UNIVERSITY OF SÃO PAULO

SCHOOL OF DENTISTRY OF RIBEIRÃO PRETO

Lucas Moreira Mendonça

INFLUENCE OF 2D VS 3D IMAGES AND PROFESSIONAL EXPERIENCE ON THE TREATMENT PLAN FOR IMPACTED LOWER THIRD MOLAR

Ribeirão Preto
2019

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Dissertation presented to the School of Dentistry of Ribeirão Preto, University of São Paulo to obtain the title of Master in Dentistry.

Concentration area: Oral Rehabilitation.

Advisor: Prof[a]. Dr[a]. Camila Tirapelli

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Dedication

Dedico...

Primeiramente à **Deus**, por sempre estar presente na minha vida, mostrando que tudo tem um propósito.

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LIST OF ABBREVIATIONS AND ACRONYMS

PAN - Panoramic Radiography
CBCT - Cone Beam Computed Tomography
IAN - Inferior Alveolar Nerve
Jr - Júnior
Sr - Seniors
2D - Two Dimensions
3D - Three Dimensions
ILTM - Impacted Lower Third Molars
CBCT - Cone Beam Computed Tomography
LSM - Lower Second Molar

Summary

SUMMARY

Abstract in portuguese

Mendonça, LM.

Influência de imagens 2D vs 3D e experiência profissional no plano de tratamento de terceiros molares inferiores impactados

RESUMO

O objetivo deste estudo foi avaliar a influência dos exames de imagem (panorâmica [PAN] ou tomografia computadorizada de feixe cônico [TCFC] e experiência profissional no diagnóstico e planejamento do tratamento de terceiros molares inferiores impactados [TMII]. Este estudo envolveu um conjunto de 218 registros de imagens contendo imagens PAN e TCFC de pacientes com TMII. Seis profissionais foram selecionados e divididos em 2 grupos: Seniors (Srs), profissionais mais experientes, e juniors (Jrs), profissionais menos experientes no tratamento da TMII. Ambos os grupos avaliaram as 436 imagens referentes a (1) posicionamento do ILTM, (2) relação com canal mandibular, (3) relação com o segundo molar inferior (LSM), (4) planejamento intraoperatório e (5) expectativas pós-operatórias. Os dados foram analisados observando a concordância interexaminador (Srs vs Jrs) e intraexaminador (PAN vs TCFC) no planejamento do tratamento com TMII. Houve diferença na classificação do posicionamento espacial e horizontal, dependendo do tipo de imagem e experiência profissional ($P < 0,05$). A concordância entre Srs e Jrs na relação do TMII com o canal mandibular foi maior nas TCFC do que nas PANs; os 7 sinais nas PANs associando proximidade da TMII com nervo alveolar inferior foram identificados com menor frequência absoluta em 2D em comparação com exames 3D sobre proximidade com o canal, interrupção cortical e estreitamento do canal. Em relação ao segundo molar inferior e o TMII, a frequência absoluta de concordância entre Srs e Jrs para reabsorção mudou de 140 nas PANs para 294 nas TCFCs. Observou-se maior frequência de decisão clínica de acompanhamento no planejamento entre os Jrs ao usar TCFCs, e maior frequência

de coronectomia (170) em comparação com as PANs (94). Srs e Jrs esperavam quase a mesma dor, inchaço e trismo nas TCFCs; essa tendência não foi a mesma nas PANs, onde Jrs esperavam menos. Para parestesia, Srs e Jrs esperavam frequências semelhantes comparando o exame de imagem; no entanto, os Jrs esperam até 5 vezes mais parestesia do que os Srs nos dois tipos de exames.

Foi possível concluir que a imagem 3D e a experiência profissional podem influenciar o plano de diagnóstico e tratamento do TMII.

Palavras-chave: Tomografia, terceiro molar, planejamento

Abstract

Mendonça, LM. **Influence of 2D vs 3D images and professional experience on the treatment plan for impacted lower third molar**

ABSTRACT

The objective of this study was to evaluate the influence of imaging exams (panoramic [PAN] or cone-beam computed tomography [CBCT]) and professional experience in the diagnosis and treatment planning of impacted lower third molars (ILTMs). This study involved a set of 218 image records containing both PAN and CBCT images of patients with ILTMs. Six professionals were selected and divided into 2 groups: seniors (Srs), who are more experienced professionals, and juniors (Jrs), who are less experienced professionals in ILTM treatment. Both groups evaluated the 436 images concerning (1) ILTM positioning, (2) mandibular canal contact, (3) lower second molar (LSM) contact, (4) intraoperative planning, and (5) postoperative expectations. The data were analyzed by observing the interexaminer (Srs vs Jrs) and intraexaminer (PAN vs CBCT) agreement in the ILTM treatment planning. There was a difference in the classification of the spatial and horizontal positioning depending on the image type and professional experience ($P < 0.05$). The agreement between Srs and Jrs on the relation of ILTM to mandibular canal was higher on CBCTs than PANs; the 7 signs in PANs associating ILTM proximity with inferior alveolar nerve (IAN) were identified with lower absolute frequency in 2D compared to 3D examinations about proximity to the canal, cortical interruption, and canal narrowing. Regarding LSM/ILTM, the absolute frequency of agreement between Srs and Jrs for resorption changed from 140 in PANs to 294 in CBCTs. A higher frequency of clinical decision to follow up was observed in the planning among Jrs when using CBCTs, and a higher frequency of coronectomy (170) was observed compared to PANs (94). Srs and Jrs expected almost the same pain, swelling, and trismus by CBCTs; this trend was not the same on PANs, where Jrs expected less. For paresthesia, Srs and Jrs expected similar frequencies comparing the image exam; however, Jrs expect up to 5 times more paresthesia than Srs on both exams types.

