International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

http://gssrr.org/index.php?journal=JournalOfBasicAndApplied

Assessing the Anatomical Variations of Lingual Foramen and its Bony Canals with CBCT

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Abstract

The purpose of this study is to investigate by means of CBCT the presence of lingual foramen and their bony canals in the midline of the mandible and to describe their anatomical characteristics. CBCT examinations of 200 patients were carefully examined in the median region of the mandible in order to detect the lingual foramen and their corresponding vascular canals. Their presence, number, position, diameter, morphology and trajectory were established.

Lingual foramen in the midline of the mandible were observed in all 200 subjects. The number of canals varied from one to tree, with the following distribution: one canal in 39.5% of the cases, two canals in 53% and three in 7.5% of the cases.

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The average diameter of the canals in mesiodistal and buccolingual side were 0.749 and 1.029 mm. 17% of the vascular canals penetrated only the lingual third of the width, 62.5% reached the middle third of the mandible and 20.5% of the canals spread to the buccal third. As a conclusion we can say that CBCT is a useful tool in planning an implant treatment. It can reveal multiple anatomic features of the mandible, including the presence and the morphology of the lingual foramen and their vascular canals in the median region of the mandible. Clinicians should acknowledge the presence of these anatomical structures and should be aware of their possible implications.

Keywords: cone beam CT; implant treatment planning; lingual foramen; lingual vascular canal; mandible.

1. Introduction

The interforaminal mandibular region is considered relatively safe for the dental implant treatment. However, the region includes some important anatomic structures, such as the incisive canal, the concavity of the lingual cortex and lingual foramen and canals. Several reports have indicated surgical complications such as the perforation of the lingual cortex and the injury of the sublingual and submental arteries, resulting in severe, life-threatening hemorrhage in the floor of the mouth [1,6].

The descriptions of lingual foramen and their bony canals dimensions and locations are important to consider during anterior dental surgery (implant placement, genioplastic, or grafting procedures) for avoiding various complications [2,3].

Some of these complications are as follow: intraoperative bleeding, nerve injury, pulp canal obliteration, and neuropraxia of the mandibular incisive nerve [5,11].

The increased usage of diagnostic imaging acquired by means of cone beam computed tomography (CBCT) has led to various studies of the median region of the mandible. CBCT analysis reveals almost in every case the presence of lingual vascular canals in the midline or canine/premolar regions [7,13].

Cone-beam computed tomography (CBCT) has been shown to be superior to panoramic radiographs in displaying the mandibular lingual foramen and their bony canals variations. Image quality of CBCT systems and their relatively lower dose and cost when compared to conventional computed tomography have allowed more accessible three-dimensional assessment of craniofacial structures in dental practice [4,11].

In this study, the lingual foramen and their bony canals from the median region of the mandible were described using the data provided by the CBCT images acquired from Iranian patients.

