Original Research Article

Three-dimensional analysis of mandibular lingula apex to guide the mandibular foramen location in North Indian population: a computed tomography study

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Abstract

Purpose: Mandibular lingula apex (MLA) acts as an important landmark for identifying the site for injection of local anesthetics during inferior alveolar nerve block. The authors aimed to determine the three-dimensional position of MLA to guide clinician for inferior alveolar nerve block and surgical procedures.**Methods:** Computed tomography (CT) images of 100 MLAs from 50 patients (12 females, 38 males) aged between 16-85 years were evaluated. Distances and angles from MLA to different anatomic landmarks on mandibular ramus were measured. Pearson's correlation was performed for the statistical comparisons.**Results:** The authors found that the shortest distance of MLA from ramus anterior, posterior, superior, inferior border and mandibular angle was 14.07 mm, 17.32 mm, 16.23 mm, 34.1 mm, and 30.9 mm respectively. The MLA was positioned nearly 1.63 mm behind the midpoint of the ramus horizontally and 8.94 mm above the midpoint vertically. Mandibular angle was 121.7 degree and MLA angle from inferior border was 87.74 degree. There was found no correlation between DLA and age and also there was strong positive correlation between DLA and height of ramus. A negative correlation was found between DLA and mandibular angle. **Conclusion:** The present study represents that CT provides reliable information about the position of MLA in relation to different anatomical landmarks of mandibular ramus which may help in successful and safe treatment procedures with reduced complications. MLA distance from anterior border of ramus will be more with increased ramus height and decreased mandibular angle and also vice versa, which may be helpful to give an accurate location of MLA during inferior alveolar nerve block procedure.

Key words: Computed tomography; Local anesthetics; Ramus; Inferior alveolar nerve.

Introduction

Background: Mandibular anesthesia is mainly got by the inferior alveolar nerve block (IANB)[1]. Clinicians uses IANB in the cases of restorative, surgical and endodontic procedures[2,3]. Common problems, with as many as 20% of inferior alveolar nerve blocks reported are failure of mandibular anesthesia and complications like pain, trismus, hematoma, facial nerve paralysis, inferior alveolar nerve injury and ocular problems[1,4-7]. Failure of mandibular anesthesia occurs due to uncertainty of location of mandibular foramen.The medial boundary of the mandibular foramen is formed by a tongue shaped bony projection called mandibular lingula. The apex of mandibular lingula, named mandibular lingula apex (MLA) is a good anatomic landmark used to determine the position of the mandibular foramen for success of inferior alveolar nerve anesthesia and reduce complications. Mandibular lingula is also a good anatomical landmark during maxillofacial surgery procedures.1,7 Computed tomography (CT) provides high resolution images in three dimensions of MLA.

Objectives: The objective of this study was to determine the distance of MLA from different anatomical landmarks of mandibular ramus that navigate operators for the most reliable and accurate approach. Also determine the correlation of the distance of MLA from the anterior border of ramus to age, height of the ramus and mandibular angle.

Material and Methods

This retrospective study was conducted on CT scans (with face view, PNS view and Brain view) of patients who visited radiology department, in a medical college (where this study was done), from July 2019 to July 2020. Before the study, ethical approval letter was taken from the ethical committee (registration number: ECR/1394 /Inst/RJ/2020). The CT images were taken with the use of Brillance-64, Philips, India, 2011 machine, 3-4.148 seconds at 120 kVp and 30 mAs with resolution of 768 × 768 and 1 mm-thick slices. The images were acquired according to the manufacturer's instructions by an experienced radiologist. Slices from a patient CT scan were reformatted in to a 3D image. Measurements were done on this 3Dimage.Convenience sampling method was used for sample selection and determining the sample size. CT images of 100 MLAs from 50 patients of 16-85 years of age were considered for this study.The shortest distances of MLA from anterior border of the ramus (DLA), posterior border of the ramus (DLP), superior border of the ramus (DLS), inferior border of the ramus (DLI), mandible angle (DLMA), anteroposterior center point (DLAPC) and superoinferior center point (DLSIC) were measured in millimeters (Fig. 1.). Also, angle at the mandibular angle (AMA)(Fig. 2) and angle of lingula apex from inferior border of ramus (ALI)(Fig. 3) were measured. Pearson's correlations were measured between DLA and age, ramus height and mandibular angle.

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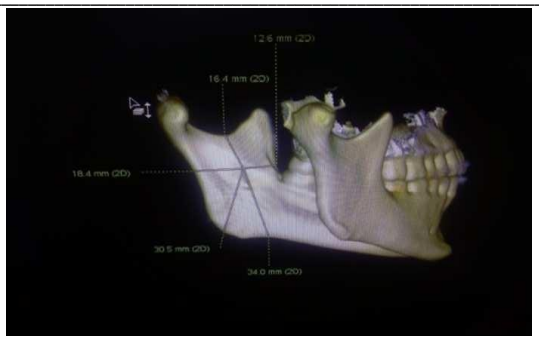

Fig 1: Mandibular lingula apex distance from anterior, posterior superior, inferior borders and mandibular angle in 3D reformatted CT image.

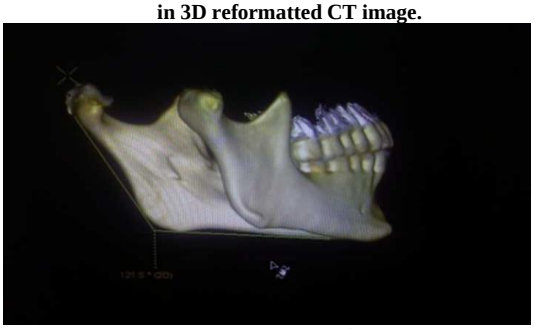

Fig 2: Mandibular angle in 3D reformatted CT image.

