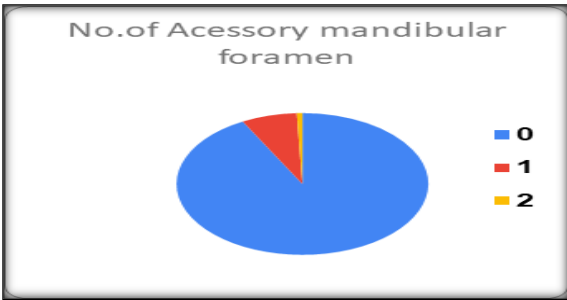


Chart 1: Showing number of accessory foramina



Figure 3: Mandible showing accessory mandibular foramina



Figure 4: Mandible showing two accessory mandibular foramina

Out of 70 mandibles studied, 11 (15.7%) mandibles presented with accessory mandibular foramina (AMF). All the accessory mandibular foramina were noticed on the posterior aspect of mandibular foramen. Among those 11 mandibles with accessory mandibular foramina, 01 mandible presented with a double accessory mandibular foramina on left side where as rest of all were with a single AMF. Among those 11 mandibles, 6 (8.5%) were left sided and 5 (7.1%) were right sided. 01 mandible (1.4%) presented with a bilateral AMF. [Table 1]

Table 1: Mean and SD of mandibular foramen from different borders

Border of mandible	Side of the mandible	Mean	SD	P Value
Anterior	Right	17.47	2.32	0.232
	Left	17	2.25	0.232
Posterior	Right	12.69	2.05	<b>0.001</b>
	Left	14.24	2.44	<b>0.001</b>
Superior	Right	20.32	3.5	0.450
	Left	19.87	3.46	0.450
Inferior	Right	25.15	4.41	0.516
	Left	25.61	3.91	0.516
Symphysis menti	Right	80.58	5.62	0.644
	Left	80.14	5.54	0.644

Table 2: Accessory mandibular foramen

	Right			Left		
	Single foramen	Double foramen	%	Single foramen	Double foramen	%
Accessory mandibular foramen	5	0	7.1	5	1	8.5

## DISCUSSION

The inferior alveolar nerve is the branch of mandibular nerve which supplies sensory innervation to the gingiva on the lower jaw and to the teeth themselves. The best way to produce

anesthesia to lower jaw teeth is by inferior nerve block i.e administrating a local anesthetic solution to the nerve as its about to pass through the mandibular foramen so as achieve temporary anesthesia to teeth of ipsilateral half of jaw, gingival tissue & mucoperiosteum of the mandibular arch. In some cases there is possibility of failure of

this procedure because of variation in the positions of mandibular foramen and presence of accessory mandibular foramen. Hence the location of mandibular foramen is very important for this procedure of nerve block. The mandibular foramen can't be palpated intraorally. So, to pinpoint the location of mandibular foramen its distance from adjoining anatomical landmarks from different borders of ramus of the mandible should be noticed. This information varies from one population to other, the morphometric values may be helpful to dentists during their routine practice in dental surgeries.

In the previous studies many investigators have reported about the location & morphometry of mandibular foramen. In the review all the authors have reported the values from different borders of ramus of the mandible. In our study the location of mandibular foramen is located on a distance of  $17.47 \pm 2.32$  on right side,  $17 \pm 2.25$  on left side from anterior border of mandible. The location of mandibular foramen from posterior border is  $12.69 \pm 2.05$  on right side,  $14.24 \pm 2.44$  left side. The location of mandibular foramen from inferior border is  $25.15 \pm 4.41$  on right side,  $25.61 \pm 3.91$  on left side. The location of mandibular foramen from symphysis menti is  $80.58 \pm 5.62$  on right side and  $80.14 \pm 5.54$ . In the review there were very few studies in which they have considered the distance of MF from symphysis menti. Kilarkaji et.al,<sup>[8]</sup> reported the values from symphysis menti. In our study we have measured the values from mandibular

foramen to outer margin of symphysis menti. But in his study he measured from the inner margin of symphysis menti. Our findings are more or less similar to the findings of different studies carried out in different populations.<sup>[9,10,11,12,13]</sup> Statistical analysis was done to see the significant difference between the right and left side values. We did not observe the significant P values in all borders except in posterior border where we did find a significant P value.

The incidence of accessory mandibular foramina has been found to be higher on the left side of the mandible in our current study.

Padmavathi et al,<sup>[4]</sup> reported a prevalence of 41.5% of accessory mandibular foramen among them 29.2% are unilateral and 12.3% are bilateral. Gopalakrishna et al,<sup>[6]</sup> reported the same as 18% and Joe Iwanaga et al,<sup>[7]</sup> noted it as 45.4% unilateral and 18.2% bilateral. In our study we observed a 15.7% prevalence of accessory mandibular foramina, among them in one mandible we noticed the presence of two accessory mandibular foramina. Our findings correlate with the previous studies. Padmavathi G et.al,<sup>[5]</sup> Gopalakrishna K et. Al,<sup>[6]</sup> reported the accessory foramens from the south Indian population when compare our finding with them we observed less percentage of accessory mandibular foramens in the local population. This clearly shows that the number of accessory mandibular foramens may varies from one population to other population.

