ORIGINAL RESEARCH PAPER

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EVALUATION OF RETROMOLAR CANAL PREVALENCE IN DIFFERENT FACIAL PATTERNS ON CONE BEAN COMPUTED TOMOGRAPHY

KEY WORDS: Anatomy, Surgery, Jaw.

George Borja De Freitas*	São Leopoldo Mandic Dental and Medicine School – SLM, School of Dentistry, Department of Radiology, Campinas, SP, Brazil *Corresponding Author
Paula Bernardon	Dentistry Master State University of Western Parana/Cascavel –PR/Brazil, 2014), Implantology Specialist (Paranaense University/Cascavel – PR/Brazil, 2013) - St. Ovalo Bilac, 1251, Cascavel, Paraná – Brazil
Irley Gonzaga Patriota	Dentist Integrated School of Patos, Patos-PB, Brazil
Milena Bortolotto Fellipe Silva	São Leopoldo Mandic Dental and Medicine School – SLM, School of Dentistry, Department of Radiology, Campinas, SP, Brazil
Alessandra De Freitas E Silva	São Leopoldo Mandic Dental and Medicine School – SLM, School of Dentistry, Department of Radiology, Campinas, SP, Brazil
Luiz Roberto Coutinho Manhães Jr	São Paulo State University – Unesp, Institute of Science and Technology, Department of Oral Radiology, São José dos Campos, SP, Brazil and São Leopoldo Mandic Dental and Medicine School – SLM, School of Dentistry, Department of Radiology, Campinas, SP, Brazil

ABSTRACT

This study aimed to evaluate the prevalence of the retromolar canal (RC) and retromolar foramen (RF) in different facial patterns in Cone Beam Computed Tomography. The sample consisted of 90 tomographies obtained from the São Leopoldo Mandic Faculty database, Campinas-SP/Brazil. These images were selected in three groups with 30 patients each, according to their facial type: mesofacial, brachyfacial and dolichofacial. RC and RF prevalence was 10.0%. 6.6% of the retromolar foramen presence was in women. Regarding the facial profile, the dolichofacial patients had a higher frequency of 13.3%, in the brachyfacials 10% and in the mesofacial ones 6.7%. 5.6% of the patients were affected on the right side, 1.1% on the left side and 3.3% on the both sides. According to the results obtained, it is concluded that retromolar foramen and retromolar canal are frequent anatomical variations (10%) and additional care should be taken to approach the retromolar region.

Introduction

In general, the mandibular canal comprises a single structure, however, in certain cases they may present variations such as a retromolar canal or bifid mandibular canal, if not identified, can cause complications during intraoral procedures (Bilecenoglu & Tuncer, 2006; Fukami, Shiozaki, Mishima, Kuribayashi, Hamada & Kobayashi, 2012; Kalantar, Navi & Sarabi, 2015; Kawai, Asaumi, Sato, Kumazawa & Yosue, 2012; Naitoh, Hiraiwa, Aimiya & Ariji, 2009; Teerijoki-Oksa et al., 2002). In addition, the presence of anatomical variations may be associated with increased difficulty in performing inferior alveolar nerve block, added to this concomitant discomfort to the patient. The most common complications are somatosensory damage during and after surgery, such as traumatic neuroma, bleeding and bruising (Claeys & Wackens, 2005; Fukami et al., 2012; Kaufman, Serman & Wang, 2000; Sanchis & Penarrocha, 2003; Reis, Abrão, Capelozza & Claro, 2006; Renton, Dawood, Shah, Searson & Yilmaz 2012; Wadhwani, Mathur, Kohli & Sahu, 2008; Yeong-Hoonk & Hun-Mu, 2015).

Retromolar canal (RC), as well as its foramen (RF), are anatomical variations present in the region of the retromolar trigone. Their presence is variable, according to Ossenberg (1987), Bilecenoglu and Tuncer (2006), through histological studies, the content of the these structures, are composed of arteriola, venule and myelinated nerve, coming from the inferior alveolar nerve, being able that this innervation extend to the areas of the temporalis muscle tendon, the buccinator muscle, the posterior region of the alveolar process and the third molar.

In addition, its path is not constant and can present itself in several ways, thus modifying the region to be innervated. Cephalometry is an examination of fundamental importance for the evaluation of facial profiles. Usually, radiographs or photographs are used, from which angular, linear or even proportional measurements are obtained (Benedicto et al., 2011). There are several nomenclatures to determine the type of facial pattern, with Ricketts has being the most used, which is the separation of the patterns in three facial types: I-mesofacial pattern (balanced growth), dolichofacial pattern II (vertical growth) and brachyfacial pattern III horizontal) (Ricketts, Bench, Gugin, Hilgers & Schulho, 1983).

