

# Anatomic Variation in Lingual Foramen: A Cone beam Computed Tomography Study

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## ABSTRACT

**Background:** Lingual foramen is usually located in the midline, leveled with or superior to the genial tubercles. The success of implant placements is dependent on the radiological examination, which helps the clinician to determine the parameters of implant placement by revealing the structures like the course of the nerves, location of foramens, height and shape of alveolar bone, etc. The present study was done to assess the appearance, visibility, location, and types of lingual foramen in the mandibular region.

**Materials and methods:** A cross-sectional retrospective study was conducted using cone beam computed tomography (CBCT) images of 116 patients who attended the department for various imaging purposes. The examinations were carried out using the Promax three-dimensional (3D) CBCT unit. The cross-sectional images were examined to detect the presence, number, and position of the lingual foramen. Chi-square and Fisher's exact tests were used for comparison of categorical data.

**Results:** We observed lingual foramen in 116 patients and their number ranged from 1 to 3. When comparing the position, it was observed that lingual foramen was located at approximately two-thirds (60th percentile from the alveolar crest) distance from the alveolar crest to lower border of the mandible and there was no significant difference in various age groups or between both genders.

**Conclusion:** Lingual foramen transmits neurovascular bundles to surrounding structures, hence any damage to the lingual foramen during surgical procedures can result in hemorrhage and/or neurosensory disturbances. It is therefore mandatory for a dentist to be aware of the structures present in the anterior mandible when considering any surgical procedures or implant planning. Hence, CBCT plays a pivotal role during implant planning and surgical procedures in dentistry.

**Keywords:** Cone beam computed tomography, Implant, Lingual foramen, Mandible.

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## INTRODUCTION

The lingual foramen, though an opening usually present in the midline on the lingual aspect of the anterior part of the mandible, could have variations in number and position. The branches of the sublingual artery—a branch of the lingual artery—and submental artery—a branch of facial artery—send branches to the peripheral muscles, mylohyoid muscle, mucous membrane, and gingiva.<sup>1,2</sup> In order to prevent hemorrhage caused due to lingual plate perforations, a thorough radiological evaluation of the frequency and distribution of the foramens in the mandible using cone beam computed tomography (CBCT) can prevent complications during surgical procedures.

## MATERIALS AND METHODS

A cross-sectional retrospective study was conducted using CBCT images of 116 patients who attended the department for various imaging purposes. The examinations were carried out using the Promax three-dimensional (3D) CBCT unit. The exposure parameters were according to the standard default values based on the field of view. The cross-sectional images were examined to detect the presence of the lingual foramen.

Parameters, such as number of canal, position with respect to inferior border of mandible, location based on region were recorded. The position of the canal was measured from the alveolar crest to the level of foramen (vd1) and from the foramen to the lower border of the mandible (vd2) and was done according to a study done by Dae Hyun Kim et al (Fig. 1).<sup>1</sup> Positions of the canal were compared in different age groups and also between both the sexes. All measurements were done by a single observer.

## RESULTS

Lingual foramen was observed in all 116 patients. There were 69 males and 47 females with age ranging from 14 to 70 years (mean 35.99 ± 5.4). While assessing the number of canals, the numbers ranged from a single (69%), two

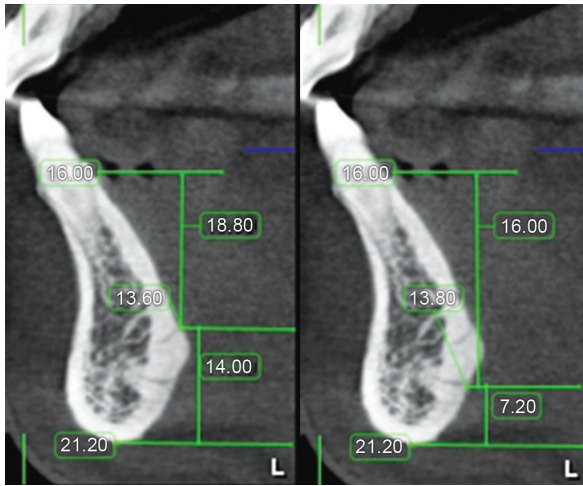
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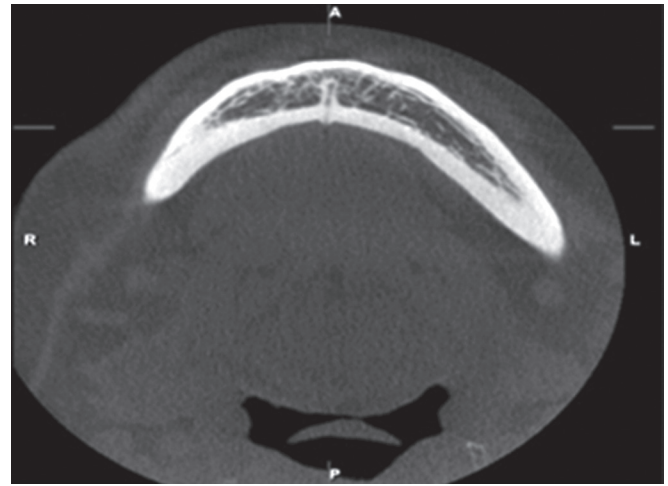
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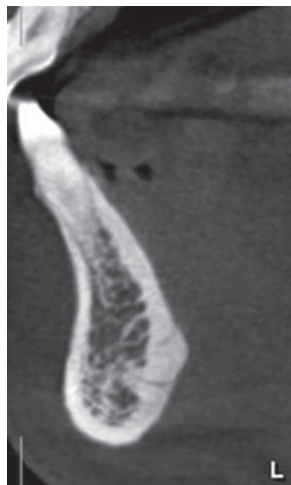
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**Fig. 1:** Cross section through mandibular midline showing the measurements done from alveolar crest to foramina and foramina to inferior border of the mandible



**Fig. 2:** Axial section showing a lingual foramen in the midline



**Fig. 3:** Cross section of mandibular midline showing two lingual foramina, one above and one below the genial tubercles

canals (29.3%), and three (1.7%) consecutively. The canals were lined by a radiopaque border. In 49.14% cases, the foramina were above the genial tubercle and in 21.55% cases below the tubercle. In the event of >1 canal present, the lingual foramina were both above and below the genial tubercle, which accounted for 29.31% of all the cases.

