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ORIGINAL ARTICLE

CBCT study on the relationship between lingula and antilingula position in a Chinese Han population

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Abstract

Objective The purpose of this article was to assess the anatomical relationship between the lingula and the antilingula by measuring the projection of lingula on the lateral side of the ramus on CBCT.

Methods This study collected CBCT images of 204 mandibular halves in 102 Chinese patients without any damage. We projected the lingula to the lateral side of the mandibular ramus and examined the distance and position relationship between the projection point and the antilingula using three-dimensional computed tomography (3DCT) created by image software.

Results In 204 sides the antilingula appeared in 92 cases, 52 on right and 40 on left. The antilingula was used as a fixed point, in four cases the lingula projection in the anterior superior part, 38 cases in the posterior superior part, 45 cases in the posterior inferior part and zero case in the anterior inferior part. Scatter plots diagrammatic representation in four quadrants centered on the antilingula showed that 79% cases (73/92) lied in a 90° fan shape ranged in 5–10 mm radius in the posterior superior and inferior quadrant.

Conclusion The lingula mainly located in the posterior superior and inferior part from the antilingula in a 90° fan shape ranged in 5–10 mm radius. The osteotomy incision should be avoided in this area.

Keywords Lingula · Antilingula · Mandibular foramen · Mandibular ramus · CBCT

Introduction

The antilingula is a bony prominence below the sigmoid notch on the lateral side of the mandibular ramus [16]. In previous studies, the protruding anatomical structure was considered as an anatomical landmark that predicted the position of the lingula [2]. Some people believed that the entrance of the inferior alveolar nerve (IAN) in front of the mandibular foramen (MF) on the medial side leaded to a response formation of a bone bulge on the lateral surface opposite the lingula [4]. In most cases, the antilingula was located in front of the MF [7]. The lingula is an irregular-shaped protrusion on the medial side of the mandibular ramus [8, 12]. It is a landmark to identify MF and mandibular canals [17] that the buccal nerve, lingual nerve, inferior alveolar artery and nerve pass through [5]. This study provided a reference for clinicians to propose safe and accurate surgery without damage to IAN during such as sagittal split ramus osteotomy (SSRO), IAN injury repair, mandibular angle hypertrophy surgery [1] and mandibular angle cyst removal [10]. However, the lingula and MF locate on the medial side of the mandibular ramus, difficult to be exposed during surgery. Therefore, by locating the antilingula in the ramus, the surgeon may approximately analyze the anatomical site of the lingula to decide a safe surgical region to prevent damage to IAN. The purpose of this article was to study the positional relationship between the antilingula and the lingula through CBCT measurement, so that the surgeons could locate the lingula and MF more conveniently during clinical operations.

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Methods

This study collected the CBCT images of 204 mandibular halves without any disease in 102 patients of Han population from June 2017 to June 2018. All selected patients were told that their CBCT would be used for this measurement study and they all approved. All CBCT examinations were performed by the same professional imaging specialist in accordance to a standardized protocol and used the same machine (New-Tom VG 10048S; QR srl Inc., Verona, Italy) with a uniform parameter setting (110 kVp). All CBCT images were measured and analyzed by SimPlant Pro 11.04 software in the department of radiology of the Affiliated Stomatological Hospital of Nanjing Medical University. All obtained data were tabulated and analyzed through Statistical Package for Social Science, version 16.0 (SPSS Inc, Chicago, IL, USA). Statistical significance was defined as $p < 0.05$.

Antilingula (Fig. 1a) was the most prominent point on the lateral surface of the mandibular ramus and lingula (Fig. 1b) was the most superior tip of the lingula. The tip of the lingula was projected to the lateral side of the ramus by SimPlant Pro 11.04 software. The distance from the projection point to the tip of the antilingula, the angle between the projection point and the antilingula line and the horizontal plane were measured (Fig. 2a, b).

Results

After measurements and analysis, in 204 sides the antilingula appeared in 52 cases of right side (25.5%), 40 cases of left side (19.6%), a total of 92 sides (45%) (Table 1). The average distance between the projection point and the antilingula was 6.55 mm: the distance of 22 sides (24%) were smaller than 5 mm, and 63 sides (68%) were between 5 and 10 mm. *T* test presented that there was no statistically significant difference in the distance between the left and right sides of the mandibular ramus ($p > 0.05$). In 33 cases, the antilingula appeared in bilateral mandibular ramus, of which 27 cases of lingula (82%) were basically consistent in two sides. The antilingula was used as a fixed point and set the lateral ramus into four quadrants: only in four cases (4.35%) the lingula projection located in the anterior superior part, 38 cases (41.30%) in the posterior superior part, 45 cases (48.91%) in the posterior inferior part and zero case in the anterior inferior part (Table 2). Scatter plots diagrammatic representation showed that 79% (73/92) lingula projection lied in a 90° fan shape ranged in 5–10 mm radius in the posterior superior and inferior quadrant (Fig. 3a–d).