It was possible to conclude that 3D imaging and professional experience can influence the ILTM diagnosis and treatment plan.

Keywords: Clinical study, cone beam computed tomography, clinical decision, third molar, oral surgery

1. Introduction

1. INTRODUCTION

According to current worldwide guidelines, a conventional bidimensional (2D) examination (panoramic [PAN] or periapical radiography [PA]) should precede tridimensional (3D) cone beam computed tomography (CBCT) exams in the process of dental diagnosis and treatment planning.[1] Considering impacted lower third molars (ILTMs), studies have shown that the use of 3D images can change diagnosis and treatment plans.[2-4]

The prevalence of ILTMs in the population can reaches 57%.[5-7] The literature shows that the inferior alveolar nerve (IAN), the lower second molar (LSM), and other anatomical structures are the most relevant points when planning ILTM removal[8] because they can cause postoperative complications such as injuries to the IAN and lingual nerve, mandible fracture, pain, edema, bleeding, and alveolar osteitis.[9-12]

Given that PAN is the first-choice image exam in the treatment of ILTM, there is a front in the literature suggesting 7 critical signs that when found in the 2D image can indicate the need for complementary 3D examinations. These signs are root apex darkening, root deflection, root narrowing, veiled or bifid apexes, interruption of radiopaque canal lines, canal deviation, and mandibular canal narrowing.[13] According to the meta-analysis by Su et al[13], the risk of IAN injury with 1 or more of these 7 signs ranges from 8 to 22%. They also concluded that more accurate imaging such as CBCT as well as coronectomy surgery, which is a more conservative procedure, could be able to produce better results in these cases.[13]

In this context, the 7 signs in PAN refer only to the relation of the ILTMs to the IAN, limiting the indication of CBCT to cases of nerve injury risk, while there are other complications to be taken into account, such as the relationship of the ILTM with the lower second molar,[2] the presence of retromolar canals or foramen,[14] and lingual cortical perforations.[15] These authors recommend the use of preoperative CBCT to understand the risk and the limitations of any procedure in this area. Despite its advantages in the diagnosis and treatment plan, the use of CBCT is questioned due to the radiation dose, high cost, and the lack of support in the literature.

The need to understand the value of an image exam in the clinical decision came up in the literature with Fryback and Thornbury, who proposed a hierarchical model for evaluating the effectiveness of various imaging exams on 6 levels: (1) image quality, (2) diagnosis, sensitivity, and specificity of image interpretation, (3) information that may lead to changes in diagnosis process, (4) efficacy of the image exam in the treatment plan, (5) effect of the information obtained from the image exam in the treatment results, and (6) cost and benefit of this image exam and the impact on society.[16] Later, Gazelle et al (2011) added to that proposal a classification consisting of 3 levels that assess population size at risk, anticipated clinical impact, and potential economic impact.[17]

Concerning the ongoing debate about when to use CBCT in Dentistry, level 5 studies are rare and level 6 are nonexistent at the moment. Guerrero et al published a level 5 study to identify whether imaging would influence the reduction of postoperative complications such as infection, trismus, hemorrhage, paresthesia, edema, and bruising.[18] The results showed that, although not statistically significant, such types of occurrences decreased in patients operated from CBCT planning.

In addition to imaging examinations, professional experience can influence dental treatment, from diagnosis and planning to treatment itself.[19-23] In 2018, Fortes et al showed that the planning for dental implant treatment might differ depending on the type of imaging exam (PAN and CBCT) and professional experience.[24]

In this context, no studies in the literature compare 2D vs 3D exams in the planning for the treatment of ILMT, taking into account its position; relation with LSM, the mandibular canal, and IAN; and transoperatory plan and postoperatory expectation. In addition, no studies have looked at the influence of professional experience. Therefore, the objective of this study was to evaluate the influence of the imaging examination (2D or 3D) and professional experience on ILTM diagnosis and treatment planning.

2. Proposition

2. PROPOSITION

To evaluate the influence of imaging (2D or 3D) and professional experience in the diagnosis and treatment planning of ILTMs.

Specific objective (or goal):

* Compare treatment plans for ILTMs based on panoramic radiography (PAN) and cone beam computed tomography (CBCT) considering experienced professionals (Srs = seniors) vs less experienced professionals (Jrs = juniors) (Study Level 3).

3. Material and method

3. MATERIAL AND METHOD

3.1 EXAM SELECTION

The inclusion criteria were as follow: medical records were selected from patients with ILTMs, as well as CBCT and PAN exams with an interexam interval of a maximum of 3 months.

The exclusion criteria were as follow: records which presented any type of bole lesion in the interest (from inferior second molar to the mandibular ramus) or poor image quality.

Panoramic radiographs were obtained on the same VATECH PaxX-400C device (Vatech Global, Korea), whereas CBCT scans were performed on i-CAT FLX (Imaging Sciences International, USA) according to the following parameters: 0.25 mm voxel size, 120 kVp, and 36.12 mAs.

