

RAFAEL REZENDE CARDOSO

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cortical óssea lingual durante a extração de terceiros
molares inferiores por meio da tomografia
computadorizada de feixe cônico**

Analyses of the factors that influence the injury of the lingual
plate bone during the extraction of lower third molars using
cone beam computed tomography

Dissertação apresentada à Faculdade de
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para obtenção do Título de Mestre em
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RESUMO

Em cirurgias para extração de terceiros molares inferiores podem acontecer várias complicações, entre elas, o rompimento da cortical lingual, cuja ocorrência pode ser influenciada por fatores anatômicos locais. Esse rompimento pode ocasionar a lesão do nervo lingual, gerando consequências neurológicas. O objetivo do estudo foi determinar os fatores que influenciam na lesão da cortical lingual durante a extração de terceiros molares inferiores impactados, através da tomografia computadorizada de feixe cônico (TCFC), tendo em conta a posição dos terceiros molares e a espessura da cortical lingual medida em diferentes níveis anatômicos. Foram utilizadas 36 imagens de TCFC de 35 terceiros molares inferiores, obtidas em dois momentos (Pré-operatório e 7 dias depois). Nas imagens pré-operatórias foram avaliados 6 parâmetros: espessura da cortical lingual, profundidade da impacção, angulação mesiodistal, angulação vestibulolingual, morfologia da cortical lingual e relação topográfica entre o ápice da raiz e a cortical lingual. Nas imagens pós-operatórias foi avaliada a cortical lingual, tendo sido classificada em íntegra ou rompida. A análise estatística para avaliar a influência das diferentes variáveis no rompimento da cortical lingual foi feita por meio de regressão linear logística. De todas as variáveis testadas, apenas a espessura da cortical lingual medida no nível da junção amelocementária influenciou significativamente na ocorrência do rompimento da mesma ($p=0.007$). Conclui-se que a espessura da cortical lingual no nível da junção amelocementária deve ser levada em conta durante o planejamento cirúrgico, com o intuito de evitar a ruptura da mesma, tendo ficado clara a importância da TCFC no planejamento cirúrgico e diagnóstico de complicações.

PALAVRAS-CHAVE: Terceiro molar; Dente impactado; Fratura óssea; Tomografia Computadorizada de Feixe Cônico

ABSTRACT

In surgeries for the extraction of lower third molars, several complications can occur, among them, the rupture of the lingual plate, whose occurrence can be influenced by local anatomical factors. This disruption can cause damage to the lingual nerve, with neurological consequences. The objective of the study was to determine the factors that influence lingual plate damage during the extraction of impacted mandibular third molars, through cone beam computed tomography (CBCT), taking into account the position of the third molars and the thickness of the lingual plate measured at different levels anatomical. 36 CBCT images of 35 mandibular third molars were used, obtained in two moments (Preoperative and 7 days later). In the preoperative images, 6 parameters were evaluated: lingual plate thickness, impaction depth, mesiodistal angulation, buccolingual angulation, lingual cortical morphology and topographic relationship between the root apex and the lingual cortical. In the postoperative images, the lingual plate was evaluated and classified as intact or ruptured. Statistical analysis to evaluate the influence of different variables on disruption of the lingual plate was performed using linear logistic regression. Of all the variables tested, only the thickness of the lingual plate measured at the level of the cementoenamel junction significantly influenced the occurrence of its disruption ($p=0.007$). It is concluded that the thickness of the lingual plate at the level of the cementoenamel junction should be taken into account during surgical planning, in order to avoid its rupture, and the importance of CBCT in surgical planning and diagnosis of complications has become clear.

