ORIGINAL PAPER

RJME
Romanian Journal of Morphology & Embryology
http://www.rjme.ro/

Cone beam computed tomography observations of the lingual foramina and their bony canals in the median region of the mandible

IULIANA BABIUC, IOANA TĂRLUNGEANU, MIHAELA PĂUNA

Department of Removable Prosthodontics,
Faculty of Dentistry,
"Carol Davila" University of Medicine and Pharmacy, Bucharest

Abstract

Purpose: To investigate by means of CBCT the presence of lingual foramina and their bony canals in the midline of the mandible and to describe their anatomical characteristics. *Materials and Methods*: CBCT examinations of 36 patients were carefully examined in the median region of the mandible in order to detect the lingual foramina and their corresponding vascular canals. Their presence, number, position, diameter and trajectory were established. *Results*: Lingual foramina in the midline of the mandible were observed in all 36 subjects. The number of canals varied from one to four, with the following distribution: one canal in 71.9% of the cases, two canals in 9.4%, three in 15.6%, and four canals in 3.1% of the cases. The average diameter of the canals was 0.84 mm. The average distance from the foramina to the base of the mandible was of 11.2 mm. 19.4% of the vascular canals penetrated only the lingual third of the width, 52.8% reached the middle third of the mandible and 27.8% of the canals spread to the buccal third. *Conclusions*: 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 foramina 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.

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 foramina 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, 2].

The increased usage of diagnostic imaging acquired by means of cone beam computed tomography (CBCT) has led to various studies of the medial region of the mandible. CBCT analysis reveals almost in every case the presence of lingual vascular canals in the midline or canine/premolar regions [3, 4]. Cadaver studies have indicated that the mandibular lingual foramina from the midline are penetrated by branches from the sublingual artery (branch of the lingual artery) or submental artery (branch of the facial artery) or branches resulting from the anastomosis between these vessels [5]. The artery is of sufficient size to present a difficulty in controlling hemorrhage intraosseously [6, 7]. Occasionally, the arterial structures can be accompanied by very small nerves, most likely part of the arterial vasomotor supply [8]. There was no evidence of a vein of compatible size to the present artery or of a neurovascular bundle.

It is therefore important for the dentist to be aware of the presence of these anatomical structures in the anterior mandible and to carefully examine the region when considering implant therapy or bone grafting techniques [9].

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

Materials and Methods

Thirty-six subjects underwent CBCT examination of the mandible for implant therapy. There were 20 men and 16 women, with an average age of 46 years, ranging from 25 to 70 years.

CBCT images were acquired using Picasso Trio from Vatech with a standardized exposure protocol, at 6 mA and 85 kVp. The tomographic volumes were analyzed with EzImplant-Plus software.

The anterior mandible was carefully examined on the midline and around the midline in order to detect the lingual foramina 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 position of the most upper foramen was described in relation to the genial tubercles, to the alveolar crest and the mandible base. The trajectory of the canals was analyzed on the sagittal slices and was judged to be horizontal, ascending or descending. On the axial slices, the trajectory of the canals was analyzed in relation to the midline. From this point of view, the trajectory was judged to be either

straight, either to the right or to the left. Any bifurcations were described in the sagittal plane and also the extent of penetration of the canals throughout the width of the mandible. All the measurements were performed by the same clinician.

Results

Lingual foramina in the median region of the mandible were observed in all 36 subjects (100% of the cases). The foramina were accompanied by canals in the bone, with distinct radio-opaque walls.

An average of 1.5 foramina/subject was identified in the midline. In 28.1% of the cases, more than one foramen and canal could be observed. The number of canals found in the midline varied from one to four, with the following distribution: one canal in 71.9% of the cases, two canals in 9.4%, three in 15.6% (Figure 1) and four canals in 3.1% of the cases.

In relation to genial tubercles, the canals were found right above them in 63.3% of the cases (Figure 2), below in 13.34% (Figure 3) and above and below (when there were multiple canals) in 23.3% of the cases.

The average diameter of the canals was 0.86 mm (SD 0.3), ranging from 0.52 to 1.74 mm. The results are consistent to similar studies [10, 11]. 31% of the canals had a diameter greater than 1 mm and if they are passed by arteries with a similar diameter, these vessels are large enough to cause bleeding in the floor of the mouth when injured (Figure 4, a and b).