3.2 EXAMINERS SELECTION

Three senior professionals (Srs) were selected with a minimum academic degree of specialist in oral maxillofacial surgery being accepted in addition to masters and doctoral degrees. They had more than 10 years of experience in the area, having performed more than 100 ILTM removals.

Three Junior professionals were general practitioner dentists with more than 10 but not more than 50 ILTM removals.

3.3 EXAM EVALUATION

Exam evaluation was standardized using a 14-inch high-resolution monitor and an appropriately lit environment for image evaluation for up 20 minutes without interval.

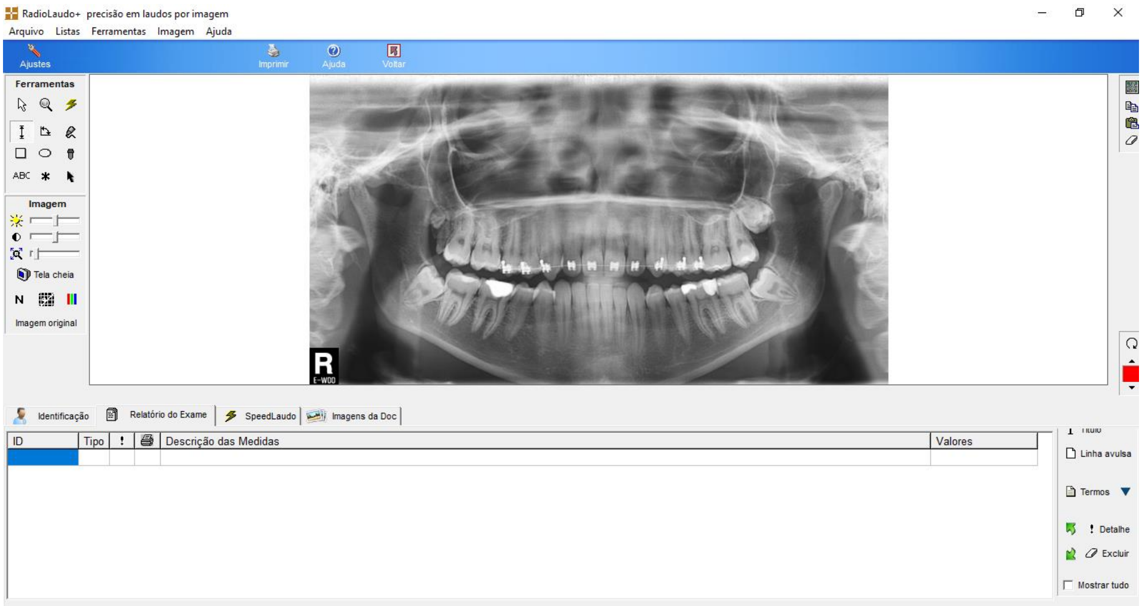
The professionals initially received 218 anonymized and randomized PANs. Using free-mode Radioimp software (Radio Memory, Brazil), they evaluated aspects related to ILTM 2D treatment planning.

After 3 months, the same professionals received 218 CBCTs of the same cases, under the same conditions previously mentioned and in another randomized order. Using Ondemand3D software (Cybermed Inc., Korea), they assessed the aspects of diagnosis and treatment plan of third molar removal presented in Figure 1.

<table>
<tr><th colspan="5">ILTM positioning</th></tr>
<tr><td>Pell and Gregory[25]</td><td colspan="4">Occlusal (A, B or C) / Horizontal (1,2 or 3)</td></tr>
<tr><td>Winter[26]</td><td colspan="4">Vertical, Mesioangular, Horizontal, Distoangular, Buccolingual or Others</td></tr>
<tr><th colspan="5">IAN relation</th></tr>
<tr><td>Proximity with mandibular canal cortex (contact)**</td><td colspan="2">YES</td><td colspan="2">NO</td></tr>
<tr><td>Absence of mandibular canal cortex **</td><td colspan="2">YES</td><td colspan="2">NO</td></tr>
<tr><td>Jaw canal flattening by tooth roots **</td><td colspan="2">YES</td><td colspan="2">NO</td></tr>
<tr><td>Root darkening *</td><td colspan="2">YES</td><td colspan="2">NO</td></tr>
<tr><td>Root deflection *</td><td colspan="2">YES</td><td colspan="2">NO</td></tr>
<tr><td>Root narrowing*</td><td colspan="2">YES</td><td colspan="2">NO</td></tr>
<tr><td>Veiled or bifid apexes*</td><td colspan="2">YES</td><td colspan="2">NO</td></tr>
<tr><td>Interruption of radiopaque lines*</td><td colspan="2">YES</td><td colspan="2">NO</td></tr>
<tr><td>Canal deviation*</td><td colspan="2">YES</td><td colspan="2">NO</td></tr>
<tr><td>Root canal narrowing*</td><td colspan="2">YES</td><td colspan="2">NO</td></tr>
<tr><th colspan="5">LSM relation</th></tr>
<tr><td>Contact location</td><td>CROWN</td><td>CERVICAL</td><td>ROOT</td><td>NONE</td></tr>
<tr><td>Distal resorption of adjacent tooth</td><td>ABSENT</td><td colspan="2">SUSPECTED</td><td>PRESENT</td></tr>
<tr><td>Radiolucent / hypodense area around ILTM crown (pericoronal space)</td><td><2 mm</td><td colspan="2">Between 2 and 4 mm</td><td>> 4 mm</td></tr>
<tr><td>Distal bone level of adjacent tooth (from cementum-enamel junction) marginal and the end at the most apical portion**</td><td><3 mm</td><td colspan="2">Between 3 and 5 mm</td><td>>5 mm</td></tr>
<tr><th colspan="5">Intraoperative planning</th></tr>
<tr><td>Exodontia (E), coronectomy (C) or Radiographic Proservation (P)</td><td>E</td><td colspan="2">C</td><td>P</td></tr>
<tr><td>Expectation of IAN exposure/ injury</td><td colspan="2">YES</td><td colspan="2">NO</td></tr>
<tr><td>Osteotomy</td><td colspan="2">YES</td><td colspan="2">NO</td></tr>
<tr><td>Dental crown sectioning</td><td colspan="2">YES</td><td colspan="2">NO</td></tr>
<tr><th colspan="5">Postoperative expectations</th></tr>
<tr><td>Expectation of paresthesia of IAN</td><td colspan="2">YES</td><td colspan="2">NO</td></tr>
<tr><td>Expectation of pain, trismus and swelling</td><td colspan="2">YES</td><td colspan="2">NO</td></tr>
</table>

