

# An Anatomical Study of Dry Mandibles to Determine the Important Surgical Reference Points in Ramus Osteotomy - An Evaluative Study

Asha K. R., Thejeshwari H. G., Archana Belavadi Jagadish, Mansour A. Alghamdi<sup>1</sup>, Vidya H. K., Honnegowda Thittamaranahalli Muguregowda<sup>1</sup>

Department of Anatomy, Siddaganga Medical College and Research Institute, Tumakuru, Karnataka, India, <sup>1</sup>Department of Anatomy, College of Medicine, King Khalid University, Abha, Saudi Arabia

## Abstract

**Introduction:** The variable relation and clinical significance of mandibular foramen (MF) and *Lingula* with inferior alveolar neurovascular bundle (IANB) is important for dental surgeons. Knowing the landmarks on the ramus of the mandible is of paramount importance to perform the surgery without causing damage to the neurovascular bundle. **Materials and Methods:** This study was conducted on 85 dry adult mandibles of unknown sex and age. The distances were measured from the anatomical reference points (anti-*Lingula*, *Lingula* and MF) using digital callipers. **Results:** The distance from the anti-*Lingula* to the anterior border of the ramus (A) was significantly longer on the right side (14.91 mm) than on the left side (14.5 mm). There was a significant difference in mean distances between the anti-*Lingula* and MF of both the sides ( $P \leq 0.005$ ). No significant difference was noted in the distances between the *Lingula* and the Anti-*Lingula*, observed for the posterior (B,  $P = 0.75$ ) and the inferior margin of the mandible (D,  $P = 0.54$ ). However we found correlation of vertical distances of anti-*Lingula* with *Lingula* and MF exhibited moderate positive correlation. **Discussion:** The IANB is prone to damage during mandibular surgery. Using anti-*Lingula* alone as a reference point is not guaranteed, but it is still an important anatomical landmark for the surgeon to operate.

**Keywords:** Anti-*Lingula*, inferior alveolar neurovascular bundle, *Lingula*, mandibular foramen

## INTRODUCTION

The mandibular foramen (MF) is located above the centre in the medial surface of the ramus of the mandible, through which it penetrates the inferior alveolar neurovascular bundle (IANB).<sup>[1,2]</sup> The correct identification of MF and IANB is important to avoid complications during the performance of surgical procedures. *Lingula* is a tongue-shaped projection on the medial side of the ramus of the mandible. However, clinically it is very challenging to perform ramus osteotomy directly observing the location of the IANB from the medial side of the ramus.<sup>[2]</sup> This identifies the most important landmarks to take into consideration when performing ramus osteotomy. Several long-term studies have been conducted to determine anatomical reference points to minimise or prevent neurovascular structures.

IANB is related to MF through which it passes into the mandible, and the protruding anatomical structure *Lingula* lies medial to foramen. Corresponding to the *Lingula*, on

the lateral side of the ramus, there is a bony tubercle or prominence called anti-*Lingula*, which acts as anatomical landmark on the lateral of the ramus to perform vertical osteotomy.<sup>[3]</sup> Although there were studies available in the literature on the anti-*Lingula*, *Lingula* and MF,<sup>[4-6]</sup> very few studies have been published with regard to a South Indian population on direct measurement and its correlation in the adult dry mandibles. This study intended to locate the important landmarks (anti-*Lingula*, *Lingula* and MF) on the

**Address for correspondence:** Dr. Honnegowda Thittamaranahalli Muguregowda, Department of Anatomy, College of Medicine, King Khalid University, Abha 61421, Aseer Region, Saudi Arabia. E-mail: honnegowda33@gmail.com

Received: 28-01-2023

Last Revised: 20-04-2023

Accepted: 11-05-2023

Published: 30-06-2023

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow\_reprints@wolterskluwer.com

**How to cite this article:** Asha KR, Thejeshwari HG, Jagadish AB, Alghamdi MA, Vidya HK, Muguregowda HT. An anatomical study of dry mandibles to determine the important surgical reference points in ramus osteotomy-An evaluative study. *Ann Maxillofac Surg* 2023;13:9-12.

### Access this article online

Quick Response Code:



Website:  
<https://journals.lww.com/aoms>

DOI:  
10.4103/ams.ams\_19\_23

dry mandible of an adult South Indian population and to find the correlation between the position of the anti-Lingula with respect to the Lingula and the MF.

