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# Investigation of the Relationship of Dental Implants in the Mandible with the Lingual Foramen by Cone Beam Computed Tomography

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## Abstract

**Objective:** The aim of this study is to retrospectively evaluate the relationship of dental implants made in the mandible with the lingual foramen by typing according to the safety margin.
**Material method:** In our study, images taken with a Planmeca 3D Mid (ProMax, Helsinki, Finland) cone-beam computed tomography device between 2017-2021 were used. The Kolmogorov-Smirnov test was used to examine the suitability of the available data for normal distribution. Relationships between categorical variables were calculated with the 'Chi-square test'.
**Results:** Cone beam computed tomography images of 450 implants in the mandible were evaluated in multiplanar planes in a total of 250 patients, 110 (44%) men and 140 (56%) women. According to the evaluation of the implants with the lingual foramen, type 1; 0 (0.0%), type 2; 3 (0.7%), type 3; It was determined as 30 (6.7%).
**Conclusion:** No relationship was observed with the lingual foramen in 92.7% of the implants. There was no statistically significant difference between the lingual foramen and typing according to gender.

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**Keywords:** Cone beam computed tomography, mandible, dental implant, lingual foramen**.**

## Introduction

The lingual foramen is located in the midline of the mandible, above or below the spina mentalis(1). Small foramens are often seen in the genial and premolar parts of the medial surface of the mandible. These are called by various namesin a previous report, Tagaya et al. (2) named them as medial lingual foramen and lateral lingual foramen. This anatomical variation has received renewed attention for optimizing surgical planning and avoiding complications(3). The mandibular intermental foramen is generally considered to be a safe area and is a site with little risk of damaging vital anatomical structures during the surgical procedure. However, these safety recommendations are not based on information about the location and course of some anatomical landmarks(4). Liang et al.(5) defined that the contents of the superior canal of the medial lingual foramen are derived from the lingual artery and the lingual nerve, and that the inferior canal contains an artery originating from the submental and/or sublingual artery. Madeira et al.(6) reported that an additional branch of the mylohyoid nerve enters the mandible through the accessory foramen on the lingual side of the mandibular symphysis. It is important to detect these formations in the anterior mandible, which cannot be visualized by two-dimensional radiographic methods such as the lingual foramen and mandibular incisive canal located in the anatomy of the region, in order to avoid possible nerve damage during implant surgery(7). It has been reported that two-dimensional dental radiographs are insufficient to detect both the lingual foramen and the mandibular incisive canal(8).

The definitions of the lingual foramen and the size and location of the bony canals are important to consider during anterior dental surgery (implant placement, genioplastic or grafting procedures) to avoid various complications (5). Some of these complications are: intraoperative bleeding, nerve damage, neuropraxia, short- and long-term nerve-sensory disorders, including change or loss of pulp sensitivity in the lower anterior teeth(9). Fokas et al. (10), a safety margin of 2 mm was suggested from vital anatomical structures when using three-dimensional data from cone-beam computed tomography (CBCT) imaging (10). CBCT detects anatomical formations and the relationship with surrounding structures much better and more accurately than periapical and panoramic radiography (11). There is no classification and study in the literature according to the safety distance of dental implants to the surrounding anatomical structures. No study has been found examining the relationship between dental implants in the mandible and the lingual foramen.

The aim of this study is to evaluate the relationship of dental implants made in the mandible with the lingual foramen by typing according to the safety margin.

### Material Method

Ethical approval of our study was obtained with the decision numbered 2021/118 of Gaziantep University Clinical Research Ethics Committee. In our study, images taken by Planmeca 3D Mid (ProMax, Helsinki, Finland) CBCT device between 2017-2021, which are in the tomography archive of Gaziantep University Oral, Dental and Maxillofacial Radiology Department, were used. In our study, images with 16x16, 16x9, 16x5 cm FOV (field of view) range, 0.4 mm3 voxel resolution, irradiation parameters 90 kVp, 12 mA, exposure time 14-27 sec, and slice thickness 1 mm Planmeca Romexis Viewer 3.2.0 version (Helsinki, Finland) software was structured and examined. In our study, 450 implant CBCT images in the mandible of 250 (110 men, 140 women) patients were evaluated in multiplanar planes. The classification of implants according to their distance from the surrounding anatomical structures is given below:

- Type 1: Implant associated with the lingual foramen
- Type 2: implant with 1-2 mm distance from the lingual foramen
- Type 3: Implant with lingual foramen distance greater than 2 mm
- No Relationship: Implants outside the examined area

According to the above classification, the relationship of the implants with the lingual foramen was examined (Figure 1).

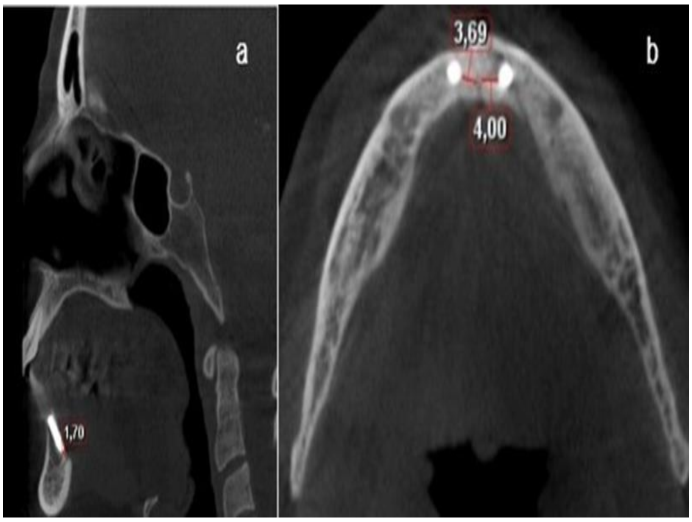


**Figure 1.** Relationship of the implants placed in the lingual foramen region with the lingual foramen in sagittal and axial section CBCT images (a) type 2, (b) type 3.