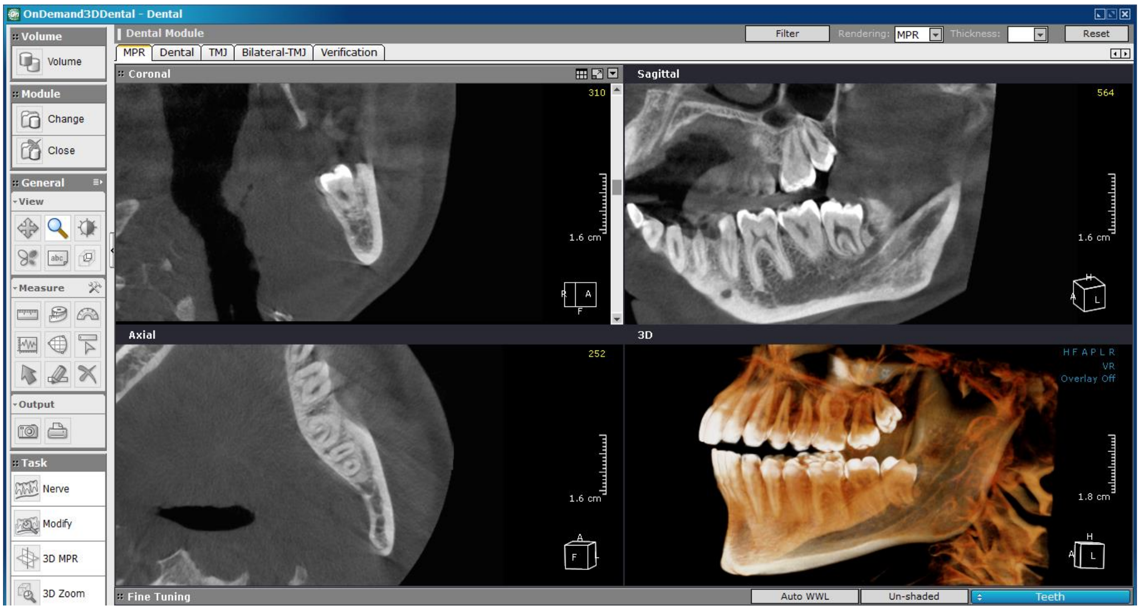
Illustration 1. Parameters evaluated in relation to (1) ILTM positioning, (2) IAN relation, (3) adjacent tooth relation, (4) intraoperative planning, and (5) postoperative expectations. Legend: *Only PAN. **Only CBCT.

Ilustration 2 - Image showing the screen of Radioimp software



Source: Own authorship

Ilustration 3 - Image showing the screen OnDemand software



Source: Own authorship

3.4 STUDY DESIGN

This was a clinical, observational, transversal study. The variable was the professional's response to the parameters referred to the ILTM diagnosis and treatment plan. The factors under variation were the type of image exam used to assess the diagnosis and treatment plan (2D vs 3D) and professional experience (Srs vs Jrs). The primary outcome was the inter- and intraprofessional agreement. The sample size was calculated based on Fortes et al (2018), with a confidence level of 95% and power of 80%.

3.5 DATA ANALYSIS

Data were analyzed using the SPSSv.22 softwares (IBM Corp., Armonk, NY, USA). For the ILTMs classifications (Pell and Gregory and Winter) kappa values and agreement percentage were compared using the McNemar-Bowker test for imaging modality (2D vs 3D) and professional experience (Sr vs Jr). Proximity signals between ILTM and IAN in PAN were calculated and compared by one-way analysis of variance (ANOVA). The same was done for evaluation of proximity between ILTM and IAN in CBCT. Kappa value was calculated for ILTM proximity local to the LSM, LSM resorption, and follicular space considering imaging modality (PAN vs CBCT) and considering professional experience (Sr vs Jr), for each imaging modality. For treatment planning and postsurgical complications, the data were expressed in absolute frequencies for each professional in the various modalities. Cohen's kappa result was interpreted as follows: values ≤ 0 indicated no agreement, 0.01–0.20 indicated none to slight, 0.21–0.40 indicated fair, 0.41– 0.60 indicated moderate, 0.61–0.80 indicated substantial, and 0.81–1.00 indicated almost perfect agreement.