## MATERIALS AND METHODS

This study was conducted on the dry mandibles of 85 adult cadavers with age and sex unknown. Ethical approval was obtained from the Institutional Review Committee (Reference Number: KMC/29/2019). A digital calliper with accuracy of 0.001 mm was used to measure all the parameters. To remove the measuring bias, each measurement was performed by two measurers and the average was noted. The measurement reference points were 'anti-Lingula', 'Lingula' and 'MF'. Anti-Lingula was the notably prominent point on the lateral surface of the mandibular ramus and was confirmed by visual and tactile measurements. Lingula is a bony projection over and medial to MF.

All the distances were measured placing the lower margin of the mandible vertically on the platform on a flat and firm surface. The points taken for measurements were the most prominent point on anti-Lingula, tip of Lingula and most anterior, posterior and inferior points of MF.<sup>[7]</sup> The measurements were denoted as A – anterior, B – posterior, C – superior and D – inferior distances on the ramus of the mandible, respectively [Figure 1].

### Statistical analysis

Data were expressed in mean and standard deviation (SD) and Student's *t*-test was applied to compare the mean distances of anti-Lingula with respect to Lingula and MF. The normality of the data was checked by the Shapiro–Wilk test. Pearson's correlation coefficients were performed to examine the correlations. Statistical analysis was performed using the Statistical Package for the Social Sciences version 20<sup>th</sup> (SPSS, Chicago, IL, USA).

## RESULTS

The anti-Lingula was located a mean of 15.0 mm (SD = 1.80) inferior from the mandibular notch (C) and 14.71 mm (SD = 1.91) posterior from the anterior border of the ramus. The Lingula was located an average of 15.5 mm (SD = 3.4) inferior from the mandibular notch (B) and 17.89 mm (SD = 1.9) posterior from the anterior border of the ramus. The MF was located an average of 24.35 mm (SD = 2.0) inferior from the mandibular

notch and 14.75 mm (SD = 2.4) posterior from the anterior border of the ramus [Table 1]. Significant difference was noted in mean distances between the anti-Lingula and MF of both the sides ( $P \leq 0.005$ ) and also in the distances between the Lingula and the anti-Lingula observed for the posterior (B,  $P = 0.75$ ) and the inferior margin of the mandible (D,  $P = 0.54$ ). Statistically, the anti-Lingula and Lingula (Pearson's correlation coefficient [ $r$ ] = 0.815,  $P = 0.025$ ) and the anti-Lingula and MF ( $r = 0.781$ ,  $P = 0.041$ ) when correlated vertically exhibited moderate positive correlation [Figure 2a and b], but the horizontal correlations between the anti-Lingula with Lingula and with MF were weak and statistically insignificant [Figure 3a, b and Table 2].