Discussion

According to our research, the rate of the certain antilingula was 45%, 68% of the distance from the lingula projection to the antilingula were between 5 and 10 mm, and 79% lingula projection lied in a 90° fan shape ranged

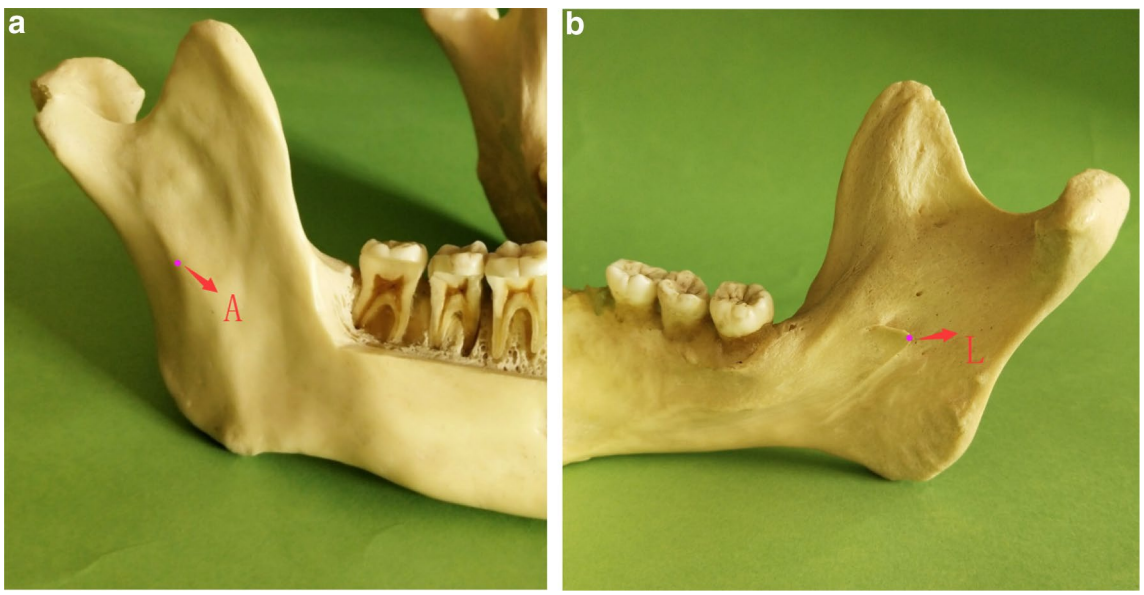

Fig. 1 **a, b** *A* antilingula (the most prominent point on the lateral surface of the mandibular ramus), *L* lingula (the most superior tip of the lingula)

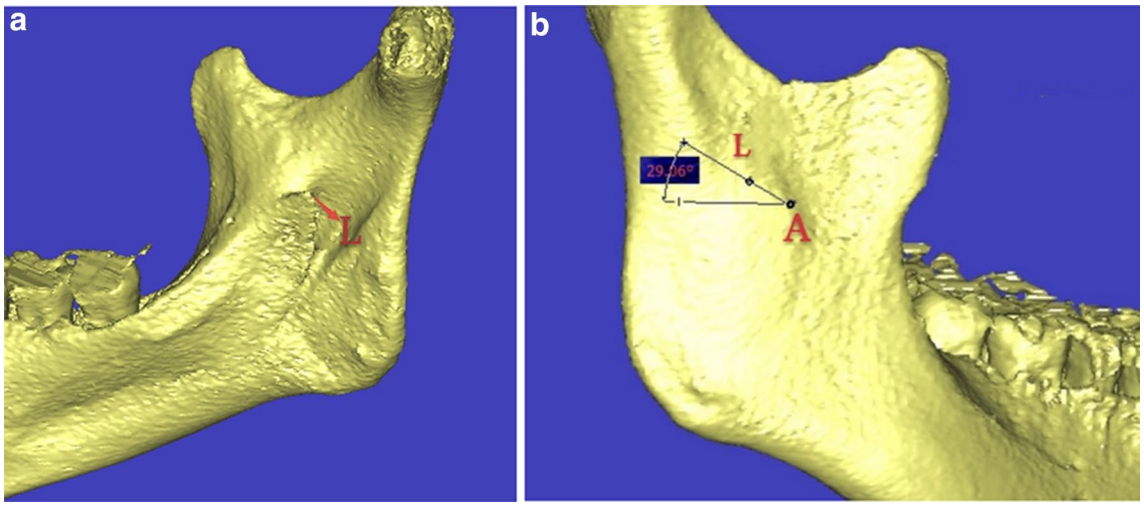

Fig. 2 **a** *L* lingula on CBCT; **b** the angle between the outer projection point of the lingula and the antilingula and the horizontal line

