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POSTOPERATIVE INFERIOR ALVEOLAR NERVE PARESTHESIA AND IMPACTED THIRD MOLAR DISTANCE TO THE MANDIBULAR CANAL

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ABSTRACT

The goals of this study were to assess the incidence of inferior alveolar nerve (IAN) paresthesia after impacted lower third molars extraction and to observe the distance between them and the mandibular canal (MC) cortical using cone beam computed tomography (CBCT). For this study, 29 patients with both impacted lower third molars (totaling 58 teeth) were selected. They initially underwent clinical examination and evaluation of preoperative sensory condition according to standard protocol for nerve injury. Subsequently, they underwent CBCT and third molar extraction at the Oral and Maxillofacial Surgery Residency Program from the Western Paraná State University. On the seventh postoperative day, they were submitted again to the sensory analysis protocol to check for IAN paresthesia. In CBCT, the distance between the MC cortical bone and the tooth was determined by the arithmetic mean of the closest measurement of these two structures in each of the tomography three sections (axial, coronal and sagittal). There was one paresthesia case (1.72%) and regarding the CBCT, 57 third molars were in close contact with the MC. It was concluded that CBCT played an important role in surgical planning and it is believed that its use contributed to the considerably low IAN paresthesia rate.

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INTRODUCTION

Due to the proximity of impacted lower third molars to the mandibular canal (MC), one of the possible complications resulting from extractions of these teeth is paresthesia of the inferior alveolar nerve (IAN) (Ramadorai *et al.,* 2019; Malkawi *et al*. 2011). This condition is uncomfortable to the patient and can be defined as a sensory disturbance that, in the region of the injured nerve, may present symptoms like numbness, edema, tingling, electric sensation and, rarely, pain and burning sensation (Ramadorai *et al.,* 2019).

Though several accidents and complications may result from extraction of impacted lower third molars, (Ramadorai *et al.,* 2019; Malkawi *et al.* 2011) the prophylactic removal of these dental elements is necessary, since they may cause resorption of the adjacent second molar roots and promote pathologies like dentigerous cyst, odontogenic keratocyst and ameloblastic carcinoma (Chu *et al*., 2003; Campbell, 2013). Thus, the professional must seek resources to enable an appropriate surgical planning, in order to avoid setbacks during surgery and provide a better experience to patients.

In this regard, an exceptional tool for impacted lower third molar extractions is the cone-beam computed tomography (CBCT), which presents advantage over the panoramic radiography, because, in addition to enabling a tridimensional view of the tooth to be removed, it can also check the actual relation of this element with the MC, structure that contains the IAN (Harada *et al.,* 2015; Ghai *et al.,* 2018).

In face of the need to analyze the results of this imaging exam in extractions of impacted lower third molars, the present study's objective was to assess the incidence of IAN paresthesia in surgical removals of these elements, and observe, via CBCT, the distance between these removed teeth and the MC cortical bone. The hypothesis is that the group of teeth closer to the MC would present higher incidence of paresthesia. Moreover, it was believed that the elements would be evenly distributed across the groups indicated according to the distances observed in CBCT.

MATERIALS AND METHODS

This is a prospective interventionist study aimed at assessing the incidence of paresthesia in IAN after extractions of impacted lower third molars and analyzing the distance between these teeth and the MC cortical bone, using CBCT.

The project of the present study was submitted on "Plataforma Brasil" (Ethical Appreciation Presentation Certificate – 29775220. 0.0000.5696) and obtained approval by the Committee of Ethics in Research with Human Beings of Londrina Evangelic Beneficent

Association (AEBEL) by means of opinion 3.940.628. Moreover, all participants that accepted to participate in the study signed Free and Informed Consent (TCLE). With regard to qualification criteria for selection of the sample, inclusion criteria considered were: patients of both genders, regardless of ethnic group, from 12 to 61 years old, presenting the two lower third molars impacted and that fit in ASA I or ASA II groups as determined by the American Society of Anesthesiologists (Mayhew *et al*., 2019). Exclusion criteria were: pregnant women with tooth 17 and/or 32 associated to one or more pathologies that demonstrated pre-operative sensory alterations in the execution of the standard protocol for assessment of nerve injury, following the model of the University of Illinois' Chicago College of Dentistry, Department of Oral & Maxillofacial Surgery (Chicago, Illinois, USA) (Zuniga *et al*., 1998), and that presented conditions that prevented the application of some of the stages established for the procedures (for example allergy to medications, except for amoxicillin). With these criteria, 29 patients were selected, corresponding to a sample with 58 teeth extracted. For the surgical procedure, the patients were initially subjected to clinical examination, then to the indicated sensory analysis protocol, and, finally, the CBCT. Exodontias of elements were conducted and on the seventh postoperative day the patients returned for removal of sutures, assessment and postoperative sensory analysis.