The measurements regarding the position of the foramina were only performed for the most upper one, in case of multiple canals. In relation to the base of the mandible, the main foramen was at an average distance of 11.2 mm (SD 3.1), with a minimum of 5 mm and a maximum of 15 mm. The average distance to the alveolar crest was of 14.2 mm (SD 4.34), with a minimum of 6.2 mm and a maximum of 26.2 mm.

The lingual vascular canals traversed the bone to a variable extent. 19.4% penetrated only the lingual third of the width, 52.8% reached the middle third and 27.8% of the canals spreaded to the buccal third.

The orientation of the lingual vascular canals was evaluated in the sagittal plane. 62% of the canals had descending trajectory, 17.3% were solely anterior and 20.7% had an ascending trajectory. The results are consistent with similar studies [8].

In the axial plane, 54.5% of the lingual vascular canals had a trajectory slightly to the right, 36.3% were slightly to the left and 9.2% were oriented anteriorly.

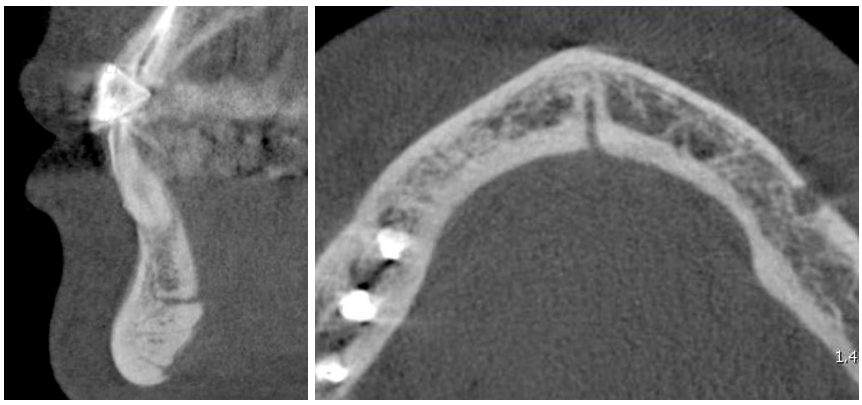
87.9% of the canals had a single trajectory, while 12.1% presented bifurcations (Figure 5).

Figure 1 – ***Multiple lingual vascular canals in the midline of the mandible.***

Figure 2 – ***Single lingual vascular canal located above the genial tubercles.***

Figure 3 – ***Multiple lingual vascular canals located below the genial tubercles.***

(a)



(b)

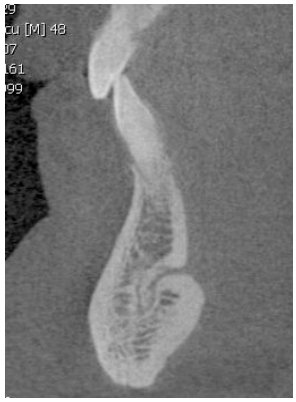


Figure 4 – ***(a) and (b): Sagittal and axial sections of a lingual vascular canal with a diameter larger than 1.5 mm. The injury of an artery of such a diameter can cause a serious bleeding of the surgical site.***

Figure 5 – ***Lingual vascular canals with bifurcations.***

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 osseo-integration and to provide a proper support for the prosthetic reconstruction.

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.

With CBCT examination, the lingual vascular canals in the midline were detected in this study in 100% of the cases, while with panoramic X-rays their presence was observed in 4.2% of the cases. The panoramic X-rays can offer little information on the presence of the lingual vascular canals, due to the superimposition of the cervical vertebrae and to the orientation of the X-ray beam in relation to the trajectory of the canals. If the X-ray beam is not parallel to the canal, it cannot be depicted. CBCT imaging proves to be superior to OPG imaging when investigating anatomical structures of the mandible [12].