4. Results

4. RESULTS

Regarding positioning (table 1), a significant difference was observed in the classification of the spatial relationship (Winter) and horizontal positioning (Pell and Gregory) of the ILTM depending on the imaging examination. Regarding agreement between Sr and Jr professionals, a significant difference was observed for both spatial relationship and horizontal and occlusal classification.

Table 1. Kappa values and agreement between PAN and CBCT (overall) and between Srs vs Jrs (for PAN and CBCT) evaluating ILTM location and statistical significance according to McNemar-Bowker test

3rd Molar Classification	PAN vs CBCT		Srs vs. Jrs		
	Kappa (% agreement)	*P* value*	PAN Kappa (% agreement)	CBCT Kappa (% agreement)	*P* value*
Pell and Gregory Occlusal (A, B, C)	0.428 (64.8%)	0.019	0.385 (62.3%)	0.196 (48.7%)	<0.001
Pell and Gregory Horizontal (1, 2, 3)	0.408 (67.9%)	<0.001	0.138 (46%)	0.072 (51.6%)	<0.001
Winter	0.627 (75.4%)	<0.001	0.591 (72.7%)	0.492 (66.8%)	<0.001

Regarding the evaluation of signs indicating ILTM proximity with IAN, in 2D examinations (Figure 1and table 2) the agreement was moderate to substantial between Srs and Jrs and no difference was observed between the evaluated parameters (one-way ANOVA, $P > 0.05$).

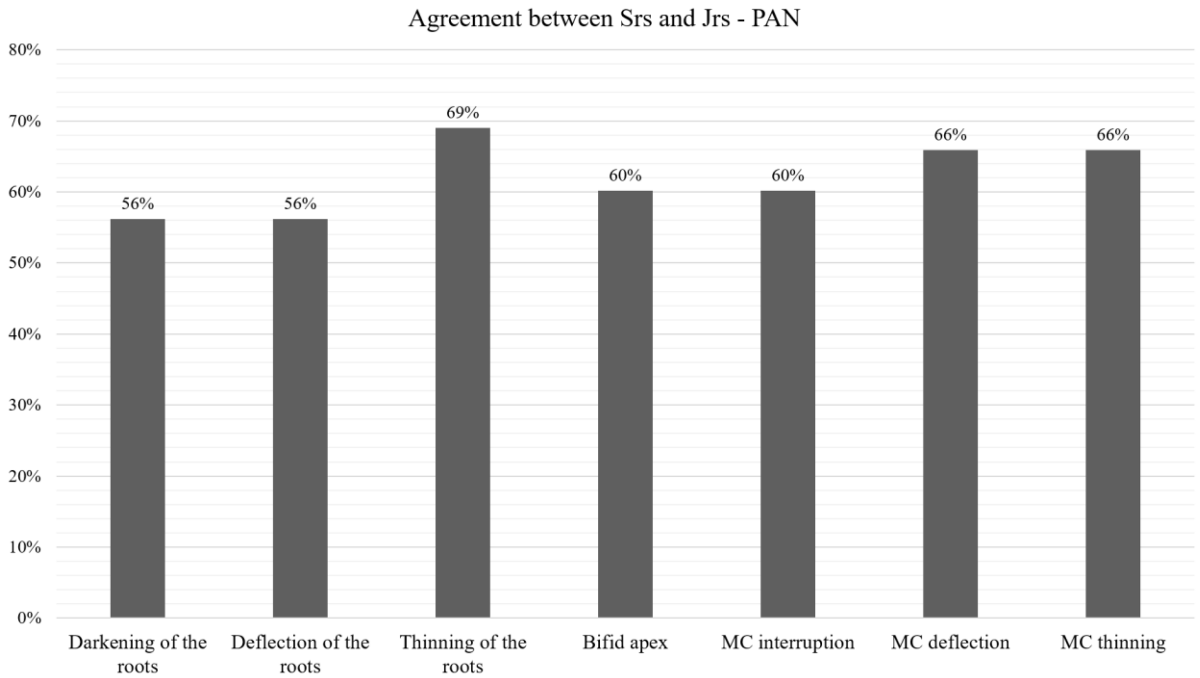


Figure 1. Srs and Jrs' agreement about ILTM and IAN proximity using PANs. There was no statistical difference between each of the evaluated items (one-way ANOVA).