Evaluations on the implants (20% of the images) in 50 patient images were repeated 2 weeks later to calculate the reliability of the measurements and the intra-observer agreement.

### Statistical analysis

In our study, the determination of intra-observer consistency in radiographic evaluations was tested with kappa. The Kolmogorov-Smirnov test was used to examine the suitability of the available data for normal distribution. Relationships between categorical variables were calculated with the "Chi-square test" and the relationship between numerical variables was calculated with the "One Way Anova test". As descriptive statistics, number (n) and percent (%) values were given for categorical variables, and mean ± standard deviation (Mean ± SD) for numerical variables. SPSS Windows version 22.0 (Armonk, NY: IBM) package program was used for statistical analysis and p < 0.05 was considered statistically significant.

## Results

Intra-observer agreement was evaluated with the kappa test and was found to be excellent (0.91). In our study, CBCT images of 450 implants in the mandible were evaluated in multiplanar planes in a total of 250 patients, 110 (44%) men and 140 (56%) women. The mean age of all cases was found to be 54.03 ± 11.86. The mean age of women was 52.86 ± 12.60, and 55.51 ± 10.71 for men. According to the evaluation of the implants with the lingual foramen, type 1; 0 (0.0%), type 2; 3 (0.7%), type 3; It was determined as 30 (6.7%). No relationship was observed with the lingual foramen in 92.7% of the implants. The distribution of typing with lingual foramen by gender is shown in Table 1. When the relationship of the implants with the lingual foramen is evaluated according to gender, type 1 in women; It was determined as 0 (0.0%), type 2 3 (0.7%), type 3 12 (2.7%). In men, this rate is type 1; 0 (0.0%), type 2; 0 (0.0%), type 3; It was found to be 18 (4.0%). There was no statistically significant difference between the lingual foramen and typing according to gender (p > 0.05). The distribution of the typing of the lingual foramen distance of the implants in the mandible according to the mean age is shown in Table 2. The mean age of the typings with the lingual foramen was observed as 59.00 ± 12.49 for type 2 and 62.96 ± 14.55 for type 3. The mean age of the cases not associated with the lingual foramen was 55.85 ± 11.92 years. The mean age of the cases with no relationship with the lingual foramen was statistically significant lower than the mean age of the cases with type 3 relationship with the lingual foramen (p < 0.05).

**Table 1.** The distribution of typing with lingual foramen by gender.

| | Lingual foramen | | | | |
|---|---|---|---|---|---|
| Gender | Type 1 N (%) | Type 2 N (%) | Type 3 N (%) | No relationship N (%) | P |
| Female | 0 (0.0) | 3 (0.7) | 12 (2.7) | 236 (52.4) | 0.063 |
| Male | 0 (0.0) | 0 (0.0) | 18 (4.0) | 181 (40.2) | |

**Table 2.** The distribution of the typing of the lingual foramen distance of the implants in the mandible according to the mean age.

| | | N (%) | Mean ± SD | P |
|---|---|---|---|---|
| Lingual foramen | Type 1 | 0 (0.0) | - | 0.008* |
| | Type 2 | 3 (0.7) | 59.00 ± 12.49 | |
| | Type 3 | 30 (6.7) | 62.96 ± 14.55 | |
| | No relationship | 417 (92.7) | 55.85 ± 11.92 | |

*P < 0.05

## Discussion

The increase in dental implant applications in recent years has also increased the number of complications. Because many of these complications are easily diagnosed on postoperative radiographic images, it is important for radiologists to be familiar with them. Radiologists should also have a basic understanding of their treatment (12).Studies on post-dental implantation are mostly related to complications, penetration into anatomical formations and perforation, and the safety distance of the implant to anatomical formations has not been evaluated. Selection and application of dental implants in the appropriate length, thickness and location are the basic elements of a good implant treatment (13).In particular, the ability to examine the bone dimensions in millimeters, to determine the bone density, and to show the relationship of the surgical region with anatomical formations in detail has made CBCT more preferred (14). When using CBCT, a safety margin of 2 mm should be considered for adjacent anatomical structures (10). In the literature, anatomical structures and variations in the maxilla and mandible were evaluated before dental implant treatment (15), and no classification or study was found according to the safety distance to the anatomical structures in the maxilla and mandible after implantation. To the best of our knowledge, our study is the first to examine the distance from the lingual foramen by classifying according to the post-implant safety interval. The mean age of the cases with type 3 relationship with the lingual foramen was found to be higher than the mean age of the cases with type 2 relationship and no relationship. The reason for this may be that resorption occurs from lingual to buccal in the mandible in advancing ages and physicians apply implants considering this.

Limitations of this study; Parameters cannot be discussed due to the fact that it is the first research in its field and there are limited studies in the literature examining the relationship between implants and anatomical formations according to the safety margin.

## Conclusion

No relationship was observed with the lingual foramen in 92.7% of the implants. When the data were analyzed according to gender, no statistically significant difference was found between the lingual foramen and typing. The mean age of the cases with type 3 relationship with the lingual foramen was found to be higher than the mean age of the other cases. No type 1 associated implant image was found with the lingual foramen. In future studies, the number of data can be increased and more comprehensive and multicenter studies can be conducted according to age groups.

**Descriptions**

**Author Contributions:**

**MED:** study design, data collection/processing, analysis, interpretation, literature review, and manuscript writing contributed in its departments and stages.

**EDY:** design, consulting and critical review in the study **contributed to the stages**

**Conflicts of Interest:** The authors declare that they have no conflict of interest.

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