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Study of the Location of the Mandibular Foramina in Indian Dry Mandibles

Dr. Kanan Shah	Associate professor, Department of Anatomy, Smt.N.H.L. Municipal Medical College, Ahmedabad, Gujarat
Dr. Pratik Shah	Consultant ENT SURGEON, Shahpur, Ahmedabad
Dr. Ajay Parmar	Resident, Department of Anatomy, Smt.N.H.L. Municipal Medical College, Ahmedabad, Gujarat.

ABSTRACT

The mandibular foramen (MF) is an opening on the internal surface of the ramus for branches of the mandibular vessels and nerve to pass. The aim of this study is to determine the position of the MF from various anatomical landmarks in several dry adult mandibles. It is generally believed that , its position is not constant in all mandibles, thus leading to the failure of inferior alveolar nerve block and other complications. Nevertheless its location is useful for the oral and maxillofacial surgeon in orthognatic surgery, especially in vertical ramus osteotomy (VRO) procedure. This study aimed to see the position of Mandibular foramen in 100 mandibles of any age. The distance from the head of the mandible, third molar , mandibular notch, angle and the symphysis manti to the foramen were measured. This study indicates that the individual variations are observed and no landmark could definitely there to locate the foramen.The aim of our study is to analyse the position of mandibular foramen in order to provide simple and reliable surgical landmarks.

KEYWORDS: Mandible; Mandibular Foramen

INTRODUCTION:

The mandible is the strongest and largest bone of the face which forms the lower jaw. It has a 'U' shaped anterior part, the body of the mandible, which bears the lower jaw teeth and a quadrilateral bony plate which is known as the ramus, which projects posterior and superior to the body. The ramus of the mandible has got anterior, posterior, superior and inferior borders and two surfaces, namely, the lateral and the medial surfaces. The mandibular foramen (MF) is an irregular foramen on the medial surface of the ramus, which is located near the centre. The medial surface of ramus of mandible presents a little above the centre an irregular mandibular foramen leading to the mandibular canal, curving downwards and forwards into the body to its mental foramen. The foramen transmits the inferior alveolar nerve and the vessels which run further down in the mandibular canal to emerge out from the mental foramen.The mandibular canal (MC) is a canal which traverses the body of the mandible. Mandibular foramen was situated in the ventral and inferior two-thirds of the ramus without difference according to the side, sex or age. The inferior alveolar (IA) nerve and the vessels, after passing through the MF, traverse the MC to supply the mandibular teeth. The lingula is a tongue shaped bony projection which is just medial to the MF Posterior and superior thirds of the ramus constitute a "safety zone" where mandibular foramen is unlikely to be found. This area can be used by the oral and maxillofacial surgeon in vertical ramus osteotomy of the mandible with low inferior alveolar nerve morbidity probability. The IA nerve block is the commonest local anaesthetic technique which is used for anaesthetizing the lower jaw in dentistry. The success of this technique highly depends on the proximity of the needle tip to the MF at the time of the anaesthetic injection . For this reason, this technique must be based on the precise anatomical knowledge of the MF. Adequate anaesthesia is a prerequisite of most of the dental procedures. Effective pain control in dentistry may be achieved by the local anesthetic techniques; the most common procedure which is followed being the inferior alveolar nerve block. The Traditional Halstead method is a direct technique in which the inferior alveolar nerve is approached by an intraoral access before it penetrates the mandibular canal. According to previous studies,the failure rate of this procedure was 20%, reaching to even higher percentages in the pulpal anaesthesia. The success of this technique highly depends on the proximity of the needle tip to the mandibular foramen at the time of the anaesthetic injection. For this reason, the technique must be based on the precise anatomical knowledge of the correct location of the mandibular foramen. This study was conducted to localize the MF accurately in several dry adult mandibles and provide the data to our students and practitioners in dentistry to improve their technique on the inferioralveolarnerveanestheticmethod.

The most frequent technique failure in anesthesia of the inferior alveolar lies in the inappropriate setting of the needle, due to the inaccurate location of anatomic structures mandible foramen

Anesthesia in the mandible may be associated with some difficulty. The success of this technique depends on the proximity between the anesthetic needle and the MF. Imperfections in the attainment of the anesthesia of the lower alveolar nerve must generally due to the lack of observance of the localization of the mandible foramen, noticing them its variations.

The absence of a specific anatomic bony landmark, along with variations in the ramus width and height and the inferior alveolar nerve foramen position, is responsible for failure to achieve profound anesthesia. Some authors have estimated the failure rate of inferior alveolar nerve blocks to be approximately20-25%.

The past studies revealed the importance of MF in the success of Inferior Alveolar nerve Block.(IANB) Although several reports in the literature mentioned about the MF position from various landmarks, no study was available to explain the technical aspect of the nerve block to overcome these failures. The purpose of this study is to determine the position of the MF from various anatomical landmarks in several dry adult mandibles and provide valuable information for dental students and dental practitioners.