Histological studies and examinations to date have revealed that the canal has a neurovascular bundle which has predominantly fine myelinated nerve fibers, innumerable venules and arterioles covered by collagen fibers and a small amount of adipose tissue. A recent study mentioned that the diameter of the nerve bundle ranged from 40 to 60 microns, the largest ranging from 80 to 180 microns. The largest arteriole had a maximum diameter of 600 microns (Von Arx, Bornstein, Werder & Bosshardt, 2011).

The aim of this study was to evaluate the prevalence of the retromolar channel in different facial patterns in concomitant computed tomography scans. Furthermore, to evaluate anatomical alterations of the mandibular canal and its clinical repercussions, to provide the knowledge and relevance of the anatomical alterations of the mandibular canal, to relate the presence of the retromolar channel between the types of facial patterns, to reveal the prevalence of the retromolar canal and foramen, relating this anatomical alteration to the different facial patterns.

Methods

The study was performed based on 90 tomographic exams obtained by the spontaneous demand of the patients attending the Department of Radiology of São Leopoldo Mandic Faculty, Campinas, SP/Brazil.

To select the tomographic acquisitions, all the exams were performed in the Classic I-Cat® (Imaging Sciences Internation, USA), with 0.25 mm standard voxel, Fov (Field of view) or 13 cm field of view and time of acquisition of 40 pulsating seconds according to manufacturer's standards, with a useful radiation time of 6.6 seconds. The factors used for these acquisitions were those pre-established by the equipment that works with 120 kV of fixed form and with variation of 5 and 7 mA according to the resolution.

All images were processed and worked on XoranCat® software (Xoran Technologies, USA) of the equipment itself. For the analysis of the tomographic images, the anatomical planes were first corrected in the tomograph's own workstation by the multiple planes reconstruction page (MPR).

With the axial cut (0.25 mm thickness), a cut plane was drawn that accompanied the bony ridge of each patient. With the realization of this, the panoramic image and the transversal cuts were formed. As standardization, for cross-sections, 1.00 mm thickness was used with a distance of 1.00 mm. In the panoramic reconstruction, the cut thickness was 5.25 mm.

Were included in this study the examinations with adequate tomographic quality of patients who performed concomitant computed tomography in the Department of Radiology and Imaging of the São Leopoldo Mandic Faculty of both genders.

Patients with a history of mandibular trauma, bone lesions in the lower arch, and orthognathic or restorative surgery in the posterior mandible were excluded from the sample.

For the facial type determination, the Ricketts cephalometric analysis (1982) was used by Vert Index. The tracing was performed on the images generated from the acquisition of the tomographies obtained in an I-Cat® cone beam scanner (Imaging Science, Hatfield, PA). The software used was Dolphin® Imaging version 11.0.

Once approved by the Research Ethics Committee of São Leopoldo Mandic Faculty, Campinas, Brazil, the work followed ethical and scientific principles established by Resolution 510/2016 of the National Health Council, which determines the guidelines and norms in research that involves the use of the collection.

The tomographic images were selected in three groups according to their facial type: mesofacial, brachyfacial and dolichofacial. The tomographic images underwent a process of standardization of their positioning, to select the cuts for measurement. The adjustments of the plans and lines were made. For the mandible was adjusted median sagittal line perpendicular to the ground and jaw base parallel to the ground. The 3x3 sharpen filter was used. The program used was Xoran (Xoran Technologies, USA)

The data were computerized using SPSS for Windows, v.22, descriptive statistical analysis using frequency, means and standard deviation were calculated. Initially, descriptive analyzes of the values obtained were performed, associated to the absolute (n) and relative (%) numbers of the data. To complement the statistical analysis, tables were performed between the types of facial profiles by the Anova test with significance of 95%, thus verifying the differences for each factor.

Results

In the 90 tomographies analyzed, 81 (90%) did not present alteration of the mandibular canal to the retromolar region. While 9 of that showed presence of RF and RC, indicating that the prevalence of this condition in the sample was 10.0%.

Among the 30 computed tomography scans (CTS) analyzed, 30 belong to the brachyfacial group, 30 to the mesofacial and 30 dolichofacial. Female prevalence was higher in 51 (56.7%) of the 90 CTS analyzed. Regarding the absolute and relative frequencies of RF and RC, according to location, 5 were exclusively on the left side, while in 3 other subjects (3.3%) the RF and RC were present only on the left side and 1 (1.1%) on both sides, as seen in Tables 1 and 2.