Table 2. Absolute values of frequency for the parameters analyzed in the 2D and 3D exams on the ILTM relationship with the IAN

PAN							
	Root Darkening	Root Deflection	Root Thinning	Bifid Apex	MC Interruption	MC Deflection	MC Thinning
Sr 1	81	89	36	51	146	109	100
Sr 2	61	104	28	123	164	40	24
Sr 3	136	28	26	39	67	20	52
Jr1	75	33	26	33	127	34	23
Jr2	109	34	54	16	169	13	15
Jr3	110	139	126	77	157	146	136
TOTAL	572	427	296	339	830	362	350

CBCT			
	Proximity to the MC	Cortical Interruption	MC Thinning
Sr 1	170	105	39
Sr 2	190	92	47
Sr 3	209	166	156
Jr1	211	148	59
Jr2	169	71	116
Jr3	183	145	159
TOTAL	1132	727	576

In 3D examinations (Figure 2) the agreement between Srs and Jrs ranged from moderate to almost perfect, with statistical difference between ILTM proximity to the mandibular canal (where Srs and Jrs agreed more; *P* <0.05), cortical canal interruption, and mandibular canal narrowing. Regarding the comparison of the parameters analyzed in 2D and 3D exams related to ILTM proximity with IAN, we observed underestimation of this relationship in 2D exams. Parameters such as canal radiopaque line interruption (830), root apex darkening (570), and bifid apexes (339) were identified with lower absolute frequency in 2D examinations vs 3D examinations evaluating proximity to the canal (1132), cortical interruption (727), and canal narrowing (576).

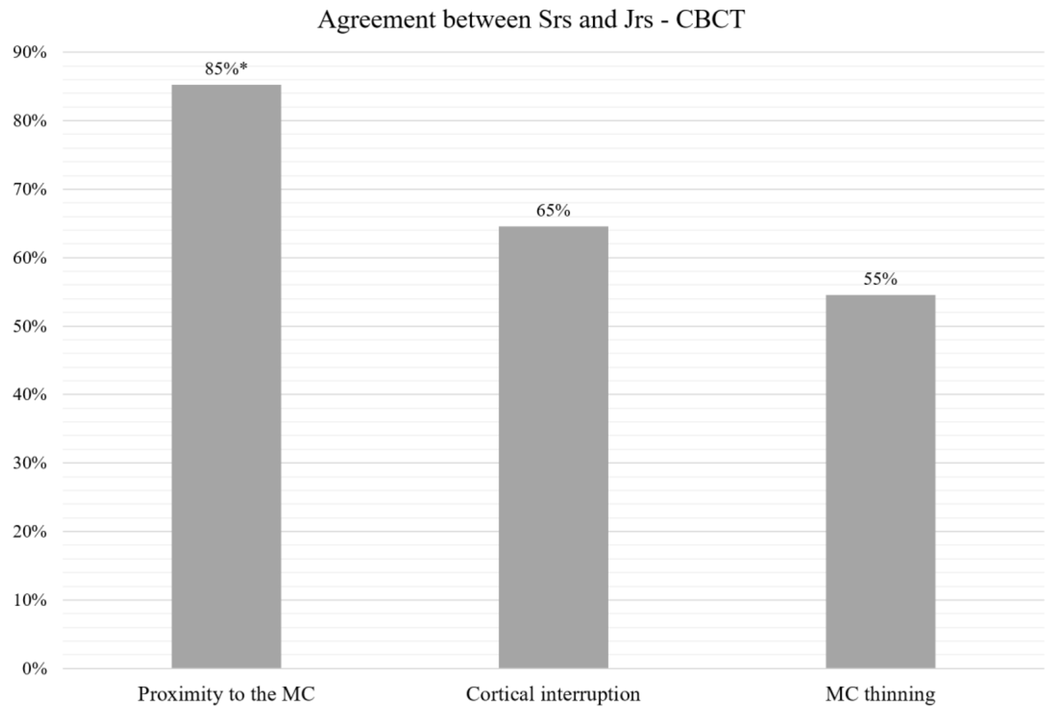


Figure 2. Srs and Jrs' agreement about ILTM and IAN proximity using CBCTs. There was statistical difference (*) between the evaluated items (one-way ANOVA).

Table 3 shows the results regarding ILTM's relationship with the LSM. The diagnosis of no proximity between ILTM and LSM in 141 cases analyzed by PANs decreased to 55 cases using CBCT; the agreement level was considered fair. Using PANs, the professionals did not agree on LSM resorption, whereas using CBCT the professionals showed slight agreement. The absolute frequency in Table 3 highlights the agreement between Srs and Jrs regarding LSM resorption occurring in 140 cases with PANs and 294 cases with CBCT.

Table 3. Agreement on LSM and ILTM relationship

Proximity		CBCT				
		Crown	Cervical	Root	None	TOTAL
PAN	Crown	**83**	52	92	3	230
	Cervical	18	**78**	133	8	237
	Root	17	69	**533**	20	639
	None	39	43	35	**24**	141
	TOTAL	157	242	793	55	1247
Kappa	0,303			Fair agreement		

LSM Resorption		CBCT			
		Present	Absent	Uncertain	TOTAL
PAN	Present	**516**	118	17	651
	Absent	362	**185**	18	565
	Uncertain	12	4	**15**	31
	TOTAL	890	307	50	1247
Kappa	0,173		None to slight agreement		

LSM Resorption - PAN		Senior			
		Present	Absent	Uncertain	TOTAL
Junior	Present	**140**	191	1	332
	Absent	184	**95**	6	285
	Uncertain	2	8	**8**	18
	TOTAL	326	294	15	635
Kappa	-0.180		No agreement		

LSM Resorption - CBCT		Senior			
		Present	Absent	Uncertain	TOTAL
Junior	Present	**294**	231	14	539
	Absent	26	**18**	0	44
	Uncertain	18	6	**6**	30
	TOTAL	338	255	20	613
Kappa	0.05		None to slight		

* Bold numbers indicate the agreement.

