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Original Research Article

Morphological and Morphometric Study of Lingula & Mandibular Foramen in Dry Adult Human Mandibles and its Clinical Significance

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Abstract

Background: The morphometric determination of position of the lingula is essential while performing osteotomy of mandible. Also, mandibular foramen is used as an anatomical landmark in various surgeries and other invasive procedures**.** The present study provides the data on morphology and morphometry of lingula & mandibular foramen which will be helpful for the surgeons during different procedures on and around the mandible.

Materials and Methods: The present study was performed in the Department of Anatomy of a tertiary care hospital, Mumbai, India. Morphology and morphometry of lingula & mandibular foramen of 100 dry adult human mandibles were recorded. Serial number was given to each mandible from 1 to 100. Gloves, thread & scale were used for the measurement of various parameters.

Result: In the present study, shape of the lingula was found triangular in 56%, truncated in 27.5%, assimilated in 10% and nodular in 6.5% of the mandibles considering both sides.

Single mandibular foramen was observed in all the mandibles. The mandibular foramen was present in all the mandibles. Out of 3 mandible, 1 bilateral and 2 right unilateral accessory mandibular foramen (4%) were noted. Also, the measurement of distance of mandibular foramen from different points on the mandible were recorded in this study.

Conclusion: The knowledge of the morphology and morphometry of lingula & mandibular foramen will help dentists, anaesthetists and surgeons in various clinical procedures and to prevent complications during these interventions.

Keywords: Lingula, Mandibular foramen, Mandibular notch, Osteotomy.

Introduction

Mandible is the largest and strongest bone in the human facial skeleton. It forms the lower jaw and holds the lower teeth in place. It consists of curved horizontal body portion and two rami, which unite with the ends of the body nearly at right angles. [1]

When performing the sagittal split ramus osteotomy (SSRO) the exact location of the lingula is crucial, since the osteotomy is performed at the region around the lingula of the mandible during the medial horizontal osteotomy. [2] Hence, the morphometric determination of position of the lingula is essential.

Mandibular foramen is a critical anatomical landmark in surgeries, for local anesthetic and other invasive procedures**.** In patients with partial or total edentulous jaw, the disappearance of alveolar portion of the mandible brings the mandibular canal close to the superior border and when these patients are evaluated for placement of implants, the distance between the canal and the superior surface of bone needs to be carefully determined to avoid surgical injury to inferior alveolar nerve**.** [3]

Materials and Methods

The present study was undertaken in the Department of Anatomy of a tertiary care hospital, Mumbai, India. Morphology and morphometry of lingula & mandibular foramen of 100 dry adult human mandibles were noted from the bone library of the Department of Anatomy. Approval of the Institutional Ethics Committee was taken prior to commencement of this study.

Inclusion Criteria: All dry adult mandibles of undetermined age and gender were taken for the present study.

Exclusion Criteria:

1. Damaged, mutilated and deformed mandibles were excluded.
2. Mandibles affected due to any pathology were excluded.

Serial number were given to each mandible and they were labelled from 1 to 100. Gloves, thread & scale were used for the measurement of various parameters.

Methods: The measurements were taken by using above mentioned instruments

1. Shape of lingula:

The shape of lingula was observed whether it was:

- Triangular (Tr) (Fig. 1)
- Truncated (Tc) (Fig. 2)
- Nodular (N) (Fig. 3)
- Assimilated (A) (Fig. 4)