The group of brachyfacial patients was composed of 15 males and 15 females, with a mean age of 30.7 years. The frequency of RF and RC in these patients was 10%. 1 (3.3%) was affected exclusively on the left side, 1 (3.3%) on the right side and 1 (3.3%) on both sides, as observed in Table 3 and 4.

Among the mesofacial patients, the incidence of the female gender was 20 (66.7%) of the 30 patients, the age ranged from 13 to 28 years, with a mean of 17.6. The prevalence of RF and RC in this group was 6.7%, with 1 (3.3%) having left side and 1 (3.3%) both sides, data described in table 5 and 6.

Patients in the dolichofacial group had a mean age of 17.8, with the female being the most prevalent with 16 women, 53.3%. RC and RF incidence were highest, being present in 13.3% of cases, 10% in the left side and 3.3% in both sides, as described in Tables 7 and 8.

Table 1. Describes the age variation of all patients in the sample.

Variable	Mean	SD	Minimum	Maximum
Age	22,07	11,79	13	79

Table 2. Sample Distribution with respect to facial profiles, gender, presence of RF and RC and affected side.

Variables		*n*	%
	Brachyfacial	30	33,3
Facial Pattern	Mesofacial	30	33,3
	Dolichofacial	30	33,3
	Female	51	43,3
Gender			
	Male	39	56,7
Retromolar Foramen Presence	Yes	9	10,0
	No	81	90,0
	Right	1	1,1
	Left	5	5,6
Affected Side			
	Boths sides	3	3,3
	Not affected	81	90,0

Table 3. Describes the age variation of brachycephalic patients.

Variable	Mean	SD	Minimum	Mximum
Age	30,77	17,79	13	79

Table 4. Distribution of relevant variables to brachycephalic patients

Variables		*n*	%
Gender	Male	15	50,0
	Female	15	50,0
Retromolar Foramen Presence	Yes	3	10,0
	No	27	90,0
	Right	1	3,3
Affected Side	Left	1	3,3
	Both Sides	1	3,3
	Not affected	27	90,0

Table 5. Distribution of age in mesocephalic patients.

Variable	Mean	SD	Minimum	Maximum
Age	17,60	2,660	13	28

Table 6. Distribution of the variables corresponding to patients in the mesocephalic group.

Variable		*n*	%
Gender	Male	10	33,3
	Female	20	66,7
Retromolar Foramen Presence	Yes	2	6,7
	No	28	93,3
	Right	0	0,0
Affected Side	Left	1	3,3
	Both sides	1	3,3
	Not Affected	28	93,3

Table 7. Age variation in dolichofacial patients.

Variable	Mean	SD	Minimum	Maximum
Age	17,83	2,33	14	22

Table 8. Distribution of variables with regard to dolichofacial patients.

Variables		n	%
Gender	Male	14	46,7
	Female	16	53,3
	Yes	4	13,3
Retromolar Foramen Presence	No	26	86,7
	Right	0	0,0
Affected Side	Left	3	10,0
	Both Sides	1	3,3
	Not affected	26	86,7

Discussion

The canal mandibular morphology understanding and its anatomical variations are of great importance for the planning of surgical procedures in the region. Lack of knowledge can lead to failure of the conventional anesthetic technique, as well as intermittent bleeding in the trans surgical.

Chavez-Lomeli Mansilla-Lory, Pompa and Kjaer (1996) reported that the mandibular canal is formed from the union of three individual nerve branches at different stages of development. In addition to the fusion of the nerve branches, the formation of bone channels around such nerves occurs. During prenatal growth, bone remodeling develops through intramembranous ossification that will definitely originate the mandibular canal. This theory explains the occurrence of retromolar canals and bifid mandibular canals, in some patients, attribute to incomplete fusion of these three nerves (Sanchis et al., 2003).

Chilvarquer, Chilvarquer, Saddy and Hayek (2007), defend the use of panoramic radiography to detect changes in the mandibular canal, and stated that panoramic radiography is the exam of choice in the initial planning of dental patients due to small doses of ionizing radiation, low cost and allows an evaluation of the maxillo-mandibular complex. However, for Orhan, Aksoy, Bicenoglu, Sakul and Paksoy (2011), the anatomical alterations identification of the mandibular canal in panoramic radiographs is hampered by ghost images created by the opposing hemi-mandible, pharyngeal space, soft palate and uvula.