Follicular space assessment (table 4) may have implications for treatment planning in cases where the value is greater than 4 mm. Regarding this evaluation, it is noteworthy that follicular space > 4 mm appears to be more frequently diagnosed when Jrs used PANs (45). The lowest frequency of pericoronal space > 4mm diagnosis occurs in CBCT for Srs (1 identification).

Table 4. Agreement on follicular space around ILTM on PAN and CBCT exams

Follicular space - CBCT		Senior			TOTAL
		<2mm	Between 2 and 4mm	>4mm	
Junior	<2 mm	**300**	64	0	364
	Between 2 and 4 mm	172	**61**	0	233
	>4 mm	13	2	**1**	16
	TOTAL	485	127	1	613
Follicular space - PAN		**Senior**			**TOTAL**
		<2 mm	Between 2 and 4 mm	>4 mm	
Junior	<2 mm	**261**	87	11	359
	Between 2 and 4 mm	77	**117**	35	229
	>4 mm	7	9	**29**	45
	TOTAL	345	213	75	633

* Bold numbers indicates the agreement.

Regarding the intraoperative planning (table 5), we noticed a higher frequency of clinical decision to follow up among Jrs, especially when using CBCTs. We also identified a higher frequency of coronectomy (170) compared to PANs (94). The other items of the intraoperative planning process do not present marked differences between absolute frequencies comparing 2D vs 3D or Srs vs Jrs.

Table 5. Absolute frequency of intraoperative planning decisions by PANs and CBCTs for Jrs and Srs

	PAN						
	Follow	Coronectomy	Exodontia	Osteotomy	Odontosection (Crown)	Odontosection (Roots)	Relaxing Incision
Sr1	0	0	218	213	166	6	213
Sr2	0	3	215	214	210	196	9
Sr3	2	66	150	207	149	80	212
Jr1	0	18	200	215	207	187	215
Jr2	7	0	211	187	162	161	185
Jr3	12	7	199	109	177	150	188
	CBCT						
	Follow	Coronectomy	Exodontia	Osteotomy	Odontosection (Crown)	Odontosection (Roots)	Relaxing Incision
Sr1	0	0	218	217	202	10	218
Sr2	0	1	217	209	202	167	7
Sr3	3	160	55	212	204	21	212
Jr1	0	9	209	218	218	218	218
Jr2	24	0	194	185	152	148	186
Jr3	17	1	200	186	189	185	189
	Coincidence						
	Follow	Coronectomy	Exodontia	Osteotomy	Odontosection (Crown)	Odontosection (Roots)	Relaxing Incision
Sr1	0	0	218	212	158	1	213
Sr2	0	0	214	209	198	160	6
Sr3	1	58	48	205	144	12	210
Jr1	0	0	191	215	207	187	215
Jr2	1	0	188	184	135	126	183
Jr3	0	1	182	108	177	149	161

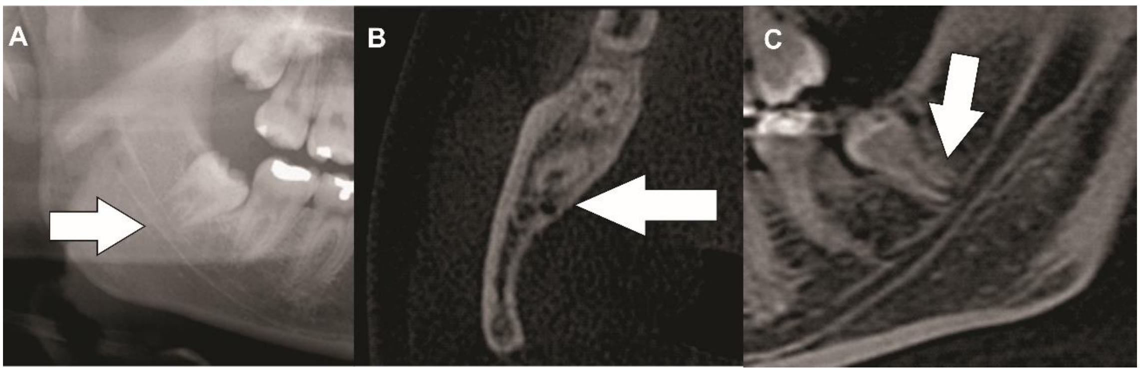
Regarding postoperative expectation (Table), the highest absolute frequency of expectation of pain, edema, and trismus occurred with Srs regardless of the imaging exam. The highest absolute frequency of paresthesia expectation occurs among Jrs regardless of the type of exam, which is a different standard for Srs.

Table 6. Absolute frequency of postoperative complications according to PAN and CBCT exams

	PAN		CBCT		Coincidence	
	PST	Paresthesia	PST	Paresthesia	PST	Paresthesia
Sr 1	217	29	218	26	217	5
Sr 2	217	43	218	40	217	27
Sr 3	123	0	52	0	34	0
Total	**557**	**72**	**488**	**66**	**468**	**32**
Jr1	215	151	217	180	215	137
Jr2	75	149	147	107	65	95
Jr3	88	128	125	123	63	86
Total	**378**	**428**	**489**	**410**	**343**	**318**

PST = Pain/Swelling/Trismus.

