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Study for Localization of Mandibular Foramen in North West Indian Population

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ABSTRACT

Introduction: the accurate location of the mandibular foramen is crucial for the success of an inferior alveolar nerve block. which is necessary in surgical procedures involving lower jaw. This study investigated the usefulness of distance from 2nd mandibular molar tooth to mandibular foramen as other conventionally described landmarks are difficult to delineate many times.

Study was performed on 70 mandibles in the skeleton collection of the Department of Anatomy in Pt. B. D. Sharma PGIMS Rohtak. Mandibular notch and mandibular molar teeth are easily palpable landmarks in the oral cavity. Due to significant variations in eruption of last mandibular molar distance from the 2nd mandibular molar tooth was used in this study. Measurements were taken by using Vernier calipers.

Mandibular canal length was 55.53 + 4.51 mm(Mean + SD) on the right side and 56.02 + 5.07mm (Mean + SD) on the left side. Smallest distance from the mandibular notch was 23.51 + 3.04 mm (Mean + SD) on the right side and 23.37+ 3.34mm (Mean + SD) on the left side. Similarly, the smallest distance from the 2nd mandibular molar was 27.54 + 4.04 mm(Mean + SD) on the right side and 28.01+ 5.00mm(Mean + SD) on the left side.

Smallest distance of mandibular foramen to 2nd mandibular molar tooth can be helpful in more accurate localization of mandibular foramen during inferior alveolar nerve block. Difference in metric data of localization of mandibular foramen between left or right side was not found to be statistically significant.

Keywords: Mandibular foramen; Inferior alveolar nerve; Second mandibular molar.

Introduction

The accurate location of the mandibular foramen is crucial for the success of an inferior alveolar nerve block. The mandibular foramen serves as the entry point for the inferior alveolar nerve, which provides sensory innervation to the lower teeth and associated structures. An inferior alveolar nerve block is a dental anesthetic technique used for performing surgical procedures on the lower teeth, gingiva (gums), and lower lip on one side of the mouth.

When performing an inferior nerve block, the injection is typically aimed near the mandibular foramen to deliver the local anesthetic solution to the nerve. However, the exact position of the mandibular foramen can vary slightly among individuals, and its location must be carefully identified to ensure effective anesthesia.To determine the location of the mandibular foramen, dental professionals and anaesthesiologists typically use anatomical landmarks and radiographic imaging.

Conventional technique of mandibular nerve block involves the insertion of a needle near the mandibular foramen in order to deposit a solution of local anesthetic near to the nerve before it enters the foramen[1]. High failure rate for the procedure of mandibular nerve block of 20-25% has been reported in literature[2]. Correct localization of mandibular foramen is an important consideration as local anesthesia should be deposited in the vicinity of inferior alveolar nerve before it enters the foramen. It is not possible to palpate the mandibular foramen, surrounding anatomical landmarks, such as the occlusal plane, sigmoid notch, coronoid notch, and external and internal oblique ridges are used for this purpose[3].

The distance of mandibular foramen from the anterior border of the ramus, posterior border of the ramus, mandibular notch, base of the mandible, third molar, and apex of retromolar trigone has been reported in studies[4]. In all these criteria except the third molar anatomical landmark in living patients is not as clear as in bones, on which study was done. Even mandibular third molars are missing in 50 percent of persons in the age group of 30-39 years. This percentage increases up to 84.9 percent in the more than 70 years age group[5]. Further there are significant variations reported in the eruption of the last molar tooth.Localization of mandibular foramen is not only difficult but also a source of disagreement[6].

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From systemic search of literature it is concluded that there is no study published for distance mandibular foramen from 2nd mandibular molar tooth from Haryanavi population. Specific populations related to anatomical variations should be considered to adapt the technique to ensure optimal anesthesia for the patient. In view of this, the authors selected to study the localization of mandibular foramen in reference to the second mandibular molar, which is a more consistent landmark.

