

CBCT and Foramina/Vascular Canals in the Anterior Mandible: a Systematic Review



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Introduction and Objectives

- Oral rehabilitation solutions with dental implants in the anterior mandible are a real therapeutic approach, especially in situations of advanced posterior mandible resorption and reduced bone height/distance between crestal bone and the mandibular canal.
- Dental implant placement between mental nerves is considered to be a safe and beneficial procedure⁽¹⁾ due to the high bone density of this area and due to the different approaches for oral rehabilitation: overdentures and hybrid prosthesis. These allow implant based solutions in patients with reduced bone height in the more posterior regions. Furthermore, this area is a reference for autologous bone grafting for oral reconstructive surgery⁽²⁾.
- Anterior mandible and floor of mouth vascularization is due to the intrabony branches of the sublingual arteries (from the lingual artery), which anastomose in the midline and penetrate the lingual cortical through lingual foramina. At this level, they anastomose with the alveolar arteries^(3,4). The presence of foramina allows for the formation of this rich vascular plexus which, if invaded, during surgical procedures, can provoke various clinical consequences⁽⁵⁾. However, in some cases, the submental artery (from the facial artery) irrigates this area and, in these cases, travels through the mylohyoid muscle and substitutes or anastomoses with the former^(6,7).
- As mentioned, surgical procedures in the anterior mandible are considered to be safe from a vascular point of view. However, early or late severity variable hemorrhage can occur. Between 1960 and 2012 19 cases of life threatening hemorrhage have been described after implant osteotomy in the anterior mandible in which perforation of lingual cortical bone was performed. These were mainly in the canine region⁽⁸⁾. In these cases, a massive immediate or late hemorrhage was reported on the floor of mouth with consequential lingual elevation and airway obstruction.
- CBCT is a diagnosis examination increasingly widespread and considered to be adequate for the localization of vascular canals and foramina in the anterior mandible⁽⁹⁾. It demonstrates high precision and low biological costs for the patient⁽¹⁰⁾.
- This study was performed based in one question: which are the vascular risks and the number of foramina/vascular canals that can be seen using CBCT previously to a surgical approach to the anterior mandible?
- This review has the objective to determine the usefulness of CBCT for: a) aid in the exact anatomical assessment of the anterior mandible prior to surgery; b) to prevent vascular surgical complications in the surgical approach to this region.

Methods

- An article search was performed using Medline (PubMed) regarding foramina/vascular canals of the anterior mandible and CBCT technology, published between 2009 and 2015.
- The following words were used in the search: “mandibular lingual foramina cone beam”. The search was completed with the review of the cited references of the selected articles in order to generate studies not initially identified. The revisers analyzed the titles of the results with the application of inclusion and exclusion criteria (see below). The authors performed a new selection of the selected articles after abstract analysis and, finally, the full text articles.
- For this study, from all the information included in the selected articles, only presence and identification of anterior mandible foramina and vascular canals was considered.
- Inclusion criteria in the study: 1) Articles published between 2009 and 2015. 2) Articles in English. 3) CBCTs obtained from live human subjects. 4) Studies that evaluate the number of foramina and vascular canals in the anterior mandible. Exclusion criteria: a) Literature reviews. b) Articles performed in pediatric patients. c) Data obtained from cadaveric studies. d) Studies that don't include the anterior region of the mandible (and exclusively focus on the posterior regions). The results were grouped in a frequency table and approximations were made to the hundreds.

Results

• 9 articles were selected (see Table 1).

STUDIES PERFORMED IN THE ANTERIOR AND POSTERIOR REGIONS OF THE MANDIBLE								
Author	Year	Number of Patients	Total Foramina/Vascular Canals	Anterior Mandible Totals		Symphysis Totals		
				n	%	n	%	
Katakami et al. ⁽¹¹⁾	2009	181	154	72	46,75%	47	30,52%	
Von Arx et al. ⁽¹²⁾	2011	198	217	123	56,68%	86	39,63%	
Kim et al. ⁽¹⁵⁾	2013	187	153	17	11,1%	-----	-----	
Sekerci et al. ⁽¹⁸⁾	2014	500	1591	987	62,03%	765	48,08%	
Wang et al. ⁽¹⁹⁾	2015	101	495	419	84,64%	196	35,59%	
STUDIES PERFORMED EXCLUSIVELY IN THE ANTERIOR MANDIBLE								
Babiuc et al. ⁽¹³⁾	2011	36	54	54	100%	36	66,67%	
Sheikhi et al. ⁽¹⁴⁾	2012	102	205	205	100%	-----	-----	
Di Bari et al. ⁽¹⁶⁾	2014	100	209	209	100%	123	58,85%	
OTHER STUDIES								
Romanos et al. ⁽¹⁷⁾	2012	299	85% of patients with intrabony canals					