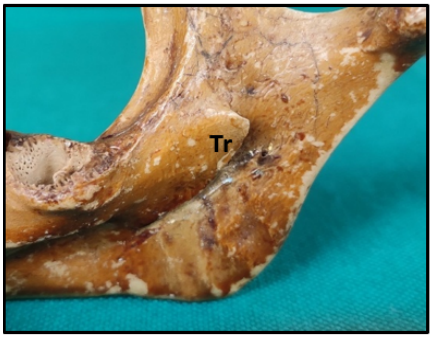


Figure 1: Illustration showing triangular shape of lingula

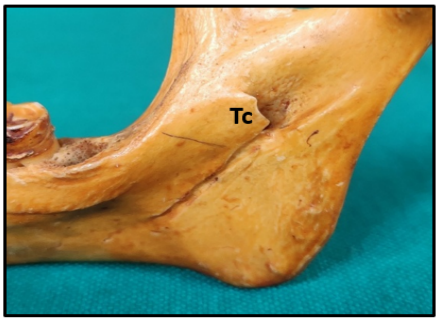


Figure 2: Illustration showing truncated shape of lingula

Figure 3: Illustration showing nodular shape of lingula

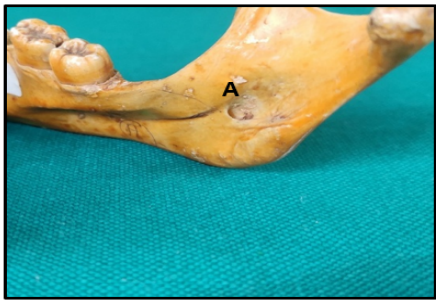


Figure 4: Illustration showing assimilated lingula

2. Number of mandibular foramina: Number of mandibular foramina were noted. (Fig. 5)

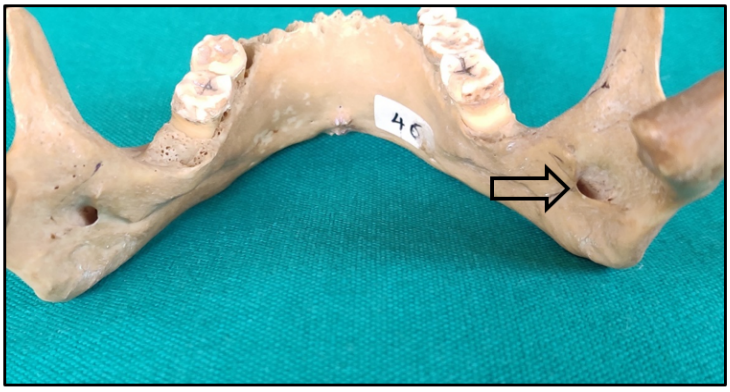


Figure 5: Illustration showing single mandibular foramen

3. Location of mandibular foramen:

Location of mandibular foramen in relation to anterior, posterior, inferior border of ramus and mandibular notch was determined as follows: (Fig. 6)

- Point A - anterior border of ramus
- Point B - posterior border of ramus
- Point C - intersection of line AB with the tip of lingula
- Point D - most caudal point of mandibular notch
- Point E - inferior border of mandible
- AC: distance from the anterior border of ramus to the most superior part of lingula (Fig. 7)
- CB: distance from the most superior part of lingula to the posterior border of ramus (Fig. 8)
- DC: distance from the most caudal point of the mandibular notch to the most superior part of lingula (Fig. 9)
- CE: distance from the most superior part of lingula to the inferior border of mandible (Fig. 10)

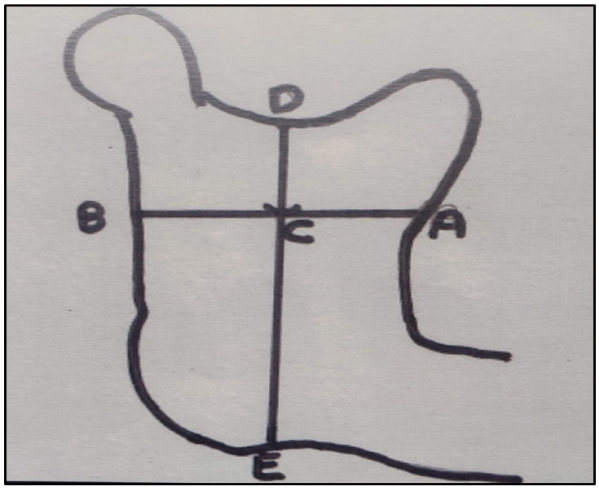


Figure 6: Illustration showing location of mandibular foramen in relation to anterior, posterior, lower border and ramus of mandible (schematic diagram)