Material and Method

This cross-sectional descriptive study was carried out on the mandibles retrieved from osteological collection in the Department of Anatomy, PGIMS, Rohtak. Skeletons belonged to subjects from north west India, having distinct ethnic composition from other parts of India. A total of 70 mandibles were measured. Although all mandibles belonged to adult skeletons, exact age and sex were undetermined. Mandibles with deformity, distortion, breaks or any pathology were excluded from the study. Mandibles of children were also excluded from study and mandibles with missing second molar were excluded from study. Normal looking mandibles with preserved teeth or alveolar processes were included in study.

Instruments used in the study include vernier calipers with the least count of 0.01 mm. All the measurements were taken three times and the mean value was calculated for each parameter. Measurements were taken from the midportion of the mandibular foramen to the landmarks such mandibular notch, second molar tooth and mental foramen. Data management and statistical analysis were done using Microsoft Excel version 2021. Paired t-test was applied to compare the mentioned morphometric parameters of two sides for any statistical difference.

The procedures in the study followed the guidelines laid down in the Declaration of Helsinki. Ethical guidelines were followed and the bones were analyzed with dignity and respect. Approval of the ethical committee was obtained.

Results

Seventy mandibles were analyzed in this study and following parameters were measured of both sided Figure 1:

1. Smallest distance from second molar mandibular tooth
2. Smallest distance from the mandibular notch
3. Mandibular canal length

Mean value of each of above parameters on both sides of the mandible is summarized in Table 1. All above three parameters were found to be bilaterally symmetrical as there was no significant statistical difference in analyzed parameters between sides. Figure 2 is showing comparison of metric parameters of mandibular foramen in the form of bar diagram.

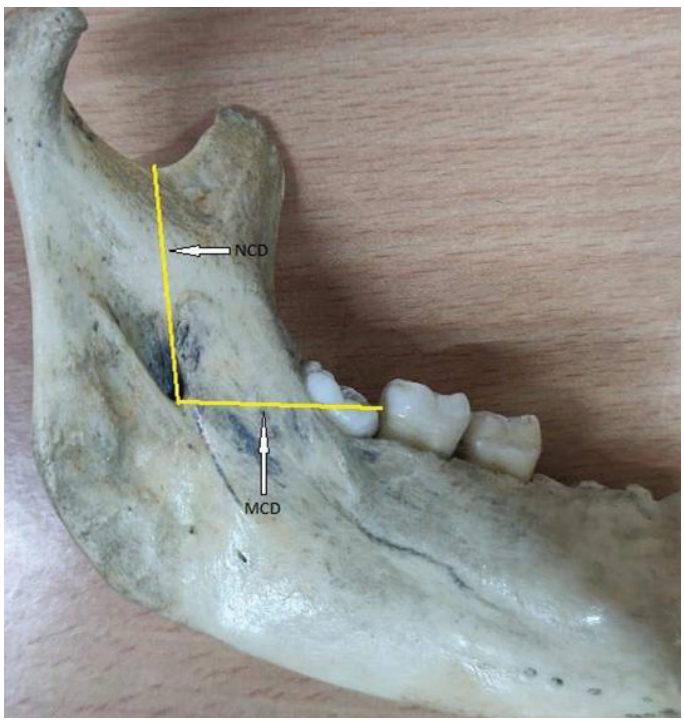

Figure 1. Morphometric localization of mandibular foramen in reference to second mandibular molar tooth.

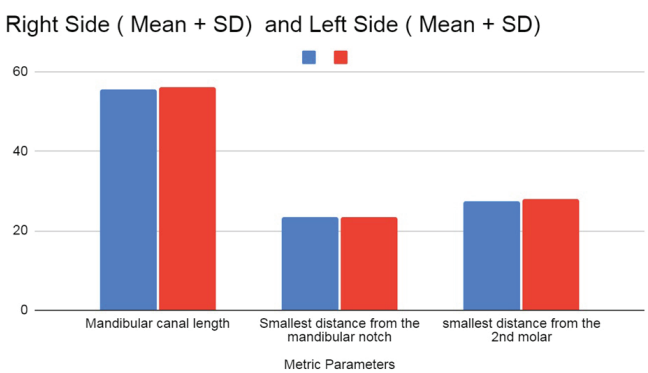

Figure 2. Chart showing comparison of metric parameters of mandibular foramen.