KEYWORDS: Third Molar; Impacted Tooth; Bone Fracture; Cone Beam Computed Tomography

1. INTRODUÇÃO E REFERENCIAL TEÓRICO

A extração de terceiros molares tanto de forma profilática quanto terapêutica é um dos procedimentos realizados com mais frequência no campo da cirurgia bucal (AKTOP et al., 2017; AL ALI; JABER, 2020; ISSRANI et al., 2021), com possíveis complicações que podem ocorrer durante e/ou após essa cirurgia, conforme relatado na literatura (EMES et al., 2015; HUANG et al., 2020). Durante a exodontia dos terceiros molares inferiores em especial, pode ocorrer o rompimento da cortical lingual que por sua vez, pode ocasionar a ocorrência da lesão do nervo lingual (AMIN et al., 2020). Tal complicação neural tem uma incidência que varia entre 0,5 e 6% e geralmente cura-se espontaneamente (TOLSTUNOV et al., 2016), no entanto, alguns casos evoluem para parestesias permanentes, hipoestesia, disestesia e distúrbios de fala ou mastigação, podendo afetar a qualidade de vida (MENZILETOGLU et al., 2019).

Essas complicações decorrentes das exodontias dos terceiros molares podem ter relação com a anatomia da região, posição dos dentes e performance do profissional (HUANG et al., 2020). As características anatômicas da cortical lingual constituem um fator potencial que pode aumentar o risco da sua fratura ou perfuração (AKTOP et al., 2017).

As complicações inerentes a exodontia dos terceiros molares podem ser previstas através dos exames de imagem, sendo os mais frequentemente solicitados a radiografia panorâmica e a tomografia computadorizada de feixe cônico (TCFC) (AL ALI; JABER, 2020). Esta última, por ser um exame tridimensional que fornece imagens sem sobreposição, com acuradas medidas lineares, tem sido usada para avaliar a relação dos dentes com estruturas anatômicas nobres adjacentes, permitindo compreender melhor as relações topográficas (MENZILETOGLU et al., 2019).

Estudos prévios (AMIN et al., 2020; WANG et al., 2016; WIHOKRUT et al., 2022) avaliaram a relação da espessura da cortical lingual com a ocorrência de rompimentos da mesma, no entanto, essas avaliações foram realizadas somente a partir de uma tomografia pré-exodontia. Portanto, são escassos estudos que analisaram a relação topográfica entre as raízes dos terceiros molares inferiores e a cortical lingual e sua influência no rompimento da cortical lingual durante a

exodontia.

Nesse contexto, o presente estudo teve como objetivo determinar os fatores que influenciam a ocorrência de lesão da tábua óssea lingual durante a extração de terceiros molares inferiores impactados, por meio da tomografia computadorizada de feixe cônico, tendo em conta a posição dos terceiros molares e a espessura da cortical lingual em diferentes regiões anatômicas.

CAPÍTULO / ARTIGO

Será enviado para Oral Surgery Oral Medicine Oral Pathology and Oral Radiology

Analyses of the factors that influence the injury of the lingual plate bone during extraction of lower third molars using cone beam computed tomography

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Highlights

- Postoperative analysis of Cone Beam Computed Tomography images of seven days after third molar extractions
- Only the thickness of the lingual plate measured at the level of the cemento-enamel junction significantly influenced the occurrence of cortical disruption

ABSTRACT

Objective: determine the factors that influence lingual plate damage during the extraction of impacted mandibular third molars, through cone beam computed tomography (CBCT), taking into account the position of the third molars and the thickness of the lingual plate measured at different levels anatomical. **Methods:** 36 CBCT images of 35 mandibular third molars were used, obtained in two moments (Preoperative and 7 days later). In the preoperative images, 6 parameters were evaluated: lingual plate thickness, impaction depth, mesiodistal angulation, buccolingual angulation, lingual cortical morphology and topographic relationship between the root apex and the lingual cortical. In the postoperative images, the lingual plate was evaluated and classified as intact or ruptured. Statistical analysis to evaluate the influence of different variables on disruption of the lingual plate was performed using linear logistic regression. **Results:** Of all the variables tested, only the thickness of the lingual plate measured at the level of the cementoenamel junction significantly influenced the occurrence of its disruption ($p=0.007$). **Conclusion:** The thickness of the lingual plate at the level of the cementoenamel junction should be taken into account during surgical planning, in order to avoid the rupture.

