

Original article:

Mandibular Accessory Mandibular Foramen - An Anatomical Study In Dry Adult Human Mandibles Of Eastern India

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Abstract:

Introduction: Inferior alveolar nerve block failure results from inaccurate localization of mandibular foramen and accessory mandibular foramina. Aim of this study is to locate mandibular foramen precisely from different anatomical landmarks and observe incidence of accessory mandibular foramina.

Methods: This study was done on 160 dry mandibles of unknown sex and age, collected from the Department of Anatomy, IPGME&R. Distance of mandibular foramen was measured from mandibular notch, angle, anterior and posterior border of mandible. We observed incidence of accessory mandibular foramina around mandibular foramen. The values were analysed statistically.

Observations and Results: Distance of mandibular foramen from notch was 19.14 ± 2.86 mm(right) and 18.89 ± 2.94 mm(left). On right side the distance from anterior border was 17.44 ± 1.95 mm and from posterior border 13.56 ± 2.93 mm, on left side they are 17.49 ± 2.21 mm and 13.69 ± 2.42 mm respectively from anterior and posterior border. Distance from angle are 20.16 ± 3.55 mm (right) and 20.65 ± 3.79 mm (left). 20.44 ± 4.4 mm and 21.21 ± 5.41 mm are the values we get from last molar tooth on right and left side respectively. Bilaterally there was no significant statistical difference. We found 63.75%(left) and 53.75% (right) specimen with no accessory foramen. Single accessory foramen was 37.5%(right) and 31.25%(left), double foramina in 2.5%(right) and 5%(left), three foramina 6.25%(right) and no such specimen with three accessory foramina on left side we found.

Conclusion: Precise knowledge about position of mandibular foramen is essential for dentistry during regional anaesthesia (inferior alveolar nerve block) and different surgical procedures. Knowledge about accessory foramina may be important for radiotherapists during planning of radiation therapy.

Key words: mandibular foramen, accessory mandibular foramen, nerve block

INTRODUCTION

Mandibular foramen is an irregular opening present little above the centre on the medial surface of ramus of mandible. It curves downward and forward forming mandibular canal and leads to mental foramen. The inferior alveolar nerve and vessels pass through this foramen, traverse mandibular canal, divides into mental and incisive branches to supply teeth of lower jaw and participates in the formation of the anterior loop^{1,2}This foramen is surgically important for maxillo-facial surgeons during correction of prognathism, retrognathia or inferior alveolar nerve block.^{3,4}Potocnik and Bajrovic have estimated approximately 30-45% failure rate of inferior alveolar nerve block, which is 20-25% according to Shah et al,^{5,6} probably due to different location of anatomic structures.⁷

Any openings in the mandible other than the mandibular foramen, mental foramen, lingual foramen, sockets of teeth are known as accessory mandibular foramen.⁸ Other than additional branches of inferior alveolar nerve, a

number of other nerves like facial, mylohyoid, buccal, transverse cutaneous nerve may pass through it and in such cases if local anaesthesia is given, failure rate will be high.^{9,10}

AIMS AND OBJECTIVES

Aim of the present study is to determine the precise location of mandibular foramen in respect with quadrant on medial surface of mandibular ramus and measure its distance from different landmarks like anterior and posterior borders of mandible, mandibular notch, mandibular angle and to determine the incidence of accessory mandibular foramina around the mandibular foramen in Eastern Indian population.

MATERIAL AND METHODS

This study was conducted over 160 dry dentulous adult mandible with unknown age and sex in the Department of Anatomy, IPGME&R, Kolkata, with Vernier callipers (precision 0.02mm). Damaged bones and those having pathological abnormalities were excluded and mandibles with sockets for third molar teeth, those with regular shape, devoid of any deformity were selected. Distance between mid-point of anterior border of ramus (AB) to mid-point of mandibular foramen (MF), mid-point of posterior border of ramus (PB) to mid-point of MF, lowest point of mandibular notch (MN) to mid-point of MF, angle of mandible (AM) to mid-point of MF, posterior margin of last molar tooth socket (LMT) to mid-point of MF were noted. Each measurement were taken thrice and the mean of the three were taken to avoid observational bias.