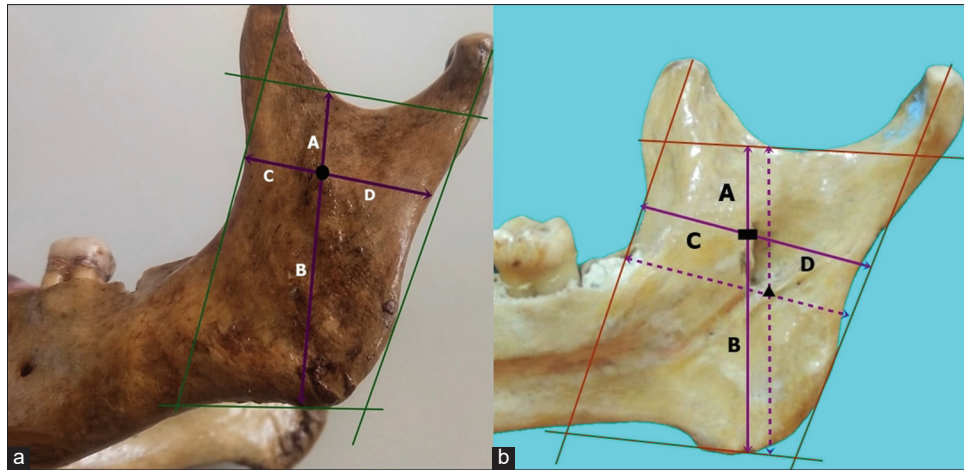
## DISCUSSION

To prevent the complication of damage to the inferior alveolar neurovascular bundle [IANB] during surgery, many studies have attempted to develop novel techniques to avoid damage to the IANB during osteotomy of the lateral side of the ramus.<sup>[8]</sup> Many studies have also been conducted to locate the anatomical placement of the IANB in the lateral side of the ramus in order to establish the theoretical underpinnings of these surgical procedures.<sup>[8-12]</sup> The anti-Lingula, a raised protrusion or tubercle, is visible on the lateral side of the ramus. Yates *et al.*,<sup>[13]</sup> the first to recognise and document a connection between the anti-Lingula and the MF in 70 dry mandibles, found that the prevalence of the anti-Lingula was 44% and asserted that although the anti-Lingula is a very changeable anatomical marker, the posterior 5–10 mm of the structure is safe for surgery. Similarly, a study by Apinhasmit *et al.*<sup>[14]</sup> on 92 dry mandibles recorded the prevalence of anti-Lingula to be 80.4%. Pogrel *et al.*<sup>[15]</sup> determined anti-Lingula in all mandibles in 20 cadavers and a similar study by Aziz *et al.*<sup>[16]</sup> found anti-Lingula on all study mandibles from 18 cadavers. From the above studies, it was noted that the Lingula were present in the posteroinferior region of the anti-Lingula. A study using three-dimensional computed tomography (CT) by Park *et al.*<sup>[17]</sup> noted that anti-Lingula was clinically identifiable in 46.7% in 25 patients with Class I occlusion, 44.4% in 50 patients each with mandibular prognathism and 45.3% with mandibular retrognathism respectively and reported the anti-Lingula as an excellent intraoperative reference point. Contrary to a previous study, Hogan and Ellis<sup>[18]</sup> reported that the anti-Lingula is not an anatomical marker and is not appropriate as a surgical guide for osteotomy.

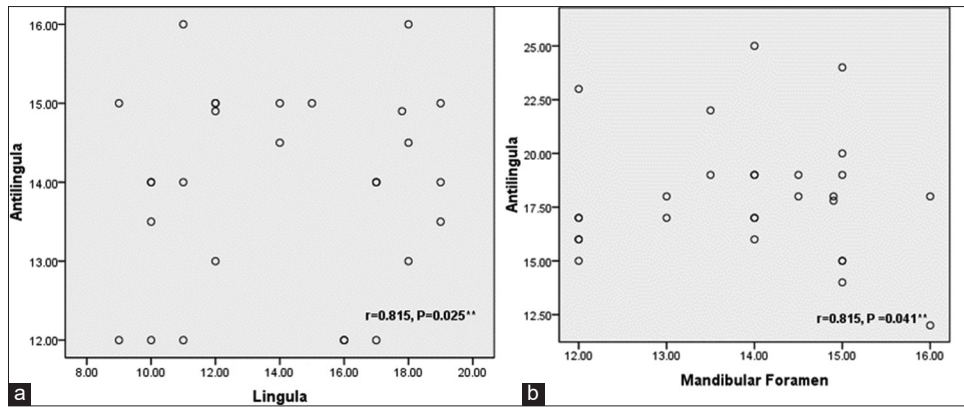
**Table 1: Mean value and standard deviation for each anatomic point**

Anatomic points	Measurements, mean ± SD (mm)							
	A		B		C		D	
	Right side	Left side	Right side	Left side	Right side	Left side	Right side	Left side
Anti-Lingula	14.91±1.80	14.5±1.0	31.62±1.65	32.1±1.65	15.0±3.5	14.7±1.91	21.59±3.74	20.1±1.3
Lingula	17.8±1.90	17.0±2.7	27.80±1.9	27.0±1.91	15.50±3.4	15.1±2.1	32.89±3.0	33.2±1.5
Mandibular foramen	14.50±2.31	15.0±2.7	12.50±3.6	11.1±2.5	25.5±2.2	23.2±2.9	22.56±2.5	21.80±2.3