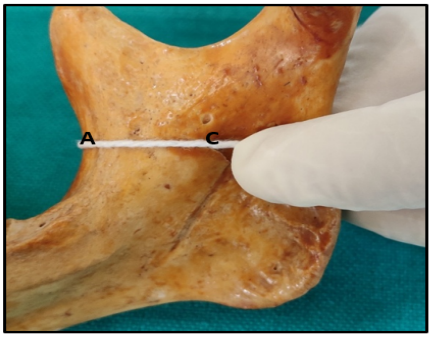


Figure 7: Illustration showing distance AC

Figure 8: Illustration showing distance CB

Where, A - anterior border of mandible, B - posterior border of ramus and C - most superior part of lingula

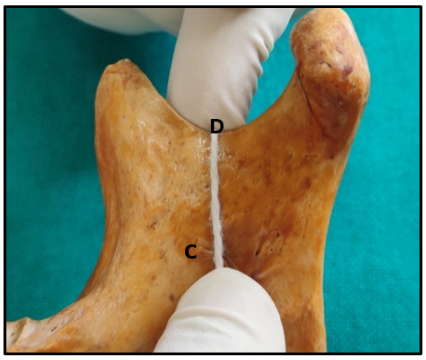


Figure 9: Illustration showing distance DC

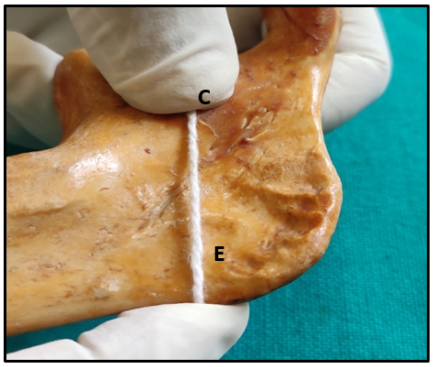


Figure 10: Illustration showing distance CE

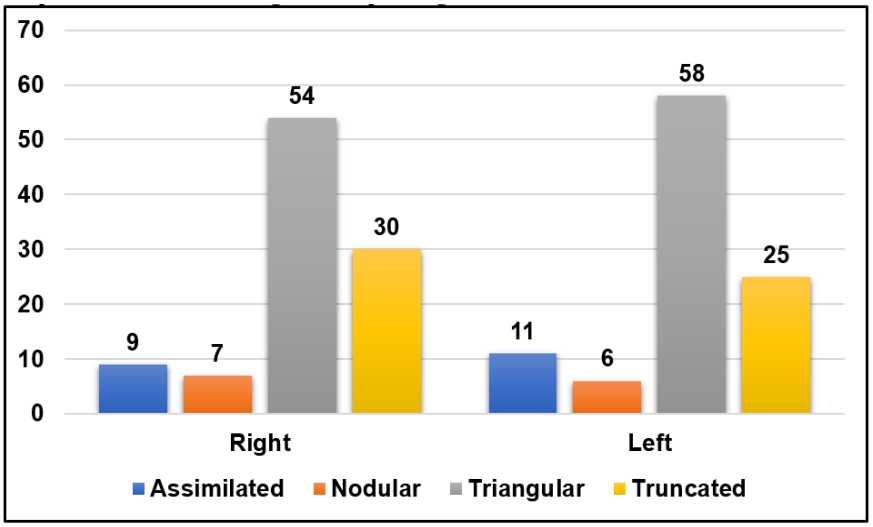
Where, C - most superior part of lingula, D - mandibular notch of ramus and E - inferior border of ramus

Results:

Table 1: Distribution according to the shape of lingula

Side	Shape of lingula			
	Assimilated	**Nodular**	**Triangular**	**Truncated**
Right	9	7	54	30
Left	11	6	58	25
Total	20	13	112	55

In the present study, shape of the lingula was found triangular in 56%, truncated in 27.5%, assimilated in 10% and nodular in 6.5% of the mandibles considering both sides.



Graph 1: Distribution according to the shape of lingula

Table 2: Distribution according to the number of mandibular foramen

Side	Number of mandibular foramen		
	Absent	Single	Double
Right	0	100	0
Left	0	100	0

In the present study, single mandibular foramen was observed in all the mandibles. The mandibular foramen was present in all the mandibles. Out of 3 mandible, 1 bilateral and 2 right unilateral accessory mandibular foramen (4%) were noted.