With regard to the standard protocol for nerve injury assessment, following University of Illinois' Chicago College of Dentistry, Department of Oral & Maxillofacial Surgery (Chicago, Illinois, USA) model, it was executed in the preoperative period, in order to check that the patient did not present sensory alteration before the surgical procedure and, also, on the seventh postoperative day, in order to diagnose possible presence of paresthesia in IAN. The protocol, similarly conducted in both periods, comprises two parts: subjective and objective. The subjective part contains questions on the sensory conditions of the patient in the face and neck region, as well as description and location of the sensory alteration, where appropriate. The objective part refers to the patient responses to stimuli of 5 tests with different levels (A, B and C) made in demarked areas in the chin. These areas were delimited as shown in Figure 1a, and each of the 5 tests was applied 10 times in each of the 4 regions of the hemi-chin, with patients blindfolded (Zuniga *et al*., 1998; Bhat *et al*., 2012).

The first test, level A, is called "two-point discrimination test" (Figure 1b) and consists in verifying, with assistance of a plastic caliper (Jon Indústria e Comércio de Produtos Odontológicos LTDA, São Paulo, SP, Brazil), the shorter distance for the patient to identify the stimulus in two points. The reference value for this test is 12 mm, with higher values indicating injuries in slow adaptation A-α fibers (Zuniga *et al*., 1998; Bhat *et al*., 2012).

The second test, level A, is called "brush stroke direction" (Figure 1c) and consists in making movements in different directions using brush number 2 (Tigre, Joinville, SC, Brazil). After each movement the patient must imitate it with the hand and in case he/she does not hit 80% of the movements made, it means that there is injury in slow adaptation A-α fibers and/or slow adaptation A-β fibers (Zuniga *et al*., 1998; Bhat *et al*., 2012).

The third test, level B, is called ''contact detection'' (Figure 1d) and is performed with a stadiometer kit (Sorri Bauru, Bauru, SP, Brazil). This test consists in inserting monofilaments on the skin that produce different forces according to their thickness. The devices are applied in ascending order of thickness, and when the patient is asked to raise the hand when he/she perceives this stimulus. At this moment the value of the force applied by the instrument is written down, and it is supposed that the patient will feel at least a four-gram force, represented by the fourth monofilament, otherwise it will be considered that there was injury in rapid adaptation A-α fibers (Zuniga *et al*., 1998; Bhat *et al*., 2012).

The fourth test, level C, is called ''sharp blunt discrimination'' (Figure 1e) and is performed with exploratory probe number 5 (Golgran, São Caetano do Sul, SP, Brazil). One of the ends is fixed in a 4 mm diameter cylindrical rubber so as to reproduce a blunt surface. These two methods of stimulus (acute and blunt) are randomly inserted and the patient is expected to hit at least 80% of the times to prove that there was no injury in A-δ and C fibers (Zuniga *et al.,* 1998; Bhat *et al*., 2012).

The fifth test, level C, is called ''thermal testing'' (Figure 1f) and aims at analyzing the patient's capacity to detect hot and cold stimuli. For the hot stimulus, Emitter A Fit curing light (Schuster Equipamentos Odontológicos, Guilin, Guangxi, China) is used and for the cold stimulus gauze with Endo Ice Spray (Maquira Indústria de Produtos Odontológicos S.A, Maringá, PR, Brazil) is used, clamped with clinical tweezers (Golgran, São Caetano do Sul, SP, Brazil). In case the patient does not hit at least 80% of the test, it means that there was injury in A-δ and/or C fibers (Zuniga *et al.,* 1998; Bhat *et al*., 2012).

Patients were classified in 5 groups according to the tests' results, in ascending order of sensory alteration: 1) Normal: patient did not present negative results in any of the tests; 2) Paresthesia level A: patient presented negative result in the two-point discrimination test and/or in the brush stroke direction test; 3) Paresthesia level B: patient presented negative result in the "contact detection'' test; 4) Paresthesia level C: patient presented negative result in the ''sharp blunt discrimination'' test and/or in ''thermal testing''; 5) Anesthesia: Patient does not perceive any stimuli (Zuniga *et al.,* 1998; Bhat *et al*., 2012).