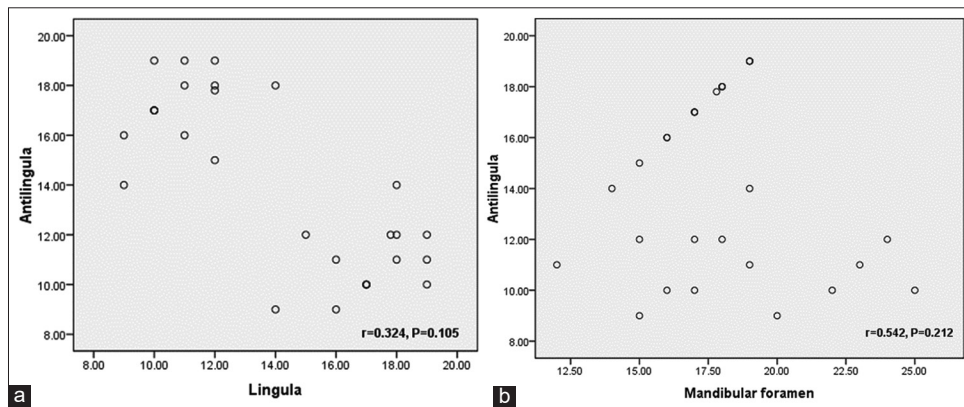
SD: Standard deviation



**Figure 1:** (a) Anti-Lingula (black circle) the most prominent point on the lateral surface of the mandibular ramus. (b) Lingula (black square) most superior point of the lingual and mandibular foramen (black triangle) the lowest point of the entrance of the IANB into the mandible



**Figure 2:** Correlation of vertical distance. (a) Anti-Lingula with Lingula. (b) Anti-Lingula with mandibular foramen



**Figure 3:** Correlation of horizontal distance (a) Anti-Lingula with Lingula. (b) Anti-Lingula with mandibular foramen

In some studies, anti-Lingula was not found and it was thought that there was difficulty in setting the anti-Lingula<sup>[6-9]</sup> and a study by Monnazzi *et al.*,<sup>[4]</sup> on 44 dry mandibles concluded that anti-Lingula cannot be recommended as a landmark for ramus osteotomy. In our study, we found that the anti-Lingula was the most prominent part on the lateral side of the ramus, which was validated by both visual and palpation methods.

With the advent of recent imaging technologies such as CT and magnetic resonance imaging aiding in confirming the course of the IANB before surgery, it is necessary to confirm the accurate structural anatomy of the mandible to reduce the associated risk in surgery.<sup>[9]</sup> The Lingula and MF are highly variable structures and difficult to visually identify and palpate when performing vertical ramus osteotomy; however, anti-Lingula is the most prominent part of the lateral side of

**Table 2: Correlation of anti-Lingula with Lingula and mandibular foramen**

	Lingula		Mandibular foramen	
	r	P	r	P
Anti-Lingula (vertical)	0.815	0.025**	0.781	0.041**
Anti-Lingula (horizontal)	0.324	0.105	0.542	0.212

\*\* $P \leq 0.05$  is considered statistically significant. *r*: Pearson's correlation coefficient

the ramus and is easy to locate and it can be highly useful as a reference point.

## CONCLUSIONS

To perform safe and accurate surgery without damaging the IANB, we recommend a posterior area of more than 10 mm from the posterior border of the ramus and a superior area of more than 16.80 mm from the sigmoid notch. The prevention of IANB damage cannot be guaranteed using anti-Lingula alone as a reference point; however, if the surgeon is able to correlate the overall anatomy of the ramus of the mandible during surgery, the success rate would be higher.

## Limitation of the study

The current study used dry mandibles of adults of unknown sex and age; therefore, further fresh mandibles of cadavers with a bigger sample size are required. In addition, due to the different anatomical characteristics of each individual, it is always advisable to identify the anatomy of the patient through pre-operative imaging to avoid any damage during surgery.

## Financial support and sponsorship

Funded by Deanship of Scientific Research at King Khalid University Under grant number RGP1/239/44.

## Conflicts of interest

There are no conflicts of interest.