Table 3: Distribution according to the location of the mandibular foramen in relation to anterior, posterior, inferior border of the ramus and the mandibular notch (mm)

Parameter	AC		CB		DC		CE	
Side	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**
Mean (mm)	21.07	21.43	17.86	17.46	19.15	19.10	32.20	32.04
Standard Deviation	2.44	2.59	2.60	2.70	3.32	3.32	3.96	4.06
Range (mm)	14 - 30	15 - 30	10 – 24	11 - 23	13 - 30	13 - 30	20 - 42	20 - 42

Where,

AC: Distance from the anterior border of ramus to the most superior part of lingula

CB: Distance from the most superior part of lingula to the posterior border of ramus

DC: Distance from the most caudal point of the mandibular notch to the most superior part of lingula

CE: Distance from the most superior part of lingula to the inferior border of mandible

In the present study,

AC: The distance along the line of AC, on the right side ranged from 14 - 30 mm with a mean of 21.07 ± 2.44 mm.

While, the distance along the line of AC, on the left side ranged from 15 - 30 mm with a mean of 21.43 ± 2.59 mm.

CB: The distance along the line of CB, on the right side ranged from 10 - 24 mm with a mean of 17.86 ± 2.60 mm.

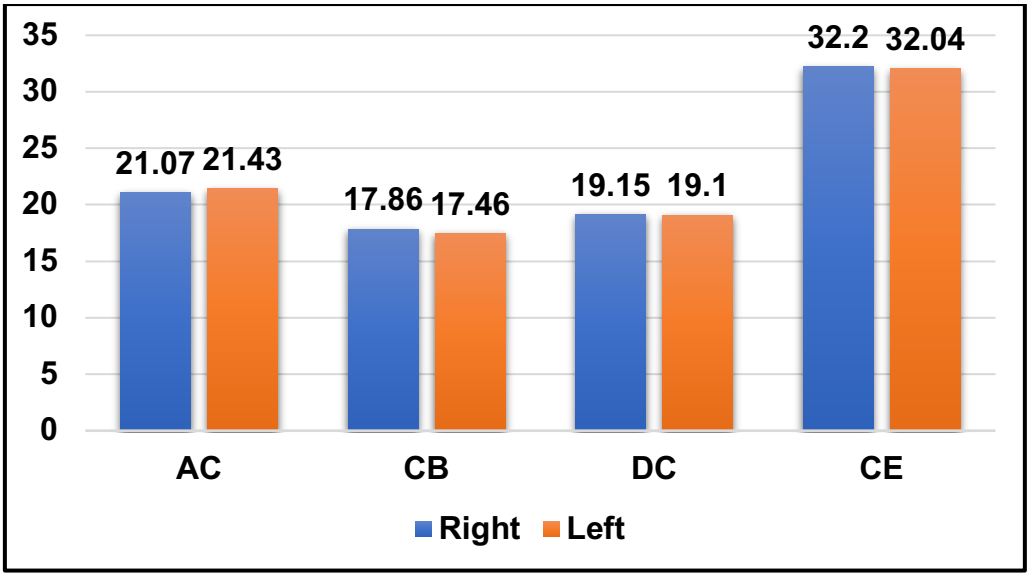
While, the distance along the line of CB, on the left side ranged from 11 - 23 mm with a mean of 17.46 ± 2.70 mm.

DC: The distance along the line of DC, on the right side ranged from 13 - 30 mm with a mean of 19.15 ± 3.32 mm.

While, the distance along the line of DC, on the left side ranged from 13 - 30 mm with a mean of 19.10 ± 3.32 mm.

CE: The distance along the line of CE, on the right side ranged from 20 - 42 mm with a mean of 32.20 ± 3.96 mm.

While, the distance along the line of CE, on the left side ranged from 20 - 42 mm with a mean of 32.04 ± 4.06 mm.



