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CLINICAL

ANALYSIS OF MANDIBULAR FORAMEN IN DRY HUMAN MANDIBLE TO AUGEMENT INFERIOR ALVEOLAR NERVE BLOCK

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A B S T R A C T

Context (Background): Adequate anesthesia is a prerequisite of most dental procedures. Effective pain control in dentistry may be achieved by local anesthetic techniques; the most common procedure being followed is inferior alveolar nerve block. Traditional Halstead method is a direct technique in which 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 even higher percentages in pulpal anesthesia. The success of this technique highly depends on the proximity of the needle tip to the mandibular foramen at the time of anesthetic injection. For this reason, the technique must be based on precise anatomical knowledge of the correct location of mandibular foramen.

K E Y W O R D S

Mandibular foramen, lingula, osteometry, sagittal split osteotomy, inferior alveolar nerve, gonial angle.

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Abstract:

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dentistry may be achieved by local anesthetic techniques; the most common procedure being followed is inferior alveolar nerve block. Traditional Halstead method is a direct technique in which 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 even higher percentages in pulpal anesthesia. The success of this technique highly depends on the proximity of the needle tip to the mandibular foramen at the time of anesthetic injection. For this reason, the technique must be based on precise anatomical knowledge of the correct location of mandibular foramen.

Aim: The aim of this study was to locate mandibular foramen in relation to the borders of mandibular ramus and

also to locate the quadrant of ramus in which, the foramen was located in a vertical and horizontal directions.

Materials and Methods:

Fifty human dry mandibles were studied to determine,

1. The distance of mandibular foramen to a) anterior border of ramus b) posterior border of ramus c) mandibular incisure d) lower border of ramus.
2. Gonial angle and correlation of gonial angle to other parameters studied and
3. To categorise lingula into various patterns depending on its shape and to measure bi-lingular distance.

Results: This study revealed that mandibular foramen was located on the third quadrant antero-posteriorly and at the

junction of second and third quadrant of ramus supero-inferiorly. There was a negative correlation between the gonial angle and other linear parameters studied. The most common type of lingula was found to be nodular variety. Conclusion: Localisation of mandibular foramen is a prerequisite prior to inferior alveolar nerve block and during

any surgical procedures on mandibular ramus.

Key Messages:

Mandibular foramen is located on the medial side of mandibular ramus, transmits inferior alveolar nerves and vessels into the mandibular canal.

Lingula is a sharp tongue shaped bony projection in proximity with mandibular foramen.

Inferior alveolar nerve block is the most common local anesthetic procedure followed in dentistry. Correct localisation of mandibular foramen will decrease the failure

rates of local anesthetic techniques.

Key Words: Mandibular foramen, lingula, osteometry, sagittal split osteotomy, inferior alveolar nerve, gonial angle.

INTRODUCTION:

Mandibular foramen (MF) is an irregular foramen on the medial surface of mandibular ramus, located near the centre. Traced below, MF leads into the mandibular canal (MC). Through the MF, Inferior alveolar (IA) nerves and vessels enter into MC. The branches of the alveolar nerves and vessels then enter the roots of the teeth and the periodontal septa and supply them.1 IA nerve block is the commonest local anesthetic technique followed in dentistry. Since the success rate predominantly lies on correct localization of MF, this anatomical structure along with accompanying bony projection, lingula was addressed in this study.

MATERIALS AND METHOD:

The following parameters were measured on 50 human dry mandibles:

4. The smallest distance between the anterior border (Ab) of mandibular ramus and the anterior limit of MF (Ab-MF)
5. The smallest distance between the posterior limit of MF and the posterior border (Pb) of mandibular ramus (MF-Pb)
6. The smallest distance between the inferior limit of MF and the mandibular base (MF-MB)
7. The smallest distance between the lowest point of the mandibular incisure and the inferior limit of MF (MI-MF)
8. The smallest distance between Ab and Pb passing by MF (Ab-Pb)
9. The gonial angle of the mandible (Go),
10. Types of lingula - categorised them into four types depending on their shapes: truncated, triangular, nodular, assimilated type and
11. Bi-lingular distance

The distances from the MF to various landmarks and lingular parameters were calculated as an average of two measurements recorded independently by two people. Data were recorded separately for both sides and expressed as average (Avg) and

standard deviation (SD). The correlation between Go and other distances was analysed by the Pearson linear correlation test.

Antero-posterior localization of MF was obtained by identifying the distance between Ab of mandibular ramus and the mean point of the MF opening. This is calculated as follows: from the Ab-Pb subtract the sum of Ab- MF and MF-Pb. This gives the width of MF. This was divided into halves to get the mean point of MF opening and added to the distance Ab-MF. Then percentage of distance between Ab-mean point of MF with Ab-Pb distance was calculated to locate MF antero-posteriorly.

Vertical localization of MF is calculated by calculating how much MI-MF represented in percentage of the addition of MI-MF and MF-MB distances.

RESULTS

Average, standard deviation, minimum and maximum values of various parameters studied on either sides of mandible are shown in Table/Fig 2. It was found that there was no significant difference in the values on right and left sides.

The correlation between Go and other distances was analysed by the Pearson linear correlation test. The coefficient might vary from -1 to +1. Positive scores indicate a direct proportional correlation, negative scores indicate an inversely proportional correlation and zero indicates no correlation, p value being ? 0.05. As described in Table/ Fig 3 in the present study correlation of Go with other linear distances of the mandibular foramen were negative.