Keywords: Third Molar; Impacted Tooth; Bone Fracture; Cone Beam Computed Tomography

1. Introduction

One of the most frequently performed procedures in the area of oral surgery is the extraction of third molars, both prophylactically and therapeutically,¹⁻³ with potential complications that may arise during and/or after this surgery, as reported in the literature.⁴⁻⁵ In particular, when lower third molars are extracted, the lingual cortex may be disrupted, which could harm the lingual nerve.⁶ These neural complications typically resolve on their own and have an incidence between 0.5 and 6%,⁷ but some cases progress to persistent paresthesia, hypoesthesia, dysesthesia, and speech or chewing difficulties have an impact on life quality.⁸

The anatomy of the area, the position of the teeth, and professional competence may all be factors in these third molar extraction related difficulties.⁵ The lingual plate's anatomical features are a potential factor that could raise the likelihood of its fracture or perforation.⁹

Imaging studies, the most popular of which are panoramic radiography and cone beam computed tomography (CBCT), can be used to forecast the complications that come with third molar extraction.² The latter has been utilized to assess how teeth relate to nearby noble anatomical components because it is a three-dimensional examination that offers images without overlapping and precise linear measurements topographic linkages to be better understood.⁸

The association between the thickness of the lingual plate and the likelihood of its ruptures has been studied in earlier researchs,^{6,10,11} but these assessments were only made before the extraction. The topographic link between the roots of lower third molars and the lingual cortex, as well as its impact on the rupture of the lingual plate after tooth extraction, has thus far only been the subject of a few research.

In this context, the present study sought to identify the factors taking into account the positions of the third molars and the thickness of the lingual plate in various anatomical regions that contribute to the occurrence of lesions of the lingual plate during the removal of inferior impacted third molars.

2. Materials and methods

This retrospective study was previously approved by the Human Research Ethics Committee of the Federal University of Uberlândia under protocol number CAAE: 37924720.3.0000.5152.

Sample calculation

In view of the absence of previous studies evaluating the factors related to lesions on the lingual wall after third molar extraction through tomographic analysis before and after extraction, an estimate of the sample size to be tested was made for later evaluation of the statistical power obtained from the study. It is estimated that the percentage of complications related to fractures of the lingual wall after extraction is between 0.4 and 22%. Due to the wide variation in the incidence of these complications, the midpoint of this interval was used as an estimated value in the general population of people who undergo third molar extraction and present these complications (11.4%).

Therefore, estimating the incidence of complications related to lingual wall fracture in the sample to be 11.4% and estimating a Type I error at 0.05 and Beta power at 0.80, using the G Power software (Version 3.1.9), it was determined that a sample size of 19 teeth would be the minimum necessary to be used in this study.

Inclusion and exclusion criteria

Tomographic images of third molars of patients of both sexes and any age, obtained in two moments (before and after extraction). Images of poor quality or containing artifacts that interfered with the identification of structures of interest were also excluded.

Tomographic analysis

Images were obtained on a Promax 3D Max device (Planmeca, Helsinki, Finland), using FOV 11x11cm, 20 seconds of scanning, 360° rotation and voxel size 0.16mm. The tomographic images were acquired for purposes unrelated to the study and were originated in a previous clinical study that evaluated the repair of third molars sites after extraction. The DICOM files were

exported to the CS3D software (Carestream Dental, Atlanta, GA, USA) for evaluation by a single calibrated evaluator in a dark environment. Tomographic evaluations were performed in random order in blocks of 10 images each. After an interval of two months, the evaluations were repeated on 25% of the images in order to verify the intraobserver agreement.

In the preoperative images, for each region of interest (mandibular third molar/lingual plate) 6 parameters were evaluated, namely:

1. Thickness of the lingual plate: parasagittal cuts were used, measuring at three levels: a) at the level of the cementoenamel junction (AC) of the second lower molar in its most distal portion (portion closest to the lower third molar) ; b) at the level of the middle third of the mandibular third molar, in the furcation region (at the root closest to the lingual cortex) and c) at the level of the apex of the distal root of the third molar (Figure 1).

2. Impaction depth: it was classified according to Pell & Gregory (1933), as follows: level A (high), level B (medium), level C (low), class I (sufficient space), class II (reduced space) and class III (no space) (Figure 2).

3. Mesiodistal angulation: it was evaluated taking into account the long axis of the second molar, in a coronal section according to (Winter, 1926), classified as: a) "distoangulated", b) "vertical", c) "mesioangulated" or d) "horizontal" (Figure 3).