The aim of the present study was to locate the MF in relation to the borders of the mandibular ramus and also to locate the quadrant of the ramus in which the foramen was located in the vertical and horizontal directions.

Many authors have studied the position of mandibular foramen. While authors like Hwang TJ et al and Oliver Trost have done study on radiographs, other authors like Mbajiorgu , Narayana Kilarkaje have studied on dry mandibles to determine the position of andibular foramen. The present study has been carried out on dry mandibles to determine the position of mandibular foramen. As the mandibles were obtained from Smt.N.H.L MunicipalMedicalcollege,Ahmedabad, Gujarat, this study gives fairly the position of mandibular foramen of the local population.

The purpose of this study is to identify the landmarks that would provide the most reliable and predictable indicators of the exact position of the MF and to provide the clinician with a suitable modifications in the technique to accommodate these variations.

AIMS & OBJECTIVES:
The aim of this study was to locate the mandibular foramen in relation to the borders of the mandibular ramus and also to locate the quadrant of the ramus in which the foramen was located in the vertical and horizontal directions.

To determine the position of the mandibular foramen on dry adult mandibles and hence provide valuable information for dental and other health practitioners for successful inferior alveolar nerve anaesthesia and other dental procedures.

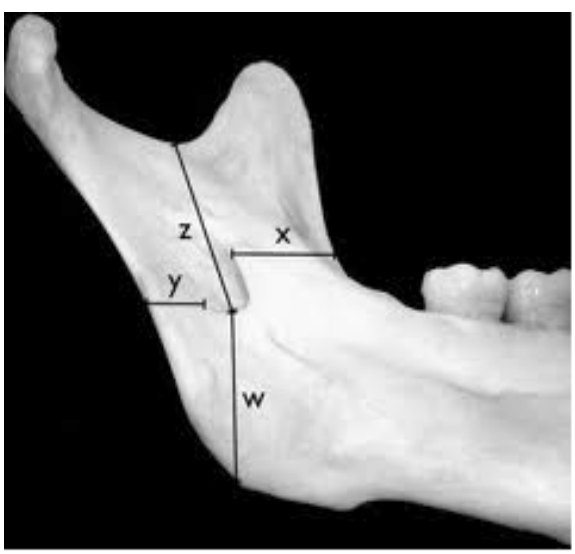
Materials and Methods: A total of 100 human dry mandibles obtained from department of anatomy, Smt.N.H.L. Municipal Medical College Ahmedabad, were examined .Out of which 94 were of dentulous and 6 were of edentulous. Vernier Calipers of 1/20mm accuracy has been used for taking measurements. The position of the centre of mandibular foramen was measured from various landmarks like (fig:1)

W. Angle of mandible.

X. Nearest point on the anterior border of the ramus of mandible

Y. Nearest point on the posterior border of the ramus of the mandible

Z. Lowest point of the mandibular notch



The distances from the MF to various landmarks were calculated as a mean of two measurements recorded independently by two people. Measurements were recorded to the nearest millimeter. All the measurements were registered in millimeters. The ramus height from the head of condyle to the inferior border of mandible was also measured. The location of the foramen in relation to the mandibular Occlusal plane and the coronoid notch was determined and recorded.

Observations:
The present study gives a fair knowledge of position of mandibular foramen in the local population. The study shows little difference in the position of the foramen in dentulous and edentulous mandibles suggesting little change in position of the same with progress of age.

The position of the foramen was found to be variable. However, the foramen was predominantly located at the anteroposterior midpoint of the ramus halfway between the mandibular notch and the lower border of the mandible and two thirds of the way down a line joining the coronoid process to the angle of the mandible. In the majority of the mandibles studied the foramen was located below the occlusal surfaces of the molar teeth. It is concluded that the marked variability in the position of the mandibular foramen may be responsible for an occasional failure to block the inferior alveolar nerve.

The average distance of mandibular foramen from the mandibular notch was found to be around 23 to 25 mm in both dentulous and edentulous mandibles. The same was found to be around 16 to18 mm from the anterior border of ramus and around 12 to 13 mm from posterior border of ramus in both groups of mandibles. The average distance from the angle of the mandible was found to be around 27 to 30 mm.