In Table/ Fig 4 the average values of various parameters of both sides is illustrated. The Avg measurement of shortest antero-posterior distance (Ab- Pb) of mandibular ramus passing through MF was found to be 3.07cm. Avg of Ab-MF was 1.62 cm, MF- Pb was 1.15 cm, MI-MF was 2.36 cm, MF- MB was found to be 2.32 cm. Avg measurement of Go of mandible was found to be 124.28 degrees.

Table/ Fig 5 shows that the centre of MF is located on a point 57.71% from the anterior border of ramus on an antero-posterior (AP) plane. If we divide the surface area of ramus into four quadrants of 25% each, this study locates MF centre to the third quadrant antero-posteriorly. At the same time on a supero-

inferior (SI) plane the MF was found to be at 50.41% from the MI, indicating that it is located at the junction of second and third quadrant on a SI plane.

This study found that nodular variety of lingula was the most common type (39 out of 100 sides), which was followed by truncated type (29 out of 100 sides), triangular (23 out of 100 sides) and assimilated type (9 out of 100 side) respectively. Table /Fig 6 shows the distribution of various types of lingula on right and left sides. Table / Fig 7 describes minimum, maximum, Avg and SD of the bi-lingular distance measured on 50 mandibles.

DISCUSSION

The localization of MF presented great variations, but in this study there was no significant variation between the right and left sides, which is in accordance with previous studies 2- 4

A study on 34 adult Turkish mandibles showed that Ab-MF were 16.9 mm and 16.78 mm on the right and left side respectively. MF-Pb was found to be 14.09 mm on the right and 14.37 mm on the left side. MI-MF was

22.37 mm on the right and 22.17 mm on the left side. MF- MB was 30.97 mm on the right and 29.75 mm on the left side. 5 According to the present study Ab-MF was 1.61 cm on the right side and 1.63 cm on the left side, MF-Pb was

1.17 cm on right side and 1.13 cm on left side, MI-MF was 2.36 cm on both right and left side, MF-MB was 2.35 cm on right side and 2.28 cm on left side.

IA nerve block is the most frequently used local anesthesia technique for restorative and surgical procedures on the mandible, with several millions being administered each year. According to previous studies, the traditional Halstead method showed 20% failure rate. Most common reason for failure of the technique was inappropriate location of the tip of anesthetic needle, due to inappropriate localization of the MF. 4, 6, 7 There are some anesthetic protocols which proclaim the utilization of long needles for IA nerve blockage. On an average long needles are 33mm long and short needles are 21.5mm long. 4 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 facial nerve branches. On the other hand, the use of short needles in big-sized mandibles might lead to needle fracture. 4

In this study the mean distance between Ab and MF was found to be 1.6 cm (Table /Figure 4), which is the ideal place for the anesthetic infiltration. The maximum value for the same parameter was found to be 2.1 cm and the minimum was 1.0 cm. According to the values of present study, IA nerve block would probably be accomplished with short needles.

Bilateral sagittal split osteotomy (BSSO) and vertical ramus osteotomy (VRO) are the common procedures done for the correction of mandibular prognathism, to reposition the mandible surgically. A thorough anatomical knowledge of mandibular ramus is essential for these procedures, since they are technically difficult procedures and are also associated with a higher incidences of complications.8,9 According to many studies, posterior and superior thirds of the ramus constitute a ‘safety zone’ where MF is unlikely to be found. This area can be used in VRO with low incidence of IA nerve damage. 10 In the present study also MF was found to be located in the third quadrant antero-posteriorly and junction of second and third quadrant supero-inferiorly (Table/ Fig 5) which is in accordance with older studies. 4, 10

Thus, familiarity with the described relationships of MF will assist in correct localisation of MF which, in turn might reduce the chances of an undesired split as well as IA nerve morbidity. Thus correct localization of MF will assist performing properly the split osteotomy procedures on mandible.

The average of Go was found to be 124.28 degrees in the present study which was similar to the findings of Ennes and Medeiros 4 but different from that described by other studies. 5 It is worthwhile observing that the Go was related to Ab-Pb width of mandibular ramus and to the distance between MF to the borders of ramus in an inversely proportional relation (Table/Fig 3) as was also found in some other studies .4, 11 This means that, in individuals with a wide Go, it is likely to accomplish IA nerve blockage with a puncture lower than the conventional one with short needles. In individuals with

a smaller Go, it is likely to accomplish IA nerve blockage with a puncture higher than the conventional one, with lower probability of success with short needles.

The lingula of the mandible is a sharp tongue-shaped bony projection on the medial aspect of ramus. It is an important landmark on the medial side of ramus as it is in close proximity to the MF. Hence both MF and lingula are of clinical significance for the orodental surgeons. According to a study conducted on 165 mandibles triangular lingulae were found in 226 sides, truncated in 52, nodular in 36 and assimilated in 16 sides. 12 Another study revealed that truncated lingulae were most commonly found (47%) which was followed by nodular (23%), triangular (17%) and assimilated shapes (13%).13 This study revealed that the nodular variety was the most common followed by truncated, triangular and assimilated varieties (Table/ Fig 6).

Conclusion: Since some investigators 7 have stated that anesthesia is essential for both the patients and the dentists

quoting that the opinion of patients on their dentists is strictly based on their experience with local anesthesia, it is

preferred to infiltrate the anesthetic solution in close proximity to MF in IA nerve block. Despite the great variation of MF, it should be kept in mind that it is located in the third quadrant 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 IA nerve.

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Conflict of Interest

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