4. Buccolingual angulation: for the third molars in the horizontal position, the measurement of the angulation was performed from the intersection of the central part of the pulp chambers of the lower first and second molars in an axial tomographic slice; for third molars in the vertical position, coronal cuts were used and the measurement was taken with reference to the long axis of the lower second molar. In both cases, a positive value was assigned to the buccal crown angulation and a negative value to the lingual angulation. A line parallel to the intersection of the second molar was drawn, and the difference between buccal and lingual angulation was measured. Buccolingual angulation less than -5° was defined as "lingual", more than 5° was defined as "buccal", and other values (between -5 and 5) were defined as "central" (Figure 4).

5. Morphology of the lingual plate, defined in the region of the third

molar in coronal tomographic sections and classified into four subgroups: a) Type R, rounded shape in the lingual portion; b) type P, parallel to the vestibular cortex; c) type S, inclined with reduced buccolingual width in the lingual portion and; d) type U, in which there is a recess in the lingual portion (Figure 5).

6. Topographic relationship between the apex of the root and the lingual plate was classified as: a) type A, in which there is bone between the root and the lingual cortex; b) type B, in which the root communicates with the lingual cortex, but does not perforate it; c) type C, in which the root perforates the lingual cortex, being observed in the parasagittal sections (Figure 6).

The extractions were performed by an experienced surgeon, following what the literature determines. There was no osteotomy in the lingual region, only in the buccal region, when necessary. To perform odontosection, the drill did not section the tooth to the end, in order to avoid damage to the lingual region. The section was finalized using a greenstick fracture using a straight Seldin lever.

Seven days after the extractions, the patients underwent a new CBCT. Evaluation of the postoperative images: In each image, the alveolus of the third molar was observed and the lingual cortical classified in its integrity, in which there was no lesion in the lingual plate, since there is no discontinuity of the bone in the tomography in the apical-coronal direction, or ruptured, in which there was some type of lesion/rupture in this lingual plate, as the discontinuation of the lingual bone is noted on the tomography (Figure 7).

3. Results

The final sample of the study consisted of CBCT images of 18 patients (9 men and 9 women) who presented consecutively to the dental office, ranging in age from 16 to 50 years, with an average age of 26.7 years. In the end, 35 lower third molars were included (17 on the left side and 18 on the right side). Twenty (57.1%) lingual cortices were classified as intact and the remaining 15 (42.9%) as injured/ruptured. In addition to perforations, other complications were also observed, such as sensitivity of the adjacent tooth (n=2), fracture of the root whose fragment was kept in the socket due to proximity to inferior alveolar nerve (n=2) and trismus (n=2).

The mean thickness of the lingual plate measured in millimeters preoperatively was greater in the region of the cementoenamel junction (2.2 ± 0.8), followed by thickness in the region of the middle third of the lower third molar (2.1 ± 1.0) and, finally, the thickness of the region from the apex of the distal root of the third molar (1.4 ± 1.0).

Regarding the depth of impaction, most third molars were classified as level A ($n = 18$) and the remainder as level B ($n = 15$) and C ($n = 2$). There was a predominance of class II ($n = 22$) over class I ($n = 13$).

Most of the third molars were in the vertical position ($n = 20$), four in the horizontal position, eleven in the mesioangular position and none in the distoangular position. As for buccolingual angulation, it was observed that most third molars ($n = 13$) were tilted lingually, 12 buccally and 10 in the central position.

Evaluating the morphology of the lingual plate, it was noticed that the P type was more predominant ($n = 16$), followed by the U type ($n = 13$), the S type ($n = 5$) and finally, the R type ($n = 1$). As for the topographic relationship between the apex of the root and the lingual cortex, it was observed that type B ($n = 18$) predominated over type A ($n = 13$) and type C ($n = 4$). This information is summarized in table 1.

4. Discussion

Surgery to extract lower third molars brings with it potential complications, including fracture of the mandibular lingual cortex, a type of complication that brings with it complex consequences.⁷ The lower third molars assume a more lingual position in the mandible, and the alveolar bone in this region is thinner than in the buccal aspect,⁶ for this reason the occurrence of perforations of the lingual plate is not considered an event rare, as shown in this study, where 42.9% of the lingual cortices were perforated.