Single lingual foramen was observed in 80 subjects, of which 79 were in the midline (Fig. 2) and one foramen was present between the central and lateral incisor. Two foramina were present in 34 subjects and 33 of them had superiorly and inferiorly placed foramina in the midline (Fig. 3) while only 2 subjects had three foramina with one located in the midline and two on either side in the pre-molar region. In one subject, the foramen was observed bilaterally on the right and left side and not in the middle.

While comparing the presence of lateral canals, it was found that 98.3% of the lingual foramina were in the midline while the rest (1.7%) were present laterally. Presence of lateral canals was more in the females (2.1%) when compared to the males (1.4%).

The distance of the foramen from the alveolar crest was at an average distance of 17.98 mm and from the foramen to the lower border of the mandible was 10.46 mm in mandibles with single canal. In cases with two foramina in the midline, the average distance from the lower border to the superior foramen was 12.18 mm and to the inferior foramen was 4.33 mm.

Two of our patients had one foramen in the midline and two foramina in the premolar region, which was visible in the axial section. The average distance of the lateral foramen from the alveolar crest was found to be 10.41 mm and the distance from inferior border was 9 mm.

The ratio of the distance from crest to foramen and the crest to base of mandible was roughly 61, indicating that the lingual foramen was located at approximately two-thirds (60th percentile from the alveolar crest, i.e., closer to the basal bone) distance from the alveolar crest to lower border of the mandible.

There was no significant difference in the position of the lingual foramen in different age groups and between both genders (Tables 1 and 2).

**DISCUSSION**

Many anatomical landmarks are present in the anterior mandible, which include the canals and the foramina. The anterior mandibular region between the mental foramina is considered to be safe and has a low risk with regard to causing damage to the vital structures

**Table 1:** Variation in number of lingual foramen based on gender

Number of lingual foramen	Distribution in females	Distribution in males	Total prevalence
1	33 (70.20%)	47 (68.10%)	80 (69%)
2	13 (27.70%)	21 (30.40%)	34 (29.30%)
3	1 (2.10%)	1 (1.40%)	2 (1.70%)
Total	47 (100%)	69 (100%)	116 (100%)

**Table 2:** Distribution of lingual foramen based on location

Number of lingual foramen	Location	Count	Percentage distribution
1	Lateral	1	1.2%
	Middle	79	98.8%
2	Lateral	1	2.9%
	Middle	33	97.1%
3	Lateral	0	0%
	Middle	2	100%

during any procedures. Any damage to the nerves or arteries can cause severe bleeding and/or nerve injury. Hence, a meticulous preoperative planning with the help of radiographic evaluation aids the clinician, especially in regard to implant placements, to determine the location, size, and angulation of the implant in accordance to the landmarks present in that specific region to prevent complications. Due to advanced lifestyles, implant placement has been regarded as a better option for the prosthetic rehabilitation, especially in the anterior region. Cone beam computed tomography provides a better visualization of the canals, foramens, and the structures than an orthopantomograph as there is no superimposition of the anatomical structures, especially in the anterior region.<sup>3</sup> Hence, a study was done with regard to the number, position, location of the lingual foramen and a comparison was done among different age groups and between both genders.

An accessory foramen in the midline of the mandible which was either superior, inferior, or in the genial tubercle was named as lingual foramen.<sup>4,5</sup>

The other synonyms include midline foramen,<sup>6</sup> superior retromental foramen,<sup>7</sup> and supraspinous foramen.<sup>8,9</sup> Przystańska and Bruska<sup>10</sup> also state that prevalence of foramen superior to the genial tubercle was more frequently observed than foramen inferior to genial tubercle in the midline which was similar to our study. A study done by McDonnell et al<sup>4</sup> with the dried specimens found that the lingual foramen was found on the lingual side of the mandible in the midline consistently. The anatomical variations, the bone density, and the crestal morphology can be obtained through CBCT examinations. There are no fixed locations or numbers of the lingual foramen as observed in our study, which is in accordance to a study done by Natekar.<sup>11</sup>

A study done by McDonnell et al<sup>4</sup> using CBCT and Tepper et al<sup>12</sup> using CT also found the presence of median, or lateral lingual foramen on the lingual side between the mental foramens.

Our study showed that there was not much difference in the position of the lingual foramen among different age groups and gender which is in accordance to a study done by Dae Hyun Kim et al<sup>1</sup> and was not in accordance to the study done by Mahnaz Sheikhi et al.<sup>13</sup>

## CONCLUSION

A good knowledge of the anatomical structures which pass through the lingual foramen, its position, and the number play a crucial role when planning for implant placement or performing surgeries like chin reconstruction, genioplasties, fracture management in the anterior region of the mandible. Any pitfalls can result in hemorrhage or sensoneurological problems. Through our study, we tried to emphasize the variation in anatomical location and number of lingual foramen that can be observed using CBCT as imaging modality.

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