Table 1 The incidence of the antilingula on lateral side of the mandibular ramus

	Patients ($n=102$) (%)	Sides ($n=204$) (%)
Absence	44 (43)	112 (55)
Presence	58 (57)	92 (45)
Right	52 (51)	52 (25.5)
Left	40 (39)	40 (19.6)
Bilaterally	33 (32)	66 (32)
Unilaterally	26 (25)	26 (12.7)

Table 2 Proportion of relative position relationship of the lateral projection of the lingula and the antilingula

Orientation	Sides	Proportion (%)
Anterior superior	4	4.35
Anterior inferior	0	0
Posterior superior	38	41.30
Posterior inferior	45	48.91
Right rear	5	5.43
Total	92	

in 5–10 mm radius in the posterior superior and inferior quadrant, which was in line with the results of previous studies. Yates et al. [15] conducted an anatomical study to measure the position of the antilingula. Three researchers examined 70 dried mandibles, only in 44% of the mandibles the antilingula could be identified with any certainty, in 15% totally absent and in 41% were categorized uncertain. They also found that the position of the antilingula varied greatly compared to MF, with only 18% antilingula and MF position within 3 mm of each other. In addition, an anatomical study of 200 cadaveric mandibles by Tamás [13] showed that the antilingula was only found on approximately 54% of the mandibles.

Pogrel et al. [11] further demonstrated a certain anatomical relationship between the lingula and the antilingula, and they also examined 20 dry mandibles by three independent observers. Although the antilingula was recognized on 40 sides, only 23% of the observations on the position of the antilingula were consistent. In addition, in only 43% of the cases were the antilingula within 5 mm of the lingula projection. The study also observed changes in the positional relationship of the lingula projection point and the antilingula on bilateral mandibular ramus in the same case. They found no obvious connection between both sides. However, based on large samples, the distance within 5 mm in our study only accounted for 24%. We also found that 82% of the lingula position was consistent in the bilateral mandibular ramus in the same case. Aziz et al. [3] obtained a study of 18 dry mandibles of unknown ethnicity and they concluded that in most instances the lingula located posterior inferior to the antilingula, and 5 mm distal to the antilingula was a statistically safe area without damage to the IAN. Jin et al. [7] found that the antilingula and the MF were located posterior from the anterior border of the ramus in average distances of 14.71 mm and 19.69 mm, which supported our conclusions.

After analyzing 46 panoramic X-rays including 24 male and 22 female specimens, Trost et al. [14] suggested that MF was always situated in the ventral and inferior two-thirds of the ramus without difference according to the side, sex or age. This area can be considered as a "safety zone" to perform vertical ramus osteotomies of the mandible with statistically low risk of IAN injury. We recognized the safety of this area, and we suggested that our conclusions should also be used as a reference in surgery to find a safer anatomical