Our study suggests that the lingual foramen is a consistent finding on the lingual side of the mandible in the midline, being present in all the CBCT investigations. The lingual vascular canals in the median region of the mandible are probably responsible for the arterial blood supply of this region and their anatomy has definite surgical implications in implant therapy and bone grafting techniques [8]. It is assumed that the diameter of the lingual vascular canal is proportional to the diameter of the entering artery. Although arteries with less than 1 mm in width are unlikely to cause a major hematoma, larger ones should be described in the radiological report, as they can present difficulty in control of the hemorrhage in the bone or in soft tissue [11]. In our study, 31% of the lingual vascular canals had a diameter of at least 1 mm.

The arteries from the lingual vascular canals are branches of the sublingual artery or the submental artery, which come in close proximity to the lingual cortical plate in the midline of the mandible. Even a minimal perforation of the lingual cortical plate can lead to bleeding in the floor of the mouth. Therefore, implant positioning in the midline of the mandible should be very carefully planned or, if possible, avoided by placing an even number of implants in the inter-foraminal region [13].

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.

References

[1] Ali A, Ahmad M, *Anatomical variations of the lingual mandibular canals and foramina*, Northwest Dent, 2008, 87(2):36–37.

[2] Kalpidis CD, Setayesh RM, *Hemorrhaging associated with endosseous implant placement in the anterior mandible: a review of the literature*, J Periodontol, 2004, 75(5):631–645.

[3] Katakami K, Mishima A, Kuribayashi A, Shimoda S, Hamada Y, Kobayashi K, *Anatomical characteristics of the mandibular lingual foramina observed on limited cone-beam CT images*, Clin Oral Implants Res, 2009, 20(4):386–390.

[4] Tagaya A, Matsuda Y, Nakajima K, Seki K, Okano T, *Assessment of the blood supply to the lingual surface of the mandible for reduction of bleeding during implant surgery*, Clin Oral Implants Res, 2009, 20(4):351–355.

[5] Kawai T, Asaumi R, Sato I, Yoshida S, Yosue T, *Classification of the lingual foramina and their bony canals in the median region of the mandible: cone beam computed tomography observations of dry Japanese mandibles*, Oral Radiol, 2007, 23(2):42–48.

[6] McDonnell D, Reza Nouri M, Todd ME, *The mandibular lingual foramen: a consistent arterial foramen in the middle of the mandible*, J Anat, 1994, 184(Pt 2):363–369.

[7] Nagar M, Bhardwaj R, Prakash R, *Accessory lingual foramen in adult Indian mandibles*, J Anat Soc India, 2001, 50(1):13–14.

[8] de Vasconcellos HA, de Siqueira Campos AE, de Almeida GH, Tan Maia ML, de Vasconcellos PHB, *The anatomy of the lingual foramen canal and its related to the mandibular symphysis*, Rev Chil Anat, 2000, 18(1):47–51.

[9] Whates E, *Essentials of dental radiography and radiology*, 2nd edition, Churchill Livingstone, 1999, 242–248.

[10] Scaravilli MS, Mariniello M, Sammartino G, *Mandibular lingual vascular canals (MLVC): evaluation on dental CTs of a case series*, Eur J Radiol, 2010, 76(2):173–176.

[11] Gahleitner A, Hofschneider U, Tepper G, Pretterklieber M, Schick S, Zauza K, Watzek G, *Lingual vascular canals of the mandible: evaluation with dental CT*, Radiology, 2001, 220(1):186–189.

[12] Dreiseidler T, Mischkowski RA, Neugebauer J, Ritter L, Zöller JE, *Comparison of cone-beam imaging with orthopantomography and computerized tomography for assessment in presurgical implant dentistry*, Int J Oral Maxillofac Implants, 2009, 24(2):216–225.

[13] Rosano G, Taschieri S, Gaudy JF, Testori T, Del Fabbro M, *Anatomic assessment of the anterior mandible and relative hemorrhage risk in implant dentistry: a cadaveric study*, Clin Oral Implants Res, 2009, 20(8):791–795.

Corresponding author

Iuliana Babiuc, PhD student, Department of Removable Prosthodontics, Faculty of Dentistry, "Carol Davila" University of Medicine and Pharmacy, 37 Dionisie Lupu, 020021 Bucharest, Romania; Phone +40724–776 020, e-mail: iuliba@yahoo.com

Received: January 11th, 2011 *Accepted: August 9th, 2011*