A thinner or perforated mandibular lingual plate has been reported as the main cause of complications.⁵ The cortical thickness directly depends on the positioning of the third molars. Therefore, in this study, factors that may influence the disruption of the lingual bone plate through CBCT were tested.

The present study indicates that a reduced thickness of the lingual plate bone at the cementoenamel junction has a statistical tendency to promote

cortical disruption. This information can be very useful for preventing these complications, as it helps surgeons to predict when the risk of plate disruption is higher.

Previous studies also evaluated the thickness of the lingual plate in three regions: cementoenamel junction, middle third and apex of the root. The mean values found in these studies for the root apex region ranged between 0.99 and 3.38mm,^{4,7} which is in agreement with the mean result of the present study (2.1mm). For the mid-root level region, the plate thickness value found should be lower compared to the apex region.⁴

The thickness of the lingual plate at the level of the cementoenamel junction should also be smaller in relation to the thickness at the level of the apex.⁷ However, the findings of the present study do not correspond to those defended by both studies mentioned above, since the plate thickness at the medium level was greater than at the apex novel, and the thickness at the level of the cementoenamel junction was greater in relation to the thickness at the apex level. The reason for this difference may be related to the sample size or even sample variation.

Previous studies classified the lingual plate morphology into several types and reported several results that associate with the possibility of lingual plate perforation.^{1,10,15} According to a previous study,¹⁰ type U plates, in which there is a lowering, and type S plates, inclined with reduced buccolingual width in the lingual portion, are risk factors. While other study,¹⁵ associates only with type S plates. In addition to these, one more associates the possibility with types U and P.¹ However, the findings of the present study do not corroborate with previous findings, since no significant relationship was noted between morphology and perforation of the lingual plate. This may be related to different classification perceptions, as this is a subjective assessment in studies.

The mesiodistal angulation of mandibular third molars is significantly associated with an increased risk of a thinner and perforated lingual cortical at mid-root height, as the lingual plate around the mid-root region is more easily fractured in cases of mesioangulated teeth and with horizontal impactions.⁵ However, in the present study, no significant relationship was found between

lingual cortical fracture and buccolingual angulation. The reason for this difference is not clear, but it could be attributed to the sample size. Therefore, the importance of using CBCT is emphasized in cases where the two-dimensional examination becomes insufficient for treatment planning in third molar extractions.

Perforation of the lingual plate may be an existing condition even before third molar extraction, as demonstrated in the study,⁶ in which they reported that more than half of the images showed cortical perforation, however, in the present study, no pre-existing perforation was observed. In this sense, a previous study,¹⁰ used tomographic images to investigate the topographic relationship between the root apex of the mandibular third molar and the lingual cortical and noticed that most of the mandibular third molars perforated the lingual cortical. Minority was without contact, having been noticed a significant association with gender, depth of impaction, number of roots and morphology of the lingual plate.

The great differential of the present research is the possibility of tomographically evaluating post-extraction socket, which means that anatomical relationships that could previously seem decisive to determine complications, now are not. In addition, all surgeries were performed by an experienced oral and maxillofacial surgeon, which practically eliminates the possibility of errors in the operative technique that could lead to the use of excessive force or carelessness during the surgical procedure. However, to validate the data obtained, further studies with a larger number of patients are needed.

For the evaluation of complex impacted mandibular third molars, they should all be performed using CBCT, however, given the higher dose compared to panoramic radiography that has been routinely used (despite providing two-dimensional images), makes the use of CBCT unfeasible in some cases, reserving it for more complex cases.^{2,9} Determining the mean thickness of the lingual plate bone using CBCT aids in treatment planning to assess surgical risks and predict potential complications.¹⁶

Despite a high number of lingual cortical bone fractures, no patient had lingual nerve paresthesia. This may be related to a subjective analysis of cortical

fractures, since any type of injury in this region was included.

5. Conclusion

It is concluded that the thickness of the lingual plate at the height of the cements-enamel junction is an important factor that can significantly influence its breakage in lower third molar extractions. This factor should be taken into account during surgical planning, in order to avoid this type of complication.