To obtain cone beam tomography images, OP 300 – INSTRUMENTARIUM – Instrumentarium Dental, PaloDEx Group Oy Nahkelantie 160 (P.O. Box 20) FI-04300 Tuusula was used. The tests were performed by the same technician, following the manufacturer's protocol.

After the positioning, the tomography images were obtained with 4x6 cm FOV, and the CBTCs were saved and exported in DICOM format (Digital Image Communication in Medicine) for later assessment. The images were analyzed in axial, coronal and sagittal sections, in MPR (multiplanar reconstruction) with Ondemand 3D Dental-Dental DBM software, and filed in the Western Paraná State University (UNIOESTE) Radiology Laboratory data bank. The location of the impacted teeth was based on the arithmetic mean of the closest distance between the dental element and the MC cortical bone in each of the three CBCT sections: axial, coronal and sagittal (Figure 2). Measurements were made by two previously calibrated researchers under radiologist supervision so as to obtain a more precise result, with lower margin of error. After analysis of structures in CBCT, the elements were categorized in the following groups, according to the measurements obtained: 1) tooth in which the distance is null (0.00 mm); 2) distance larger than 0 mm and shorter than 1 mm; 3) distance larger or equal to 1 and shorter than 2 mm; 4) distance larger or equal to 2 mm and shorter than 3 mm; and 5) distance larger or equal to 3 mm.

Residents from UNIOESTE Oral and Maxillofacial Surgery Residency Program, were responsible for the surgical procedures. The operators underwent a calibration process and conducted the extraction following the same surgical technique, prescribing the same pre and post-operative medication, and using the same local anesthetic and suture thread. All patients participating in the study received, one hour before the surgery, 8 mg of dexamethasone, oral, to reduce edema and postoperative discomfort (Chaudhary *et al*., 2015). Procedures were conducted under local anesthesia, with blocking of inferior, lingual and oral alveolar nerves and subperiosteal infiltration. For such, mepivacaine hydrochloride 2% with adrenalin 1:100.000 was used.

The surgical technique used was based on Miloro principles (Miloro *et al.,* 2012). The appropriate access to the bone and subjacent tooth was made by means of planned soft tissue flap; the bone had to be removed with atraumatic, aseptic and refrigerated technique, with the least possible bone tissue amount removed and harmed. The tooth, when necessary, was divided into sections and extracted with dental elevators, with suitable force to avoid complications. The surgical wound was debrided and irrigated to provide the best possible environment for cicatrization in the postoperative period. The surgical technique chosen for removal of impacted tooth consisted in raising the mucoperiosteal flap, with suitable size, to enable access to the surgical site with an envelope flap extended from the anterior border of the mandibular branch, not straightly, to avoid damage to the lingual nerve, following with a relaxing incision in the mesial of the second molar (Miloro *et al*., 2012; Miloro *et al*. 1997). The mucoperiosteal flap was raised laterally to the external oblique line with the periosteal elevator and kept in this position with a modified Farabeuf retractor or Minnesota retractor, thus obtaining access to the region.

The second step was the removal of the bone around the impacted tooth, which was removed, where necessary, bone in occlusal, vestibular and distal regions, with high speed handpieces and 702 bur. Once sufficiently exposed, the tooth was sectioned in parts in order to take it out from the alveolus with dental elevators. After the tooth removal from the alveolar process, there was mechanical removal in the cavity and, in the area below the flap, with periapical curette and bone file was used to smooth any sharp or rough bone edge. Halsted hemostatic forceps was used, carefully, to remove remnants of the dental follicle. The location was fully irrigated with sterile saline solution (30 to 50 ml). The incision was closed by first intention, since the flap tissue was placed in the original position and sutured with simple stitches with 4-0 or 5-0 nylon (Miloro *et al*., 2012).