Graph 2: Distribution according to the location of the mandibular foramen in relation to anterior, posterior, inferior border of the ramus and the mandibular notch (mm)

Discussion

The proper anatomical knowledge of various parameters of the mandible is crucial to perform various surgical procedures such as local anaesthetic block, tooth extraction, dental implants, various osteotomies and corrective surgeries. Understanding the location of various anatomical landmarks and location of mandibular foramen helps to deliver complete anaesthetic block and to prevent any complication. It may be useful in developing the minimal invasive surgeries which will provide better post-operative results. In the past, various qualitative and quantitative anatomical studies have been conducted on adult mandibles by many authors across the world. Many authors have studied the various parameters of mandible using different materials such as dry bones, cadaveric specimens, plain radiographs, Computed Tomography (CT) scans and Magnetic Resonance Imaging (MRI) scans. The following tables present the comparison of morphology of lingula and means morphometry of mandibular foramen of present study with previous studies.

The measurements of different morphological and morphometric parameters of mandible in present study have been considered for comparisons.

Table 4: Comparison of the shape of lingula with previous studies

Study	Country	Sample Size	Shape Of Lingula (%)			
			Triangular	Truncated	Nodular	Assimilated
Lopez PT et al. [4]	Brazil	80	41.30	36.30	10.5	11.9
Sanmugam K [5]	India	100	48	26	7	19
Srimani P et al. [6]	India	36	51.39	23.61	20.83	4.17
Present study	**India**	**100**	**56**	**27.5**	**6.5**	**10**

In the present study, the most common shape of the lingula was found as triangular, which was followed by truncated shape. The findings of the present study were comparable with the study done in India and abroad.

Table 5: Comparison of the number of mandibular foramens with past studies

Study	Country	Material	Accessory Mandibular Foramen (%)
Lopez PT et al. [4]	Brazil	Dry bones 80	Right - 11.3 Left - 3.8
Shalini R et al. [7]	India	Dry bones 204	32.36
Covantev S et al. [8]	Republic of Moldova	Dry bones 50	4
Present study	**India**	**Dry bones 100**	**4**

In the present study, incidence of the accessory mandibular foramen was 4%, which was comparable with the study done by Covantev S et al. [8] The other studies done in India and abroad have shown variable incidence. The knowledge of variation in the mandibular foramen and canal is surgically important to provide complete anaesthetic block of inferior alveolar nerve.

Table 6: Comparison of the location of mandibular foramen with other studies

Study	Country	Material	Mean Distance (mm)				
			Side	AC	CB	DC	CE
Hoque MM et al. [9]	Bangladesh	Dry bones (185)	Rt	16.34	14.14	22.29	-
			Lt	16.27	14.04	22.18	-
Padmavathi G et al. [10]	India	Dry bones (65)	-	21.30	19.60	18.60	36.10
Srimani P et al. [6]	India	Dry bones (36)	-	18.21	16.33	18.17	32.07
Rajkumari K et al. [11]	India	Dry bones (50)	Rt	16.77	11.05	22.93	22.96
			Lt	16.90	11.21	23.15	23.64
Jain N et al. [12]	Latvia	Dry bones (125)	Rt	16.88	12.31	17.41	-
			Lt	17.33	11.75	18.01	-
Present study	**India**	**Dry bones (100)**	**Rt**	**21.07**	**17.86**	**19.15**	**32.20**
			Lt	**21.43**	**17.46**	**19.10**	**32.04**

Where, Rt: Right, Lt: Left

- AC: Distance from the anterior border of ramus to the most superior part of lingula
- CB: Distance from the most superior part of lingula to the posterior border of ramus
- DC: Distance from the most caudal point of the mandibular notch to the most superior part of lingula
- CE: Distance from the most superior part of lingula to the inferior border of mandible

In the present study, the values of the mean distances AC, CB, DC and CE found were 21.07 mm, 17.86 mm, 19.15 mm and 32.20 mm on right side; while they were 21.34 mm, 17.46 mm, 19.10 mm and 32.04 mm on left side. These observations were like the studies conducted by Padmavathi G et al [10] and Srimani P et al. [6]

Conclusion:

The present study provides a comprehensive data about the morphology and morphometry of lingula & location of mandibular foramen of dry adult human mandibles. The knowledge of distances of surgically important anatomical landmark in the present study provides necessary information to dental surgeons that will help them in correct localization of neurovascular bundle. The data obtained from the present study will help dentists, anaesthetists and surgeons in various clinical interventions and to prevent complications related to the various surgical procedures.

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