Each mandible was further observed visually for the presence of accessory mandibular foramina (AMF) near MF over the medial surface of mandibular ramus and if present, their prevalence were noted.

Medial surface of each ramus was divided by one vertical line (joining mid-point of notch of mandible with mid-point of lower border of ramus) and one horizontal line (mid-point of posterior border of mandibular ramus with mid-point of anterior border of ramus) into four quadrants. Supero-anterior, supero-posterior, infero-anterior and infero-posterior quadrants were named as 1,2,3 and 4 subsequently. Each mandible was observed to note in which quadrant MF was present.

Results were analysed statistically. Student's t test was used to compare mean values between right and left side and P-values less than 0.05 was taken statistically significant. Number of AMF and quadrant-wise position of MF were expressed in percentage.

OBSERVATIONS AND RESULTS

The mean distance of MF from MN on left side is 18.89 ± 2.94 mm and 19.14 ± 2.86 mm on right. There was no significant difference between the two sides ($P = 0.44$). The mean distance between AB to MF is 17.49 ± 2.21 mm on left and 17.44 ± 1.95 mm on right side. It also has no statistically significant difference ($P = 0.83$). On left side the mean distance between PB mandibular ramus to MF is 13.69 ± 2.42 mm and it is 13.56 ± 2.93 mm on right. P value between these two is 0.72, which is also statistically insignificant. The mean distance between AM to MF on right and left side are 20.16 ± 3.55 mm and 20.65 ± 3.79 mm respectively. The difference between them are also insignificant ($P = 0.22$). We found statistically insignificant difference between the mean distance of IIM to MF on right (20.44 ± 4.4 mm) and left side (21.21 ± 5.41 mm) with P value 0.18.

On right side we found single AMF in 37.5% (60 out of 160) specimens, 2.5% with double AMF (4 of 160), 10 specimens with three AMFs (6.25%), and rests had no AMF. Whereas on left side these values are 31.25% (50 out of 160), 5% (8 of 160), 0% and 63.75% (102 of 160) respectively.

In 1.88% specimen MF was at 1st quadrant and in 22 cases in quadrant 3. In 51.88% at 2nd and 36.25% at 4th quadrant. Only in 4 cases MF were along the vertical line in superior part and 3 cases along transverse line in posterior part of the ramus.

DISCUSSION

The precise location of MF is clinically very important for dental surgeons, as inferior alveolar nerves and vessels which go through this foramen may get damaged during surgeries.

Mbajjorguet al¹¹ studied over adult black Zimbabweans. Oguz and Bozkir¹² tried to locate the MF in Turkish population. Ennes and Medeiros¹³ as well as Prado et al¹⁴ studied on Brazilian mandibles to localize MF. Different studies have been undertaken to locate the MF in different parts of India also. In our study we compared the position of MF in eastern India with different parts of this country. (table 1)

Shalini R et al¹⁶ in their study in 2016 among south Indian population divided the medial surface of mandibular ramus into 16 divisions by antero-posterior and supero-inferior axis to define position of MF. They got mandibular foramen in the third quadrant in antero-posterior axis and junction between second and third in the supero-inferior axis of mandibular ramus. In our study we divided it into four quadrant and found 90% of foramen into posterior half of ramus and 43.13% in the inferior quadrant. In 1985, Nicholson²¹ studied over dry mandibles of East Indian ethnic origin and opined that, the MF to be located at the antero-posterior midpoint of the ramus halfway between the mandibular notch and inferior border of ramus of mandible. Though only in 3 out of 160 specimens we found MF to be located at halfway between the mandibular notch and lower border.