During the postoperative period, with standard medication used at UNIOESTE, amoxicillin 500 mg, oral, at each 8 hours for 7 days, nimesulide 100mg, oral at each 12 hours for 3 days and Dipyrone 500 mg, oral, at each 6 hours for 24 hours and after that in case of pain were prescribed. For those allergic to penicillin, the prescribed antibiotic was clindamycin 300 mg, oral, at each 8 hours for 7 days. In the 7-day postoperative period assessment, in case of paresthesia, the patient received free treatment with laser therapy at UNIOESTE, following clinical protocol for laser MMO (MMOptics Ltda, São Carlos, SP, Brazil) recommended by the manufacturer. Infrared 808 nm laser was used in fixed power of 100 mW, according to the subsequent application mode for paresthesia: cover of the whole nerve area, from 50 to 80 seconds per stitch, using 5J to 8J energy, always starting with the lower energy and increasing it over the treatment, depending on the clinical response. Since the paresthesia was recent, daily applications were made in the first week, or at least twice a week.

To obtain the results the demographic data of patients, distances measures in CBTC, as well as the presence and level of paresthesia in IAN were observed to calculate the incidence of this complication.

RESULTS

After application of the methodology, it was observed that the patients selected were mostly white women from 20 to 29 years old (Table 1).

As to the proximity of impacted inferior third molars to the MC cortical bone, it was observed that in almost all cases these structures were in close contact (Table 2).

Table 1. Demographic data of selected patients (n=29).

	Age			Color	
	< 20 years	20 - 29 years	>29 years	White	Brown
Sexo					
Female (24)	12	11	1	18	6
Male (5)	1	4	0	5	0
Total (29)	13	15	1	23	6

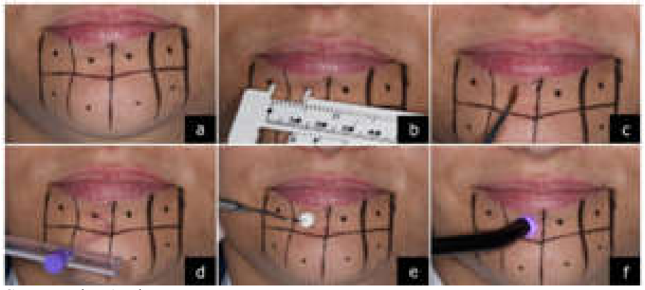
Source: the Authors

With regard to occurrence of paresthesia in IAN, only one patient presented this condition, which represents 1.72% incidence. The participant was 18 years old, white, and presented distance equal to 0 between the third molar and the mandibular canal cortical bone (Figure 2a, 2b and 2c) and, in this case, sensory alteration was classified as level A left IAN paresthesia, since the patient presented negative result only in the two-point discrimination test.

Table 2. Distribution of dental elements in groups according to paresthesia presence after exodontia and the distances between these teeth and the mandibular canal cortical bone (n=58)

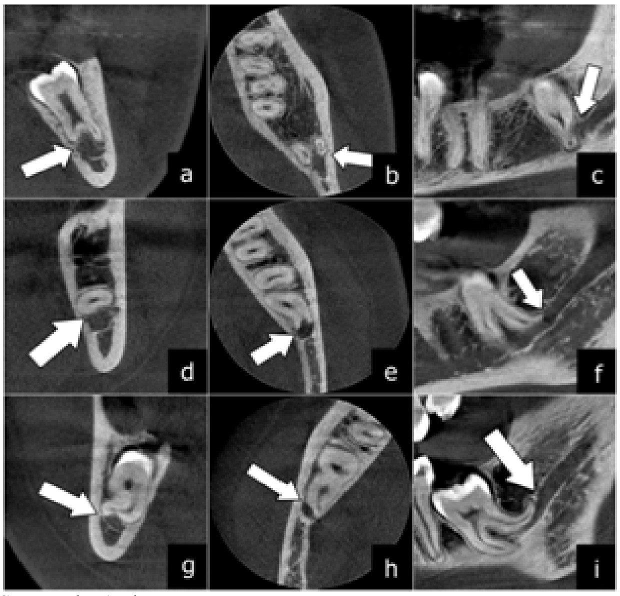
	0mm	>0mm and<1mm	≥1mm and<2mm	≥2mm and<3mm	≥3mm
Total (58)	57	0	0	1	0
Paresthesia (1)	1	0	0	0	0
Withoutsensory alteration (57)	56	0	0	1	0

Source: the Authors



Source: the Authors

Figure 1. (a) Demarcation of areas to conduct the objective part of the sensory analysis protocol (b) Two-point discrimination test. (c) Brush stroke direction. (d) Contact detection. (e) Sharp blunt discrimination. (f) Thermal testing.