Illustration 4 shows a change in ILTM surgery planning; the 2D and 3D exam images show a case where the PAN-planning was total removal and CBCT-planning was coronectomy due to the contact of ILTM apices and IAN.



Ilustration 4. Right ILTM (#48). A: PAN, the proximity of the ILTM apex and the mandibular canal was not evidenced by any of the 7 signals. B, C: CBCT, on axial, ILTM apex in contact with mandibular canal, on sagittal (flipped) mandibular canal with cortical interruption.

5. Discussion

5. DISCUSSION

This study evaluated the influence of 2D and 3D images and professional experience in the diagnosis and treatment planning of ILTM, showing that both can have significant influence on the 5 parameters evaluated.

Although Pell and Gregory's[25] and Winter's[26] classifications are widely used, they were based on 2D imaging exams. In our study, the data suggest that there is a significant difference between the ILTM positioning assessment considering 2D and 3D images, for both Srs and Jrs. The same findings were observed by Hasani et al and Brasil et al; the latter showed that 2D images can underestimate the level of ILTM impaction.[4,27]

One of the most considered aspects in ILTM surgery is the positioning in relation to the mandibular canal due to the possibility of IAN injury.[28-30] From our results, we can highlight that the professional agreement (Srs vs Jrs) regarding the proximity of ILTM to the IAN was almost perfect (85%) for the 3D examinations. The result using 2D images was lower, reaching a maximum of 69% (substantial) for the identification of root narrowing, which may suggest the proximity of the ILTM with the mandibular canal. In addition, in this study, the level of professional agreement for white line interruption and root darkening was 60 and 56%, respectively. According to Winstanley et al, these 2 findings are the most predictive of ILTM contact with IAN.[21] Hasani et al, in a level 5 study (Fryback & Thornbury, 1991), performed surgery on 59 ILTMs previously evaluated for IAN exposure using 2D and 3D examinations. These authors commented that PAN may miss about one-third of exposure cases.[16, 25]

The resorption of LSM caused by ILTM ranges from 20 to 40% in studies using 3D images.[31-33] This study showed a higher frequency of LSM resorption when the professionals used CBCT (890) compared to PAN (651) and no or slight agreement between the exams (kappa = 0.17). Oenning et al corroborated such results by detecting prevalence of LSM resorption up to 4 times higher in 3D examinations.[2] Moreover, the agreement between Srs and Jrs regarding the presence of LSM resorption is higher using CBCT exam (294) than PAN (140).

Pericoronal spaces larger than 4 mm may be related to pathologies, such as cysts and pericoronaritis, and can influence the treatment planning.[34-35] In our study, we observed that the diagnosis of pericoronal space larger than 4 mm can vary greatly according to the exam type and professional experience, being oversized when evaluated by junior professionals using 2D examinations.

In the intraoperative stage, the surgical technique for ILTM removal may vary depending on operator preferences and/or treatment needs.[36] In addition to these influential factors, imaging may also change the professional decision about the surgical technique.[36] This can be observed in our study; for example, 1 senior professional planned 94 coronectomies using PAN and 171 using CBCT. According to the systematic review on the influence of 2D and 3D images on the treatment of ILTMs by Araujo et al, the surgical approach did not change independently of the imaging method; however, professional experience has not been studied.[37]

Advancing to what is expected in the postoperative period, complications such as trismus, IAN injury, and edema are present in the literature.[10, 22, 38-40] Guerrero et al, in a level 5 study[16] compared postoperative complications in planned ILTM removals from PANs or CBCTs. They showed that 2 of them in the CBCT group versus 5 in the PAN group resulted in IAN sensory disturbance, evidencing that precisely knowing the level of proximity can help in the intraoperative step by allowing the surgeons to be more cautious or to use less pressure on the removal of the ILTM.[18] However, it was not possible to state that CBCTs allow a better postoperative result compared to PANs. In our study, Srs and Jrs appeared to expect almost the same pain, swelling, and trismus by CBCTs; this trend is not maintained when using PANs, where Jrs expected fewer of these postoperative issues. For paresthesia, Srs and Jrs expected similar frequencies of this neurosensorial disturbance comparing the image exam; however, Jrs expected up to 5 times more paresthesia than Srs on both exam types.

Some patterns in this study were corroborated by Fortes et al, in which more experienced examiners changed the treatment plan less, whereas less experienced examiners behaved differently, changing their planning depending on the 2D or 3D image.[24] Another point is that Srs and Jrs agree more when the exam used is tridimensional. Besides the discussion on 2D vs 3D images, in the era of artificial intelligence,[40] senior professionals or experts define the best label for a diagnosis. In this sense it is important to explore the differences and similarities that might exist between theirs and other nonexpert professionals.

One of the limitations of this study is that it was not possible to standardize the conditions for the examination of the images, since professionals can have different sequences of analyzing images. Thus, the examiners were able to make their plans without time limits for each exam, and they were free to manipulate the imaging exams in their respective software. The lack of studies containing findings on the influence of imaging and professional experience in ILTM treatment also makes it difficult to establish comparisons.

6. Conclusion

CONCLUSION

Taken together, the results obtained in this study indicated that there are differences in ILTM treatment planning, depending on whether 2D or 3D images were used and according to professional experience, and that CBCT increased the agreement level between professionals for all parameters analyzed.

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