**Table 3: Studies on mandibular foramen morphometry by various authors**

Author	Population	Year	Side	Anterior border	Posterior border	Lower border	Upper border	Symphysis menti
Kilarkaji et.al. <sup>8</sup>	Asian	2005	Right	18.5±19	----	----	21.6±3.4	69.8±4.6
			Left	18.5±20	----	----	21.6±3.4	69.8±7.6
Thangavelu et.al <sup>9</sup>	Indian	2011	Right	18.9±2.14	14.31±1.82	27.62±4.2	20.±8.0	-----
			Left	18.88±2.34	14.39±1.79	21.30±4.19	20±5.4	-----
Khan IA et al <sup>10</sup>	North India	2016	----	16.9±2.14	12.02±1.99	----	-----	-----
Varsha Shenoy et.al. <sup>11</sup>	Tamilnadu	2012	Right	1.64±0.2	1.68±0.2	2.35±0.312	2.352±0.281	-----
			Left	1.634±0.188	1.13±0.195	2.35±0.310	2.284±0.27	-----
Syed Insha et.al. <sup>12</sup>	North Indian	2023	Right	18.1±2.4	13.6±1.6	26.5±0.30	20.6±2.25	----
			Left	18.2±17	13.5±1.92	26.8±0.28	19.99±1.5	-----
Magnesh et. al. <sup>13</sup>	Maharashtra	2020	Right	16.37±2.43	13.83±2.38	20.54±2.14	26.93±3.89	-----
			Left	17.03±2.82	14.17±2.19	20.11±2.83	26.32±4.802	-----
Present study	Andhra pradesh	2024	Right	17.47 ± 2.32	12.69± 2.05	25.15± 4.41	20.32± 3.5	80.58 ±5.62
			Left	17 ± 2.25	14.24± 2.44	25.61± 3.91	19.87± 3.46	80.14 ±5.54

## CONCLUSION

The anatomical variations of location of mandibular foramen causes the failure of inferior nerve block which leads to incomplete anesthesia of lower jaw which makes any procedure planned on the teeth quite painful for the patient. understanding of basic landmarks for location of mandibular foramen and accessory mandibular foramens is important for dental surgeons. Mandible is the very highly variable bone with age, sex and race. Though

umpteen number of studies have been done on this we believe our data will add up to the information available and helps the dental surgeon to plan the procedures better.

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## REFERENCES

1. Standring S (2008). The anatomical basis of clinical practice. In: Susan Standring (Chief Editor). Gray's Anatomy. 40th ED. Churchill, Livingstone. Elsevier. Chapter 31, p 530-533, 595-614.
2. Shalini R, RaviVarman C, Manoranjitham R, Veeramuthu M. Morphometric study on mandibular foramen and incidence of accessory mandibular foramen in mandibles of south Indian population and its clinical implications in inferior alveolar nerve block. *Anat Cell Biol.* 2016; 49(4):241-248.
3. Kanan S, Prathik S, Ajay P. (2013). Study of the location of the mandibular foramina in Indian dry mandibles. *Global J.Res.Anal. (GJRA)* 2: 128-130.
4. Shalini R, RaviVarman C, Manoranjitham R, Veeramuthu M. Morphometric study on mandibular foramen and incidence of accessory mandibular foramen in mandibles of south Indian population and its clinical implications in inferior alveolar nerve block. *Anat Cell Biol.* 2016; 49(4):241-248.
5. Padmavathi G, Tiwari S, Varalakshmi KL, Roopashree R. An anatomical study of mandibular and accessory mandibular foramen in dry adult human mandibles of south Indian origin. *IOSR J Dent Med Sci* 2014; 13:83-8. 13.
6. Gopalakrishna K, Deepalaxmi S, Somashekara SC, Rathna BS. An anatomical study on the position of mandibular foramen in 100 dry mandibles. *Int J Anat Res* 2016; 4:1967-71. 14.
7. Joe Iwanaga, Shogo Kikulo, Soichiro et .al. Clinical Anatomy of the accessory mandibular foramen: application to mandibular ramus osteotomy. *Sur Radiol Anat.* Jan 2020; 42(1):41-47.
8. Kilarkaji N, Nayak SR, Narayan P, Prabhu LV. The location of the mandibular foramen maintains absolute bilateral symmetry in mandibles of different age groups. *Hong Kong Dent J.* 2005; 2:35-7.
9. Thangavelu K, Kannan R, Kumar NS, Rethish E, Sabitha S, Sayeeganesh N. Significance of localization of mandibular foramen in an inferior alveolar nerve block. *J Nat Sci Biol Med.* 2012; 3(2):156.
10. Khan IA, Ansari M. An anatomical study and clinical correlations of mandibular foramen in dry adult human mandibles of north Indian Origin. *Ann Int Med Dent Res.* 2016; 2(4).
11. Varsha shenoy, S.vijaya Lakshmi, P.Saraswathi. osteometric analysis of the mandibular foramen in dry human mandibles. *Journal of clinical and diagnostic research*, 2012 May (suppl-2), vol - 6(4): 557-560.
12. Syed Insha Saify, Kaneez Fatima, Shaheen Shahdad, G.M,Bhat. Morphometric study of mandibular foramen and its clinical significance in inferior nerve block. *International Journal of Research in Medical Sciences.*2023 may: 11(5): 1600-1604.
13. Mangesh Santram, Geetanjali Bhagwanrao sudke. Anatomical study of mandible foramen in dry adult human mandibles. *Medplus international journal of anatomy:* Oct 2020;16(1):06-09.