Table-1 (w)

	Dentulous Mandible				Edentulous Mandible			
	min	max	Mean	SD	min	max	Mean	SD
Left	18	38	26.67926	6.49011	26	34	29	3.03315
T value				0.388242				
Right	18	37	26.79255	5.791823	27	35	29.33333	3.011091
T value				0.29095				0.852317

Table 2 (x)

	Dentulous Mandible				Edentulous Mandible			
	min	max	Mean	SD	min	max	Mean	SD
Left	13	23	18.19681	3.072789	15	21	17.83333	2.316607
T value				0.77696				
Right	14	23	18.28723	2.905769	15	20	17.83333	2.136976
T value				0.708179				1

Table 3 (y)

	Dentulous Mandible				Edentulous Mandible			
	min	max	Mean	SD	min	max	Mean	SD
Left	10	20	14.12766	2.920024	10	15	13.16667	1.94079
T value				0.42972				
Right	10	18	13.85638	4.242641	10	16	13.33333	2.160247
T value				0.63431				0.890993

Table 4 (z)

	Dentulous Mandible				Edentulous Mandible			
	min	max	Mean	SD	min	max	Mean	SD
Left	19	25	21.94681	1.547575	23	26	24.16667	1.169045
T value				0.000844				
Right	20	25	21.89362	1.756512	20	26	23.33333	1.966384
T value				0.055986				0.393203

mandibular

Discussion
The average, standard deviation and the minimum and maximum values of various parameters which were studied on either sides of the mandible are shown in [Table]. It was found that there was no significant difference in the values on the right and left sides. The positive scores indicated a direct proportional correlation, the negative scores indicated an inversely proportional correlation and zero indicated no correlation.

The localization of the MF presented great variations, but in this study, there was no significant variation between the right and left sides, which was in accordance with the findings of previous

Studies. The data were compared using Student's t-test. The MF is positioned at a mean distance of 18 mm (with SD 3.07) from the anterior border of the ramus study on 100 adult human mandibles showed that the MFwas 16.9 mm and 16.78 mm on the right and left sides respectively. The IA nerve block was the most frequently used local anesthetic technique for restorative and surgical procedures on the mandible, with several million blocks being administered each year. According to previous studies, the traditional Halstead method had shown a 20% failure rate. The most common reason for the failure of the technique was the inappropriate location of the tip of the anesthetic needle due to inappropriate localization of the MF.There are some anesthetic protocols which proclaim the utilization of long needles for the IA nerve blockage. On an average, the long needles are 33mm long and the short needles are 21.5mm long. If the long needles are used in patients with small mandibles, the procedure can end in a technical failure, since there is a risk of perforating the parotid gland capsule where the infiltration of the anesthetic solution may lead to the blockage of the facial nerve branches. On the other hand, the use of short needles in

big-sized mandibles might lead to needle fracture. In this study, the Average distance between the w and MF was found to be 26.6 mm, which was the ideal place for the anesthetic infiltration. The maximum value for thesame parameter was found to be 38 mm and the minimum was

18mm. According to the values of the present study, the IA nerve block could probably be accomplished with long needles. Bilateral sagittal split osteotomy (BSSO) and vertical ramus osteotomy

(VRO) are the common procedures which are done for the correction of the mandibular prognathism, to reposition the mandible surgically. A thorough anatomical knowledge of the mandibular ramus is essential for these procedures, since they are technically difficult procedures and as they are also associated with a higher incidence of complications . According to many studies, the posterior and the superior thirds of the ramus constitute a 'safety zone' where the MF is unlikely to be found.

In the present study also, the MF was found to be located in the third quadrant antero-posteriorly and at the junction of the second and third quadrants supero-inferiorly which was in accordance with the findings of older studies. Thus, familiarity with the described relationships of the MF will assist in the correct localization of the MF, which in turn, might reduce the chances of an undesired split as well as IA nerve morbidity. Thus, the correct localization of the MF will assist in performing proper and safe split osteotomy procedures on the mandible.The Avg of x-MF was 18 mm, that of MF- y was 14 mm, that of MF- z was found to be 22 mm.

If we divided the surface area of the ramus into four quadrants then this study could locate the MF centre to the third quadrant antero-posteriorly.ablehowing Lingular pattern on the right and left.

The lingula of the mandible is a sharp, tongue-shaped, bonyprojection on the medial aspect of the ramus. It is an importantlandmark on the medial side of the ramus as it is in close proximity to the MF. Hence, both the MF and the lingula are of clinical significance for the orodental surgeons

CONCLUSION

Since some investigators have stated that anaesthesia is essential for both the patients and the dentists, quoting that the opinion of the patients about their dentists was strictly based on their experience with local anaesthesia, it was preferred to infiltrate the anaesthetic solution in close proximity to the MF in the

IA nerve block. Despite the great variation of the MF, it should be kept in mind that it is located in the third quadrant of the ramus antero-posteriorly and supero-inferiorly. It is also preferable to locate the MF by a CT scan prior to any surgical approach to the ramus, to prevent inadvertent injury to the IA nerve.

The study has shown similarities and differences between the rameal dimensions and the position of the mandibular foramen in adult mandibles .The clinical significance of accurately locating the mandibular foramen during a local anesthetic block of the inferior alveolar nerve is discussed.

We conclude that failures in the anesthesia of the inferior alveolar nerve are due to the operator error and not due to the anatomical variation.

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