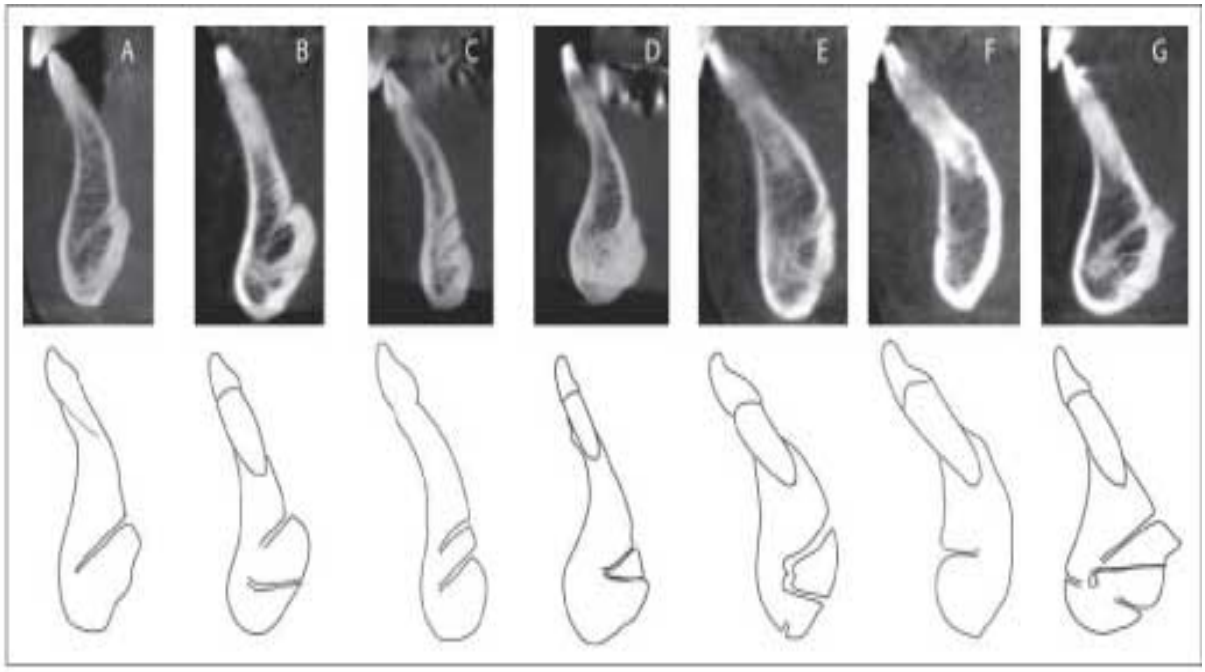
2. Materials and Methods

This was a cross-sectional study in which CBCT images taken from 200 patients referred to the private oral & maxiofacial radiology clinic in babol. The sample size was 200. There were 98 men , and 102 women , with an average age of 47/7 years ,ranging from 19-78 years .

All CBCT images were acquired using Giano (Newton Italy) with a standardized exposure protocol, at 2-10 mA and 60-90 kVp. The anterior mandible was carefully examined on the midline and around the midline in order to detect the lingual foramen and their vascular canals. The number of the canals observed on the sagittal slice was recorded. The diameter of the greatest canal was measured at the level of the lingual cortical bone.

The anatomical variations of lingual foramen morphology was carefully categorized according to the picture no. 1 (e.g. [2]). The trajectory of the canals was analyzed in relation to the midline.

In this study, we divided participants into three age groups for statistical analysis: under 35, 35–55, and above 55 years. Afterward, we evaluated the effect of patient age on the dimensional measurements of the anatomical landmark mentioned above. All data were gathered and statistically analyzed by SPSS version 16. A five percent level of significance was used. The *t* test and analysis of variance (ANOVA) were used to determine the effect of age on gathered data and pearson correlation was applied to obtain the relation between age and measured dimensions.



Picture no.1, source [2].

3. Results

CBCT imaging of the mandible, from 200 patients which included 98 males (49%) and 102 females (51%), were investigated. The mean age was 47.7 (SD: 14.11) years, range 19-78 years.

Lingual foramen in the median region of the mandible were observed in all 200 subjects (100% of the cases).

106 mandibles (53%) had two foramina at the lingual side of the mandibular midline and 15 mandibles (7.5%) showed three foramen in the mandibular midline. The remaining 79 mandibles (39.5%) had a single foramen and canal. The average diameter of the canals in mesiodistal side was 0.749 mm (SD: 0.2), ranging from 0.3 to 1.5 mm, and in buccolingual side was 1.029mm (SD: 0.3), ranging from 0.3-2.6 mm.

The lingual vascular canals traversed the bone to variable extent. 17% penetrated only the lingual third of the width, 62.5% reached the middle third and 20.5% of the canals spreaded to the buccal third. In the axial plane, 22.5% of the lingual vascular canals had a trajectory slightly to the right, 24% were slightly to the left and 53.5% were oriented anteriorly.

The anatomical variations of lingual foramen morphology was categorized , 79 mandibles(39.5) were type A, 108 mandibles(54%) were type B, 3 mandibles (1.5%) were type C, 1 mandible(0.5) was type D, 2 mandibles(1%) were type E and 7 mandibles(3.5%) were type G . Furthermore, we evaluated the correlation between the diameter measurements in mesiodistal and buccolingual side and patient's age. As a result, we did find significant correlation between age and measurements of lingual foramen.(Figure 1,2) (Table 1)