Declaration of Competing Interest

The authors have nothing to declare.

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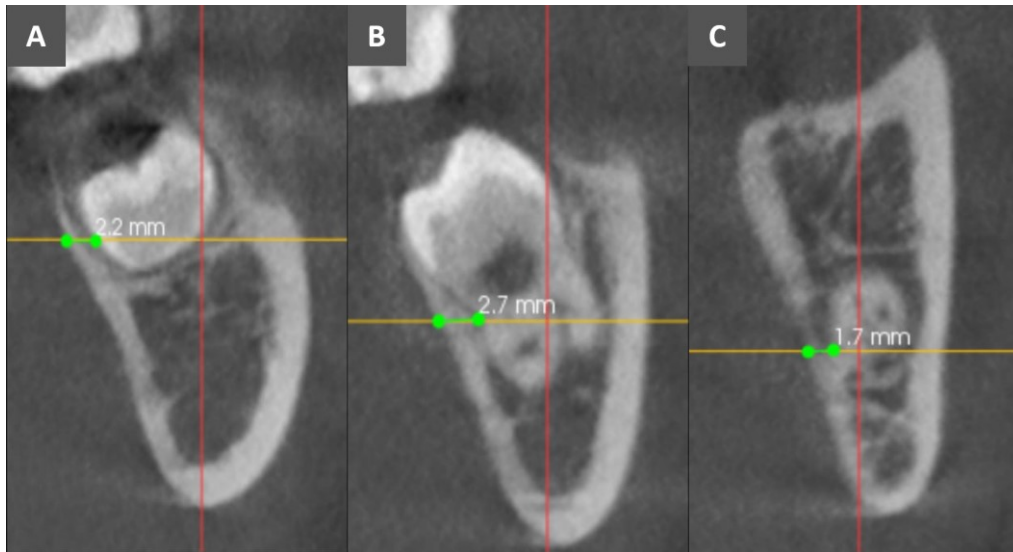


Figure 1. Tomographic images of the regions chosen for measuring the thickness of the lingual plate. A) at the level of the cemento-enamel junction; B) at the middle level; C) at the level of the root apex.

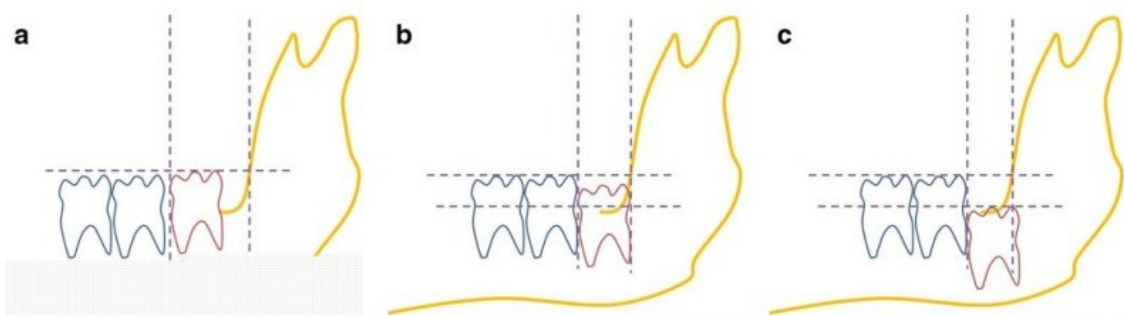


Figure. 2. Impaction depth of lower third molars. a) Level A, class I; b) Level B, class II; c) Level C, class III.



Figure. 3. Mesioangulated third molar.