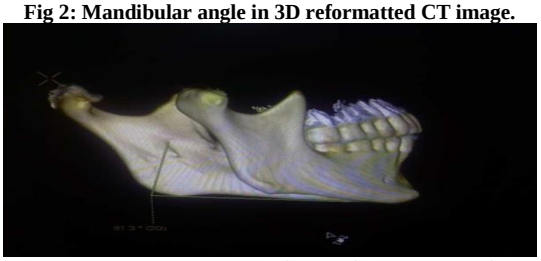

Fig. 3:Mandibular lingula apex angle from inferior border of mandible in 3D reformatted CT image.

Inclusion and exclusion Criteria:

Inclusion criteria

1.Patients CT scans with face view or PNS view or brainview.

2.Patients were between 16 to 85 years ofage from North India.

Exclusion criteria

1.Patients were having pathologic lesion/lesions which causing asymmetry and deviation of themandible.

2.Patients were having fractured mandible

Results

In this study, mean age was 35.55 ±15.8. Table 1 gives the measurements of the distances and angles between MLA and the specific points.The mean DLA was14.07±2.46 mm and mean DLP was 17.32 ± 1.95 mm, whereas the mean DLS, mean DLI and mean DLMA were 16.23 ± 2.73 mm, 34.1 ± 4.24 mm and 30.9 ± 4.03 mm respectively. The mean of center point of anteroposterior width was on 15.69 ± 1.52 mm and mean of center point of superoinferior height was on 25.17 ± 2.20. The mean DLAPC was 1.63 ± 1.62 mm backwards. The mean DLSIC was 8.94 ± 2.81 mm upwards. The mean values of AMA and ALI were 121.7 ± 6.64 and 87.74 ± 6.95 respectively (Table 1).

Table 1: Measurements of the distances and angles between MLA* and the specific points.

S.No.	Measurement	Mean ± Standard deviation
1	Shortest distance from MLA to anterior border of ramus (DLA)	14.07 ± 2.46 mm
2	Shortest distance from MLA to posterior border of ramus (DLP)	17.32 ± 1.95 mm
3	Shortest distance from MLA to superior border of ramus (DLS)	16.23 ± 2.73 mm
4	Shortest distance from MLA to inferior border of ramus (DLI)	34.1 ± 4.24 mm
5	shortest distance from MLA to mandibular angle(DLMA)	30.9 ± 4.03 mm
6	Mandibular angle (AGA)	121.7 ± 6.64 degree
7	MLA angle from inferior border (ALI)	87.74 ± 6.95 degree
8	Anteroposterior centre point (APC)	15.69 ± 1.52 mm
9	Distance of MLA from anteroposterior centre point (DLAPC)	1.63 ± 1.62 mm backwards to the center point
10	Superoinferior centerpoint (SIC)	25.17 ± 2.20 mm
11	Distance of MLA from superoinferior center point(DLSIC)	8.94 ± 2.81 mm upwards to the center point

***MLA denotes mandibular lingula apex**

Strong positive correlation was found between DLA and ramus height and significant negative correlation was found between DLA and mandibular angle. No correlation found between DLA and patient's age(Table 2).

Table 2: Pearson's correlations between DLA* and age, ramus height, and mandibular angle.

S.No.	Measurements	r	P
1.	Age and DLA	0.173885	0.083596
2.	Ramus height and DLA	0.316516	0.001335@
3.	Mandibular angle and DLA	-0.22219	0.026296@

***DLA denotes shortest distance of mandibular lingula apex from anterior border of ramus. @ Shows statistical significance at P < 0.05.**

Discussion

The knowledge of MLA position is important to get an effective anesthesia and reduce complications during different procedures in dental department[8]. Researchers have been studied to investigate the position of MLA using dry mandible and different radiographic techniques[9,10]. CT provides an image produced has minimal unequal magnification and distortion and produces more reliable and accurate data.In the present study, the position of MLA in 3-dimension image was measured relative to the anatomical landmarks in the mandibular ramus.The authors found that the shortest distance of mandibular lingula apex to anterior border was 14.07 mm, to the posterior border was 17.32 mm, to the superior border was 16.23 mm and to the inferior border was 34.1 mm. These results are different from a study done by Sandhya K et al and Feuerstein D et al. These differences may be due to regional differences and different study method. Results clearly showed that MLA was positioned nearly 1.63 mm behind the midpoint of the ramus horizontally and 8.94 mm above the midpoint vertically. Mandibular angle was 121.7 degree and MLA angle from inferior border was 87.74 degree. Shortest distance of mandibular lingula apex to anterior border (DLA) is most important measurement during the insertion of local anesthetic injection. So, Pearson's correlation of this distance was been measured with age, mandibular angle and ramus height (Table 2). In this study, there were no correlation between DLA and age. This may be due to end of growth at age of 16-18 years and after that an increase in size of mandibular ramus is not expected. This finding was similar in lines to the study conducted by Aglarci OS et al.15 While there was a strong positive correlation was found between DLA and ramus height, this shows that the DLA will be more when the height of the ramus is more and vice versa. There was negative correlation was found between DLA and mandibular angle. So, the DLA will be more when mandibular angle is less and vice versa[10-15]

Conclusion

The present study represents that CT provides reliable information about the position of MLA in relation to different anatomical landmarks which may help in successful and safe treatment procedures with reduced complications. MLA located just postero superior of the midpoint of the ramus. MLA distance from anterior border of ramus will be more with increased ramus height and decreased mandibular angle and vice versa. Mandibular lingula apex distance from anterior border of ramus is not affected with the age after attaining the age ofmaturity.As a limitation of the study, the measurements were not analyzed by race or ethnicity. In future more research conducted on CT technologies and wide patient groups are needed.

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