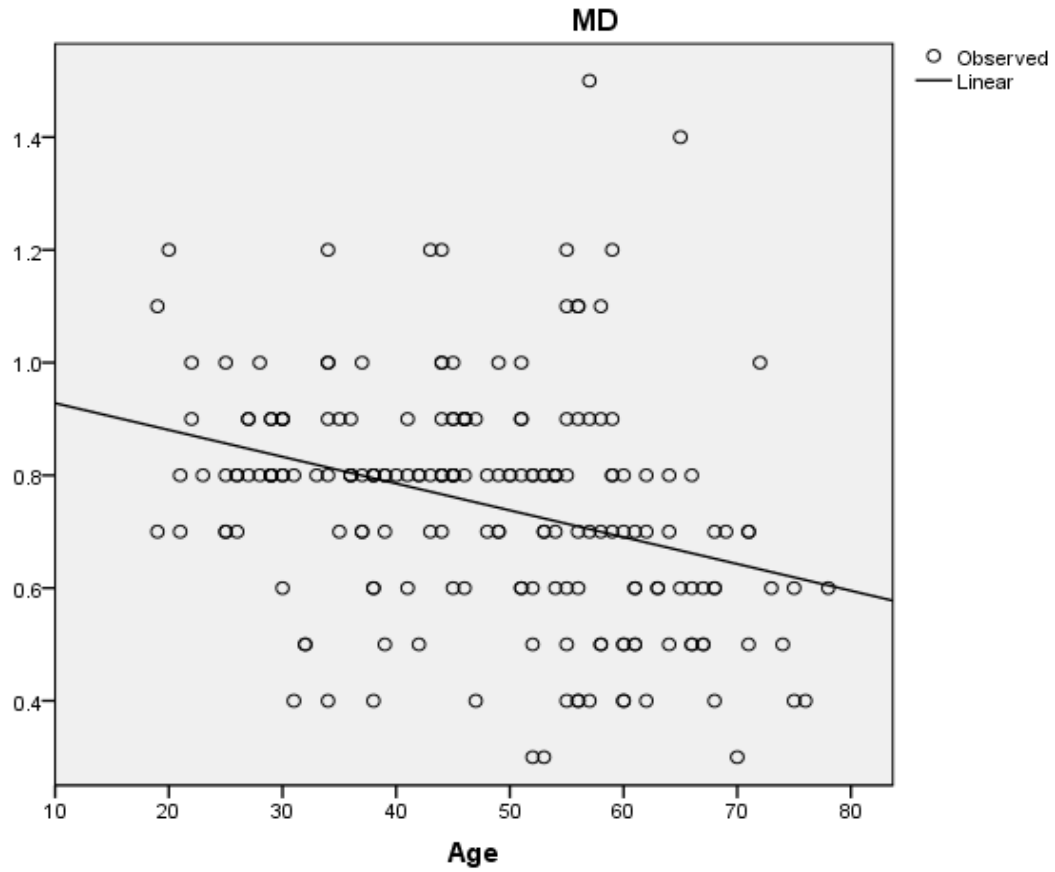


Figure 1: The differences between diameter of canal in mesiodistal side with age groups

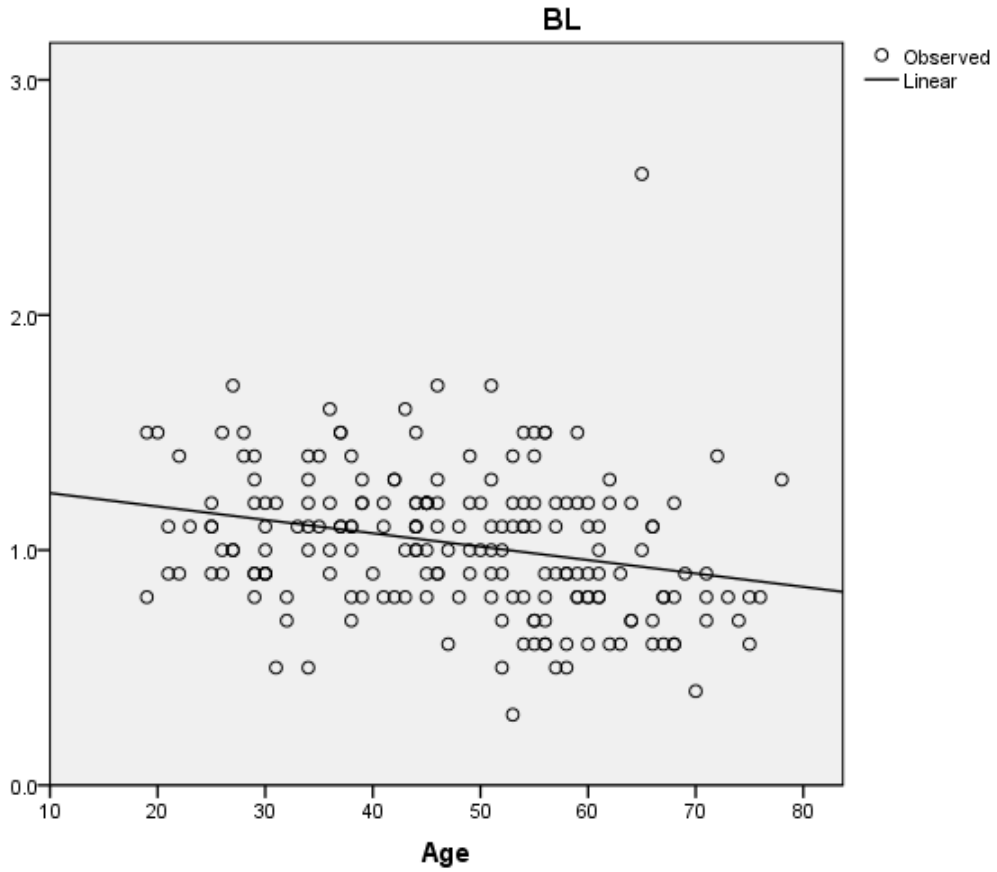


Figure 2: The differences between diameter of lingual canal in buccolingual side with age groups