Table 1. Mean (mm) ± SD values of mandibular foramen metric parameters.

S. N°	Metric Parameter	Description of metric parameter	Right Side (Mean ± SD)	Left Side (Mean ± SD)	p-value
1	MCD	Smallest distance of mandibular foramen from the second molar mandibular tooth	27.54 + 4.04 mm	28.01+ 5.00mm	>0.05
2	NCD	Smallest distance of mandibular foramen from the mandibular notch	23.51 + 3.04 mm	23.37+ 3.34mm	>0.05
3	MCL	Mandibular canal length	55.53 + 4.51 mm	56.02 + 5.07mm	>0.05

Discussion

The accurate localization of the mandibular foramen is of utmost importance for the success of an inferior alveolar nerve block. Foramen lies on the medial surface of the ramus of the mandible. Nicholson 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. Further methods to localize mandibular foramen were not simple and not easy to reproduce. The success of an inferior alveolar block depends on the proximity between the anesthetic needle and the MF[7].The present study has evaluated a simple method to locate mandibular foramen in subjects having intact second mandibular molar teeth.

Present study confirmed findings reported by Narayana *et al* which concluded that mandibular foramen maintains absolute bilateral symmetry as difference in sides of all parameters measured in this study was not found statistically significant[8]. Saify *et al* proposed on the basis of a morphometric study on 50 dry human mandibles suggested that the deposition of anesthetic agent if spread equally from 21 mm to 24 mm of distance from anterior border of ramus will produce an effective alveolar nerve block[9]. However, authors emphasize that palpation of the anterior border of the ramus of the mandible from inside the oral cavity requires a lot of practice and proper training.

Feurstein *et al* reported in their radiological study that The mandibular foramen is located from - 0.4 to 2.9 mm above the occlusal plane[10]. However, the landmark they studied for localization was the leading edge of the mandible which is not visible in living subjects and thus of limited utility in live patients. Current study proposes that second mandibular molar teeth can be a better landmark for localization of MF. Hence usefulness of distance of mandibular foramen from second mandibular molar teeth may be explored further.

In an osteological study on 50 mandibles Narayan *et al* concluded that the occlusal plane should be the preferred plane of approach for inferior nerve block[11]. It has been reported that in reference to this plane foramen lies up to 4.2 mm above the occlusal plane in some subjects and below the occlusal plane in 75% of subjects and 22% subjects at the same level [12,13]. Thus keeping the needle in the occlusal plane is justified only if the facility for radiography is not available. This can happen in some situations in remote areas and in poor countries. When the results of Hwang *et al*. are considered, in which MF was found even 4.2 mm above the occlusal plane, in adults. But not justified when confronted with the results presented by Nicholson, who found MF below the occlusal plane in 75% of the examples and 22% at the same level, similar to the findings of Afsar *et al*.

In view of above discussion, By using the mandibular second mandibular molar tooth as a reference point, dental professionals can estimate the position of the mandibular foramen and administer local anesthesia more effectively because this is a visible landmark as opposed to other landmarks mentioned in literature, which primarily need to be palpated. It is important to note that clinical expertise and a comprehensive understanding of the anatomical variations are crucial for successful localization of the mandibular foramen in individual patients.

Conclusion

Smallest distance of mandibular foramen to 2nd mandibular molar tooth can be helpful in more accurate localization of mandibular foramen during inferior alveolar nerve block. Difference in metric data of localization of mandibular foramen between left or right side maintained symmetry.

Ethical Statement

The authors state that every effort was made to follow all local and international ethical guidelines and laws that pertain to the use of human cadaveric donors in anatomical research.

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