## REFERENCES

1. Standring S. Gray's anatomy: The anatomical basis of clinical practice, 40<sup>th</sup> ed. London: Churchill Livingstone; 2008.
2. Leung YY, Wang R, Wong NSM, Li DTS, Au SW, Choi, et al. Surgical morbidities of sagittal split ramus osteotomy versus intraoral vertical ramus osteotomy for the correction of mandibular prognathism: A randomized clinical trial. *Int J Oral Maxillofac Surg* 2021;50:933-9.
3. Truong MK, He P, Adeeb N, Oskouian RJ, Tubbs RS, Iwanaga J. Clinical anatomy and significance of the retromolar foramina and their canals: A literature review. *Cureus* 2017;9:e1781.
4. Monnazzi MS, Passeri LA, Gabrielli MF, Bolini PD, de Carvalho WR, da Costa Machado H. Anatomic study of the mandibular foramen, lingula and antilingula in dry mandibles, and its statistical relationship between the true lingula and the antilingula. *Int J Oral Maxillofac Surg* 2012;41:74-8.
5. Zhao K, Hou Y, Zhang B, Wang R, Yuan H. CBCT study on the relationship between lingula and antilingula position in a Chinese Han population. *Surg Radiol Anat* 2019;41:663-7.
6. Park JH, Jung HD, Kim HJ, Jung YS, Park JH, Jung HD, et al. Anatomical study of the location of the antilingula, lingula, and mandibular foramen for vertical ramus osteotomy. *Maxillofac Plast Reconstr Surg* 2018;40:15.
7. Baena RY, Beltrami R, Tagliabo A, Rizzo S, Lupi SM. Differences between panoramic and cone beam-CT in the surgical evaluation of lower third molars. *J Clin Exp Dent* 2017;9:e259-65.
8. Akcay H, Kalabalik F, Tatar B, Ulu M. Location of the mandibular lingula: Comparison of skeletal Class I and Class III patients in relation to ramus osteotomy using cone-beam computed tomography. *J Stomatol Oral Maxillofac Surg* 2019;120:504-8.
9. Hsu KJ, Tseng YC, Liang SW, Hsiao SY, Chen CM. Dimension and Location of the Mandibular Lingula: Comparisons of Gender and Skeletal Patterns Using Cone-Beam Computed Tomography. *Biomed Res Int* 2020;2020:2571534. doi: 10.1155/2020/2571534.
10. Ahn BS, Oh SH, Heo CK, Kim GT, Choi YS, Hwang EH. Cone-beam computed tomography of mandibular foramen and lingula for mandibular anesthesia. *Imaging Sci Dent* 2020;50:125-32.
11. Cvetko E. Bilateral anomalous high position of the mandibular foramen: A case report. *Surg Radiol Anat* 2014;36:613-6.
12. Lipski M, Tomaszewska IM, Lipska W, Lis GJ, Tomaszewski KA. The mandible and its foramen: Anatomy, anthropology, embryology and resulting clinical implications. *Folia Morphol (Warsz)* 2013;72:285-92.
13. Yates C, Olson D, Guralnick W. The antilingula as an anatomic landmark in oral surgery. *Oral Surg Oral Med Oral Pathol* 1976;41:705-8. doi: 10.1016/0030-4220(76)90182-1.
14. Apinhasmit W, Chompoopong S, Jansisyanont P, Supachutikul K, Rattanathamsakul N, Ruangves S, et al. The study of position of antilingula, midwaist of mandibular ramus and midpoint between coronoid process and gonion in relation to lingula of 92 Thai dried mandibles as potential surgical landmarks for vertical ramus osteotomy. *Surg Radiol Anat* 2011; 33:337-43.
15. Pogrel MA, Schmidt BL, Ammar A. The presence of the antilingula and its relationship to the true lingula. *Br J Oral Maxillofac Surg* 1995;33:235. doi: 10.1016/0266-4356(95)90007-1.
16. Aziz SR, Dorfman BJ, Ziccardi VB, Janal M. Accuracy of using the antilingula as a sole determinant of vertical ramus osteotomy position. *J Oral Maxillofac Surg* 2007;65:859-62.
17. Park KR, Kim SY, Kim GJ, Park HS, Jung YS. Anatomic study to determine a safe surgical reference point for mandibular ramus osteotomy. *J Cranio-Maxillofac Surg* 2014;42:22-7.
18. Hogan G, Ellis E. The "antilingula"—fact or fiction? *J Oral Maxillofac Surg* 2006;64:1248-54.