4. Discussion

Defining the anatomy during preoperative planning can help the clinician take the correct decisions regarding an implant treatment. The CBCT examination of the recipient site can offer information on where and how implants can be placed in order to achieve osseointegration and to provide a proper support for the prosthetic reconstruction [9,10].

Anatomical structures such as the incisive canal or the lingual vascular canals and anatomical features like the bone density or the morphology of the crest can be best observed with a three-dimensional investigation. These findings dictate the appropriate size of the implant and the correct surgical procedure for the case, making it as safe as possible and reducing to a minimum the risk for post-operative failures [12].

In our study, 200 mandibles were investigated and all of the images had at least one lingual foramen. Our results support those of Tepper and his colleagues [14], Gahleitner and his colleagues [4], and Mc Donnell [8] studies. Yet, our results provide no evidence for those of Jacobs *and his colleagues.* study, in which lingual foramen was seen in 82% of the spiral CT images [14,15]. One possible explanation for this discrepancy is that the reformatting procedure with some CT scans lacking a reformatted cross-sectional slice exactly at the mandibular midline.

In our study, two lingual foramens were more frequent (53%), this has also been shown in the previous studies [10,14], However, the results are in disagreement with those of Liang and his colleagues, and Tepper and his colleagues studies, in that, they found single foramen was most frequent [6,9].

Table 1: The differences between diameter of lingual canal in mesiodistal and buccolingual side with age groups

Descriptives

		Number	Mean Diameter	Std. Deviation	Std. Error	Minimum	Maximum
MD	Under 35	90	0.808	0.1646	0.0174	0.4	1.2
	35-55	72	0.747	0.2289	0.0270	0.3	1.5
	Above 55	38	0.613	0.1891	0.0307	0.3	1.4
	Total	200	0.749	0.2064	0.0146	0.3	1.5
BL	Under 35	90	1.107	0.2458	0.0261	0.5	1.7
	35-55	72	0.994	0.3044	0.0359	0.3	1.7
	Above 55	38	0.905	0.3690	0.0599	0.4	2.6
	Total	200	1.028	0.3027	0.0215	0.3	2.6

Only those patients with a single lingual foramen (39.5% occurrence in our study) will benefit from the inferior location of this foramen, allowing deeper flap surgery or implant placement without risk of damage to the canal.

In this study the mean diameter of the lingual canal in mesiodistal side and buccolingual side was 0.749 and 1.029 mm, respectively. From these data, we can suggest that may be there is no significance difference of the mean diameter of the lingual canals between various studies.

In this study 22.5% of the lingual vascular canals had a trajectory slightly to the right, 24% were slightly to the left and 53.5% were oriented anteriorly. Our results support those of Tepper and his colleagues, Babiuc and his colleagues, and Mc Donnell studies.

In our study, the lingual vascular canals traversed the bone to avariable extent. 17% penetrated only the lingual third of the width, 62.5% reached the middle third and 20.5% of the canals spreaded to the buccal third. Our

results support those of Tepper and his colleagues, Babiuc and his colleagues, and Mc Donnell studies. Yet, our results provide no evidence for those of Jacobs *and* his colleagues study.

In this study, the anatomical variations of lingual foramen morphology was categorized [according to picture no.1] , 79 mandibles (39.5) were type A, 108 mandibles (54%) were type B, 3 mandibles (1.5%) were type C, 1 mandible (0.5) was type D, 2 mandibles (1%) were type E and 7 mandibles (3.5%) were type G .

Of 389 consecutively taken cone-beam computed tomograms of the mandible by Arx and his colleagues, there was no statistically significant influence on the vertical diameter of the lingual foramen by age ($P = 0.45$) [14]. Also according to the results of our study, there were significant relation between the diameter of lingual foramens and age groups.

5. Conclusions

CBCT examination can reveal multiple anatomic features of the mandible that must be taken into account when planning an implant treatment. It can demonstrate the presence, position and size of the lingual vascular canals in the median region of the mandible. Implantologists should be aware of this anatomic structure and its possible implications.

Conflict of Interest: The authors declare no conflicts, real or perceived, financial or nonfinancial

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