Histological studies revealed that RC has a neurovascular bundle and contains mostly fine myelin nerve fibers, innumerable venules and arterioles, covered by collagen fibers and a small amount of adipose tissue (Von Arx et al., 2011).

Cavalcanti (2013) advocated the use of CT that is an imaging diagnostic method, which uses X-ray to reproduce a section of the human body in one of three planes of space (axial, sagittal or coronal). Unlike conventional radiographs, which project in a single plane all structures crossed by X-rays, overlapping anatomical structures, the CT shows the relationships in depth. The technique provides images in "slices" of the human body, allowing to analyze all the structures in layers, mainly of the mineralized tissues, allowing the delimitation of three-dimensional irregularities (Carvalho, 2012).

According to Perin, Suzuki, Ferandes, Westphalen And Schussel (2004), the vast majority of dental surgeons are unaware of the mandibular canal anatomical variations, and the presence of these variations has a number of clinical implications when not previously identified. These variations can bring complications to anesthetic and surgical practices. According to Neves Rodrigues, Burgos, Oliveira, Campos and Rebello (2009), it is up to the dental surgeon to know the possible anatomical variations of the mandibular canal, in order to reduce the risk of failure during surgical or anesthetic techniques.

Not differently, in this study, the CBCT was used to visualize the structures in three-dimensional form and it was verified that the RC and RF were observed in 10.0% of the cases. Previous studies with panoramic radiographs have reported incidences lower than 1% (Nortjé, Farman & Grotepass, 1977; Sanchis et al., 2003). However, studies with CBCT images showed a much higher incidence with percentages of prevalence ranging from 15.6% to 65% (Kuribayashi et al., 2010; Naitoh et al., 2009; Ohran et al., 2011; Oliveira-Santos, Capelozza, Dezzoti, Fischer, Poleti & Rubira-Bullen, 2011).

The present study documented the prevalence of the retromolar foramen and its canal, relating this anatomical alteration to the different facial patterns. The prevalence in our research was 10.0%, in a total of 90 CT scans analyzed. Based on the literature, the previous studies with dry jaws and by computed tomography evaluation, the values range from 3.2% to 75.4% (Alves & Deana, 2015). The RF was predominantly found in women in our study 6.6% and 3.3% in men. A study of a sample of 475 skulls from dry cadavers revealed a higher rate of occurrence of RF in male skulls of 9.6% and 6.1% in females (Pyle, Jasinevicius, Lalumandier, Kohrs & Sawyer, 1999). However, some authors have not mentioned gender preference in previous studies.

Regarding the facial profile, the dolichofacial patients had a higher frequency (13.3%), 10% in the brachyfacials and 6.7% in the mesofacial. No study was found in the literature that related the presence of the retromolar foramen and canal with the type of facial profile, thus confirming the importance of this study. The RC and RF were unilaterally more frequently 6.7%, being 5.6% affected on the right side, 1.1% on the left side and both sides with 3.3%. Some authors have shown a higher incidence on the right side, corroborating the results of our work (Narayana, Nayak, Ahmed, Bhat & Devaiah, 2002; Han & Hwang, 2014). In addition, other studies found higher prevalence of the left side (Motta-Junior, Ferreira, Matheus & Stabile, 2012; Priya, Manjunath & Balasubramanyam, 2005) as well as some authors found no predilection for the affected side in their studies (Muinelo-Lorenzo, Suárez-Quintanilla, Fernández-Alonso, Marsillas-Rascado & Suárez-Cunqueiro, 2014; Patil, Matsuda, Nakajima, Araki & Okano, 2013).

In relation to the morphology of the canal, in most cases it presents a vertical course or in a superior direction, to end in the RF (Von Arx et al., 2011). Kawai et al. (2012) state that CRM generally has an alveolar direction or the lingual portion of the mandibular canal. In this study, all RC and RF showed a superior or alveolar direction, which increases the chances of accidents and vascular and neurological complications during surgeries in this anatomical region. According to Von Arx et al. (2011), the important aspect of RC is the fact that it contains the nerve responsible for innervating the most posterior region of the alveolar process, including the mandibular molars.

Conclusion

According to the results obtained in the research, it can be confirmed that the RC and RF are frequent anatomical variations. Thus, specific care should be taken in surgical procedures, such as third molar extraction, removal of grafts, installation of mini implants and sagittal osteotomies of the mandibular ramus. It ratifies that these interventions can lead to complications in the intraoperative period such as hemorrhages and another's complications.

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