Source: the Authors

Figure 2. Images obtained during the tomography analysis of dental elements. (a) Patient 1, tooth 17, coronal section, distance = 0. (b) Patient 1, tooth 17, axial section, distance = 0. (c) Patient 1, tooth 17, sagittal section, distance = 0. (d) Patient 2, tooth 17, coronal section, distance = 0. (e) Patient 2, tooth 17, axial section, distance = 0. (f) Patient 2, tooth 17, sagittal section, distance = 0. (g) Patient 3, tooth 32, coronal section, distance = 0. (h) Patient 3, tooth 32, axial section, distance = 0. (i) Patient 3, tooth 32, sagittal section, distance = 0

DISCUSSION

The study results showed that, because the third molars were impacted, the tendency was that some region of the tooth was in close contact or inside the MC. In this regard, the shorter the distance between these structures, the higher the risk of injury in IAN during the odontoectomy of third molars (Miloro *et al*., 2005). The erupted lower third molars, compared to those impacted, are more distant from the MC. That would suggest that the risk of iatrogenic injury in IAN with a drill, for example, would be lower than that of impacted lower third molars, which requires bone removal and, sometimes, section of the tooth (Miloro *et al*., 2005). According to the literature, the incidence of injury in IAN after removal of lower third molars is 0.4 - 8% (Rood, 1983; Carmichael *et al*., 1992). In our study, the incidence of paresthesia was 1.72%, a low rate in the interval of values presented by the literature. (Sarikov and Juodzbalys, 2014) claimed that age above 24 years, horizontal impaction in radiography and extraction by surgeons with little skill are considered risk factors that can increase the chances of causing injury in the nerve. However, in other studies, statistical analysis showed that paresthesia was not associated to age, sex, location, dental angulation of the impacted element, operator level, bone removal or dental division (Ramadorai *et al*., 2019). The visualization of the whole IAN beam during surgery of lower third molars points to a close relationship of this nerve structure with the mentioned tooth and represents 20% risk of postoperative paresthesia and 70% chance of regenerating in one year (Tay *et al*., 2004). In our study, though 98% of the elements were in close contact or inside the MC, there was low incidence of paresthesia, when compared to other studies, which can be explained by the surgical planning using CBCT, which enabled the acquisition of a tridimensional image, which, in turn, enabled more precise observation of the MC relation with the impacted lower third molar. In this regard, a study published by Umar *et al*. (2013) concluded that the use of CBCT was useful to avoid IAN injury during the transoperative period. The use of CBCT brings many advantages, like tridimensional images and the possibility of basic improvements, addition of annotations and measurement algorithms guided by cursor, which provide interactive capacity for dimensional assessment in real time (Scarfe *et al*., 2008). Moreover, compared to other imaging exams, the CBCT presents significantly lower effective radiation dose (Patel, 2009) and its benefits, like for example IAN exact localization, assist the surgeon in distinguishing safe regions from hazardous zones to measure the dislocation direction (Jung *et al*., 2012). From this same perspective, panoramic radiographies present the following disadvantages: producing only a bidimensional view with mistaken denotations of complex tridimensional structures, overlapping, distortion and magnification (Ghai *et al*., 2018).

In cases of paresthesia, most of the times full recovery occurs from 6 to 8 weeks after the nerve injury, though it can last up to 24 months. If, within around 2 months the condition is not fully solved, the probability of permanent sensory alteration increases significantly (Robinson, 1988). Such information is highly important for the treatment planning, as well as the injury recovery prognosis. In our study, only level A sensory alteration was observed, which corroborates information in the literature, because there was significant improvement in this condition in the first month, and absence of paresthesia symptoms in the second month. The study limitations included difficulties in the sample recruitment due to the pandemic, patients that presented agenesia in one of the third molars and lack of commitment of the study participants in terms of attending consultations or make the CBCT on the dates and times previously scheduled. Such setbacks limited the sample number. Considering the study conducted, we can conclude that the distance from impacted lower third molar to MC can influence the occurrence of paresthesia; however it is not the preponderant factor. Moreover, it was observed that the CBCT enable an efficient surgical planning, with the perspective of tridimensional localization of the dental element in relation to the MC, thus drastically reducing the possibility of paresthesia. So, the use of CBCT can be the factor that influenced the low rate of paresthesia in our study.

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