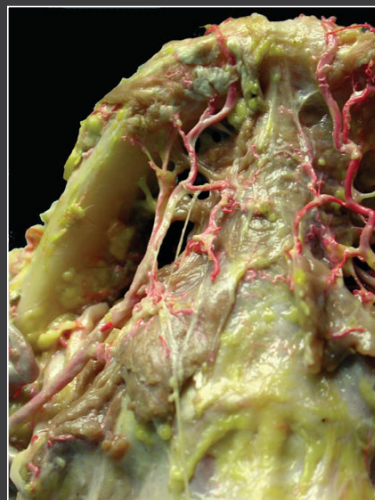


Figure 1 – Anatomical detail of the submental arteries

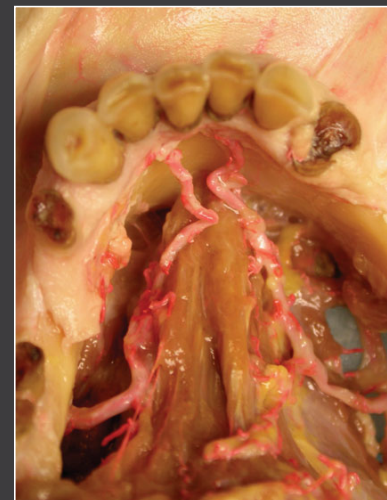


Figure 2 – Anatomical detail of the sublingual arteries

Conclusions

- After considering the frequency of observation of foramina and vascular canals, most studies indicate that the anterior mandible is a highly vascularized area.
- The mental symphysis presents a high concentration of foramina.
- Studies performed in the anterior and posterior mandible allow to conclude (except the study from Kim et al.) that there is an abundance of vascular canals in the anterior mandible. In this context, their location must be determined previously to the surgery in order to avoid iatrogenic vascular damage of the anterior mandible.
- CBCT allows the visualization of lingual foramina and to determine their location.
- CBCT is a useful tool in the diagnosis and surgical planning of the anterior mandible. The information on the regional presence of foramina is important to reduce the occurrence of vascular surgical complications in the anterior mandible.

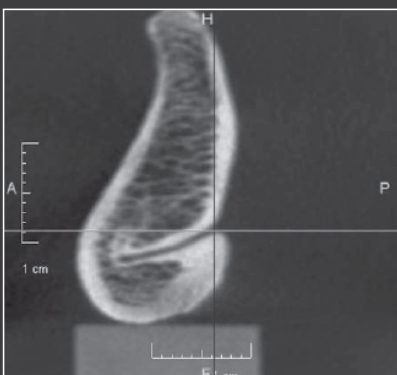


Figure 4 – Example of the lingual canal in the mental symphysis

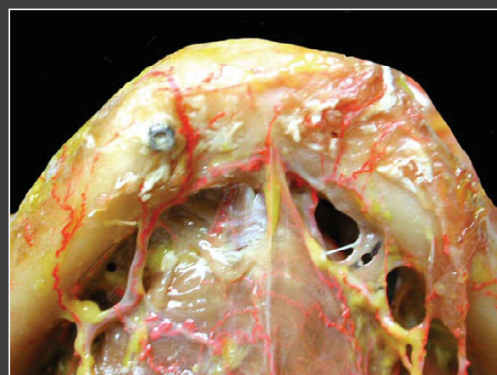


Figure 5 – Detail of submental vascularization with dental implant perforating the inferior border of the mandible

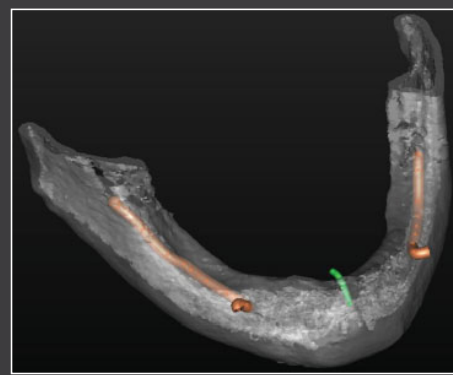


Figure 6 – Position of the neurovascular bundles



Figure 3 – Example of the lingual canal in the symphysis

Clinical Implications:

- By using CBCT for presurgical planning, the probability of vascular damage is reduced and, thus, the morbidity diminishes and the predictability is increased.

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