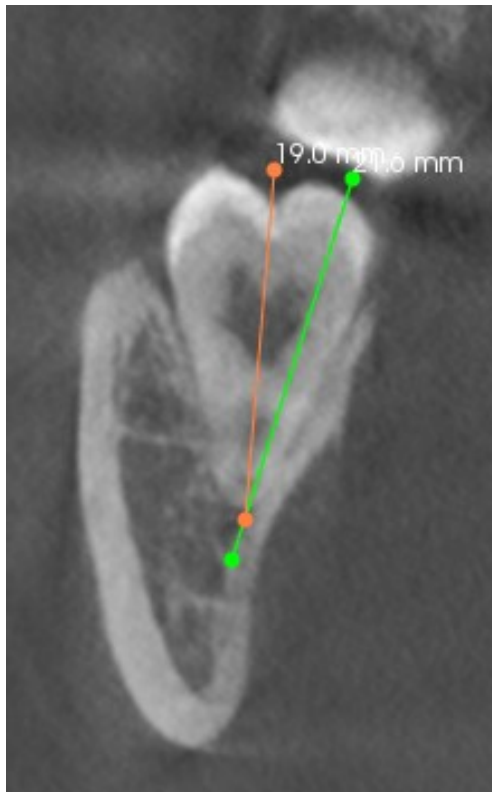


Figure. 4. Buccal third molar.

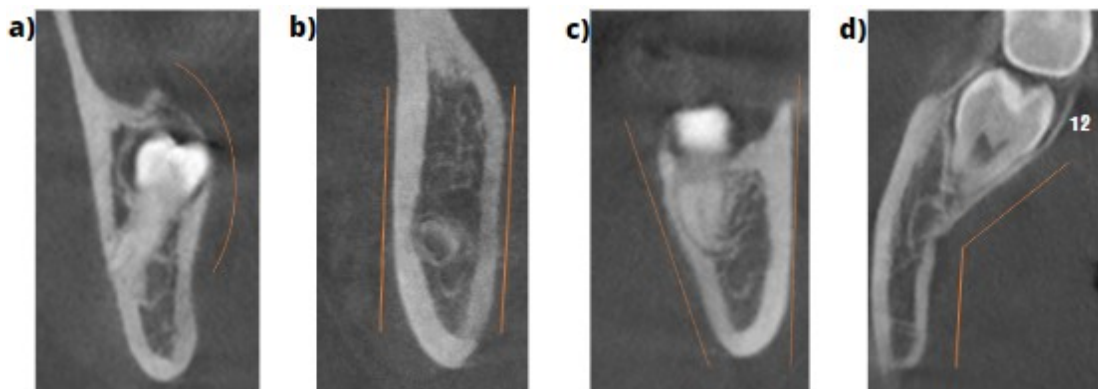


Figure. 5. Morfology of the lingual plate, where a) is Type R, b) is Type P, c) is Type S and d) is Type U.

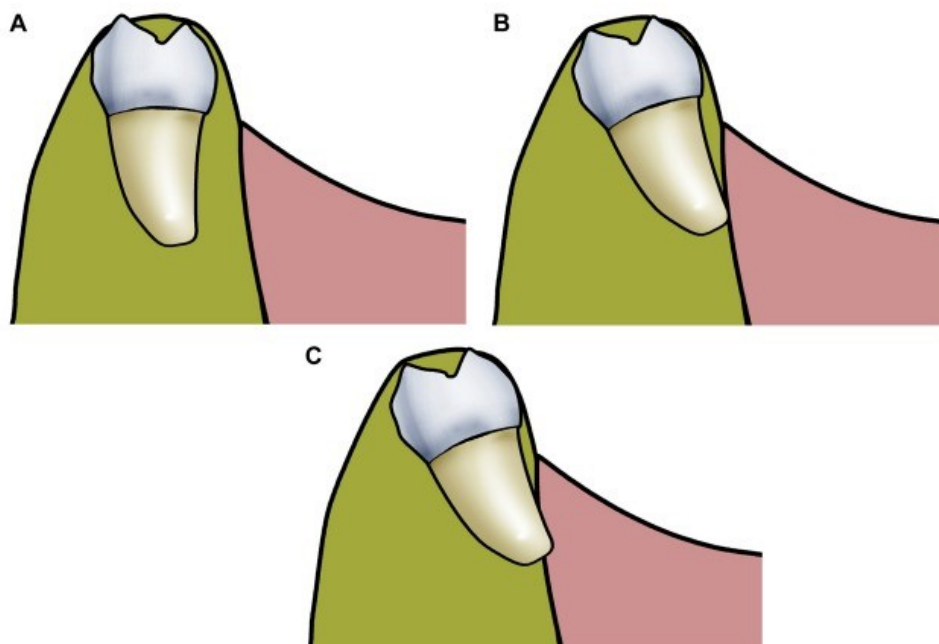


Figure. 6. Topographic relationship between the apex of the root and the lingual plate. A) type A relationship (there is bone between the root of the tooth and the lingual plate bone; B) type B relationship (the root communicates with the lingual plate bone, but not perforated; c) type C (the root perforates the lingual plate bone, being observed in the parasagittal sections).