The presence or absence of AMF with its number were also compared. In 2016, Gopalkrishna et al¹⁵ found that in Kerala only 18% mandible had AMF, and the number of AMF were single. They didn't found any specimen with double foramina. Whereas, Samanta et al⁹ found 10% mandible with single AMF, 6.66% with double AMF in north Indian population in the year 2013. In a study over population of Bangalore in 2014, Padmavathiet al¹⁷ found 29.2% mandible with unilateral AMF and 12.3% with bilateral presence of AMF. Shalini et al¹⁶ in their study over south Indian population noted 8.33% specimen with right side single AMF, which we get 37.5%. In 3.92% cases they found double AMF on right side, which was 2.5% in our study. In 31.25% cases they found single AMF on left, whereas 5% double AMF on the same side, which we noted to be 31.24% and 5% successively. In our study we noticed 5 specimens with three AMF on right side ([figure 3](#)) but no specimen with the same over left, which was not reported in any of the above study.

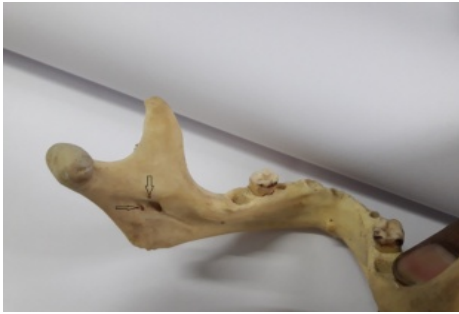
Regarding embryological explanation of AMF Chavez-Lomeli et al²² opined that, primarily three inferior alveolar nerves were present to supply mandibular teeth. Later they join and form a single trunk. Incomplete fusion of these nerves may lead to formation of accessory mandibular foramen. In our study we found 6.25% cases with three AMF, which may be explained by the presence of more than three inferior alveolar nerves primarily.

Table 1: comparison of distances(in mm) with previous studies

Position of MF	Side	Present Study	Gopalkrishna K et al ¹⁵	Shalini R et al ¹⁶	Padmavathi G et al ¹⁷	Laishram D et al ¹⁸	Samantha PP et al ⁹	Reddy AJ et al ¹⁹	Sandhya K et al ²⁰
MN-	Right	19.14± 2.86	21.23± 4.56	21.74± 2.74	22.0± 3.0	41.0	22.7± 3.0	24.03± 6.83	20.48± 3.89
	Left	18.89± 2.94	21.16± 3.12	21.92± 3.33	22.3± 3.4	38.0	22.27± 2.92	23.96± 6.62	20.15± 3.8
AB-	Right	17.44± 1.95	14.63± 3.16	17.11± 2.74	16.8± 2.8	27.9	15.72± 2.92	17.34± 2.69	16.00± 3.5
	Left	17.49± 2.21	15.31± 3.11	17.41± 3.05	16.9± 2.5	27.7	16.23± 2.88	17.64± 2.87	16.27± 3.9
PB-	Right	13.56± 2.93	12.34± 3.1	10.47± 2.11	11.7± 2.0	26.2	13.29± 1.74	15.08± 1.88	10.21± 2.34
	Left	13.69± 2.42	13.51± 3.92	9.68± 2.03	12.1± 2.4	24.0	12.73± 2.04	14.81± 1.76	10.28± 5.24
AM-	Right	20.16± 3.55	22.14± 3.18	-----	22.6± 3.4	31.5	21.54± 2.92	-----	-----
	Left	20.65± 3.79	22.1± 4.12	-----	22.2± 2.9	32.3	21.13± 3.43	-----	-----
LMT -	Right	20.44± 4.4	14.37± 3.16	22.84± 3.94	-----	-----	-----	-----	-----
	Left	21.21± 5.41	19.26± 2.57	23.23± 4.21	-----	-----	-----	-----	-----

CONCLUSION

Different studies have been carried out in different regions of India for decades to determine the position of mandibular foramen and accessory mandibular foramen from surgical point of view. To avoid injury to the neuro-vascular bundle passing through the mandibular foramen and accessory mandibular foramen, precise location of these foramina are important¹⁵. Their exact location may decrease ineffective inferior alveolar nerve block, orthognathic reconstructive and other surgeries of mandible²³. Our study will help dental surgeons for proper planning about the site of local anaesthesia and other maxolli-facial surgeries in eastern Indian population. This study will also help clinicians, radiologists, oncologists and radiotherapists to locate MF & AMF precisely as these are routes for infection and tumor cells to spread²⁴.



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