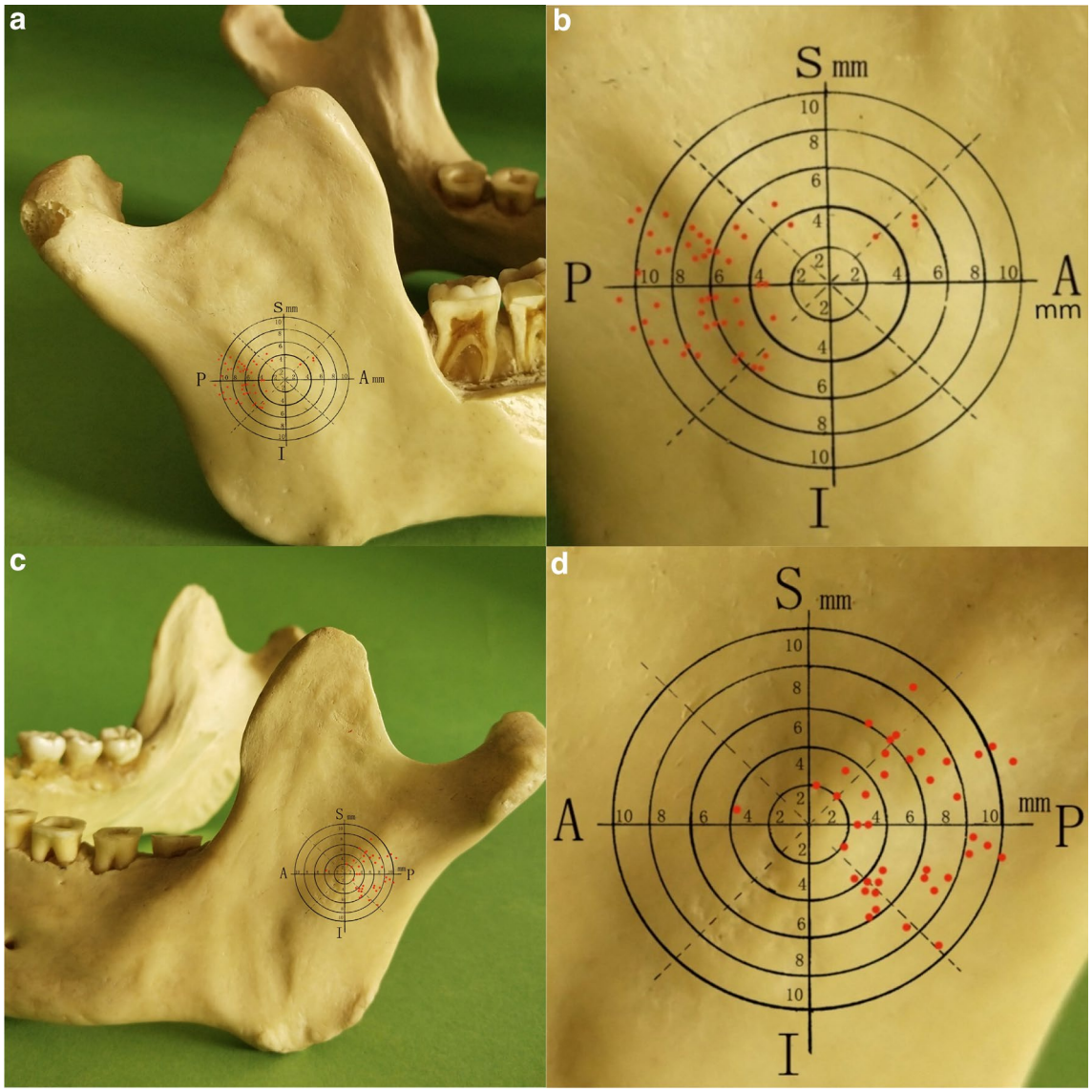

Fig. 3 **a, b** Scatter plot of the right lingula lateral projection position relative to the antilingula; **c, d** scatter plot of the left lingula lateral projection position relative to the antilingula

location by excluding the fan-shaped dangerous area we proposed to avoid IAN injury.

In 2006, some scientists [6] suggested that the presence of the antilingula was only related to the muscle spasm attached to the mandible, rather than IAN entrance on the medial surface of the mandibular ascending branch. Therefore, the use of the antilingula as a surgical landmark was uncertain. The presence rate of the antilingula determined that this anatomical structure was not useful to be a landmark for all patients, so we admitted that our research was not universal. It cannot be considered as an accurate surgical landmark to the lingula when the antilingula is absent [9] and prevention of damage to the IAN cannot be absolutely guaranteed [7]. However, according to the experience of the clinicians, once the anatomical site is found in the orthognathic surgery, it is of great help in determining the position of the lingula and avoiding the rear IAN. For guiding the clinical operation such as SSRO, IAN injury repair, mandibular angle hypertrophy surgery [1] and mandibular angle cyst removal, it still has important reference value.

Conclusion

The lingula projection is mainly located in the 90° angle posterior to the antilingula on lateral surface of the mandibular ramus and within a fan shape ranging of 5–10 mm. Therefore, when performing operation such as bone incision or

removal of cyst and cutting mandibular angle in the mandibular ramus, this fan-shaped area posterior to the antilingula should be avoided. The positional relationship between the lingula and the antilingula obtained in this study provides a reference for clinicians in clinical work.

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Author contributions KZ and YH carried out the experiments and drafted the manuscript; BZ and RW were involved in the statistical analysis; RW and HY critically reviewed the manuscript; HY managed the experimental design, reviewed the manuscript and provided funding support. All authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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