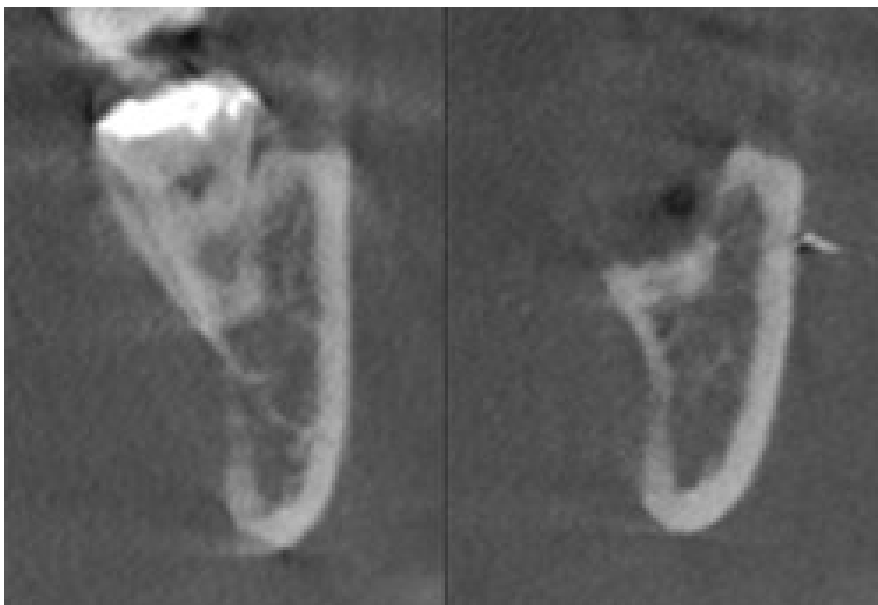


Figure. 7. Tomographic images of the intact (A) and ruptured (B) lingual plate.

Table 1: Average and standard deviation of plate thickness values; distribution according to the classifications of impaction depth, buccolingual angulation, lingual plate morphology and topographic relationship between the root apex and the lingual plate.

		Plate thickness					
		Amelocementary junction		Medium level	Apex level		
Average and standard deviation		2.2±0.8		2.1±1.0	1.4±1.0		
		Mesiodistal angulation					
		Vertical	Distoangular	Mesioangular	Horizontal		
n (%)		11 (31.5)	0	20 (57.1)	4 (11.4)		
		Depth of impact					
		Level			Class		
		A	B	C	I	II	III
n (%)		18 (51.4)	15 (42.9)	2 (5.7)	13 (37.1)	22 (62.9)	0
		Buccolingual angulation					
		Vestibular		Central		Lingual	
n (%)		12 (34.3)		10 (28.6)		13 (37.1)	
		Morphology of the Lingual plate					
		P		R	S	U	
n (%)		16 (45.7)		1 (2.9)	5 (14.3)	13 (37.1)	
		Topographic relationship between the root apex and the lingual plate					
		Type A		Type B		Type C	
n (%)		13 (37.1)		18 (51.4)		4 (11.5)	

Table 2: Data on p values and confidence intervals of the different risk factors tested as influencing lingual plate disruption.

Risk factors for IC rupture	p	IC (95%)
Plate thickness (at the cemento-enamel junction level)	0.007	-1,19 ; -0.20
Plate thickness (médium level)	0.63	-0.84 ; 0.52
Plate thickness (apex level)	0.75	-0.57 ; 0.79
Mesiodistal angulation	0.58	-0.45 ; 0.78
Impact depth	0.08	-0.12 ; 1.82
Buccolingual angulation	0.12	-0.12 ; 0.98
Morphology of the lingual plate	0.85	-0.49 ; 0.59
Topographic relationship between root apex and lingual plate	0.56	-0.59 ; 0.32

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