ORIGINAL ARTICLE

Depth and proximity of third molars to the inferior alveolar canal in panoramic radiographs of a Latin American population

Profundidad y proximidad de terceros molares al canal alveolar inferior en radiografías panorámicas de una población latinoamericana

María Claudia Garcés-Elías[1], *Roberto A. León-Manco*[2], *Jorge A. Beltrán*[3]

[1] Master of Business Administration (MBA). Academic Department of Social Dentistry, Facultad de Estomatología, Universidad Peruana Cayetano Heredia, Lima, Perú. 0000-0003-4873-7661

[2] MPH, Professor, Academic Department of Social Dentistry, Facultad de Estomatología, Universidad Peruana Cayetano Heredia, Lima, Perú. 0000-0001-9641-1047

[3] PhD. Estomatology. Academic Department of Medicine and Bucomaxillofacial surgery, Facultad de Estomatología, Universidad Peruana Cayetano Heredia, Lima, Perú. 0000-0001-9910-0930

ABSTRACT

Introduction: *extraction of lower third molars involve the possible occurrence of complications such as injury of the content of the Inferior Alveolar Canal.* ***Methods:*** *a cross-sectional study was conducted with a sample of 6488 lower molar records of digital panoramic radiographs of patients from 6 Latin American countries from 2010-2015. The variables studied were the depth of lower third molar according to the Pell and Gregory classification, and the proximity of a third molar to the Inferior Alveolar Canal that was evaluated according to the proposed classification, based on a modification of the Langlais et al classification.[20] Descriptive and bivariate statistical analyses were performed.* ***Results:*** *in terms of the proximity, the highest frequency was Intact with 27.45%(n=1781). Regarding the depth of the lower third molar, the most frequent were the Position B with 46.90%(n=3043) and Position A with 46.75%(n=3033). The proximity and depth of the lower third molar had statistical difference according to age(p<0.01) and sex (p<0.001). The overall proximity of the lower third molar to the Inferior alveolar canal, according to depth was 37.52%(n=1766) in Position A, in Position B it was 54.51%(n=2566) and Position C was 7.97%(n=375) and had association between variables(p<0.001).* ***Conclusions:*** *taking into consideration the modified classification of Langlais et al.[20], lower third molars are close to the Inferior Alveolar Canal, and according to the Pell and Gregory classification for the depth, the most frequent positions are A and B. In addition, proximity and depth were associated with each other, and with the co-variables country, age, and sex.*

Keywords: *radiography panoramic, molar third, mandible, adult.*

Resumen

Introducción: *la extracción de terceros molars inferiores implica la posible aparición de complicaciones, como la lesión del contenido del Canal Alveolar Inferior.* ***Métodos:*** *se realizó un estudio transversal con una muestra de 6488 registros de terceros molares inferiores de radiografías panorámicas digitales en pacientes de 6 países latinoamericanos, entre 2010-2015. Las variables fueron profundidad del tercer molar inferior según la clasificación de Pell y Gregory, y proximidad del tercer molar al Canal Alveolar Inferior, evaluada según una clasificación propuesta, basada en la clasificación modificada de Langlais et al.[20] Se realizaron análisis estadísticos descriptivos y bivariados.* ***Resultados:*** *en la proximidad, la mayor frecuencia se presentó en Intacto con 27,45%(n=1781); en cuanto a la profundidad del tercer molar inferior, las más frecuentes fueron la Posición B con 46,90%(n=3043) y la Posición A con 46,75%(n=3033). La proximidad y profundidad del tercer molar inferior presentaron diferencias estadísticas de acuerdo con la edad (p<0,01) y sexo (p<0,001). La proximidad total del tercer molar inferior al canal alveolar inferior, según la profundidad fue de 37,52%(n=1766) en Posición A, en Posición B de 54,51%(n=2566) y Posición C de 7,97%(n=375). Además, se presentó asociación entre las variables (p<0,001).* ***Conclusiones:*** *considerando la clasificación modificada de Langlais et al.[20], la mayoría de los terceros molares inferiores están próximos al canal alveolar inferior; y según la profundidad de Pell y Gregory, las posiciones más frecuentes son A y B. Además, la proximidad y la profundidad se asociaron entre sí, y con las co-variables país, edad y sexo.*

Palabras clave: *radiografía panorámica, tercer molar, mandíbula, adulto.*

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INTRODUCTION

Third molars, with an average appearance of around 20 years of age[1,2], usually face obstacles for an adequate eruption, representing 98% of the impactions, located mostly at the mandibular level[3,4]. There are also preponderant factors in the eruption pattern such as limited skeletal growth, distal eruption, verticalization in the growth of the condyle, the increase in the size of the dental crowns, and the delayed maturation of the third molars[5]. However, the eruption and possible impaction of these teeth is mostly linked to the space availability at the posterior ends of the dental arch[6]. Additionally, they can be linked to certain pathological conditions such as dental caries, periodontitis, pericoronaritis, external root resorption of the adjacent tooth, and the possible development of infections or cysts, among others[7,8].

On the other hand, the extraction of third molars is considered one of the most frequent surgical procedures in oral surgery, even though it involves the possible occurrence of intra and post-operative complications[9]. One of them is the injury to the vascular-nerve bundle contained in the Inferior Alveolar Canal (IAC), caused by direct or indirect trauma[10,11], with a prevalence of 0.4 to 8.4%[12,13] that can have a significant impact on the quality of life of patients due to the damage caused to speech, chewing, etc[14,15]. However, these scenarios can be avoided with an accurate diagnostic imaging prior to the procedure, highlighting the importance of the panoramic radiography as a useful tool to evaluate the potential risk caused by the IAC, based on its proximity to the third molars due to the wide visualization it provides of the mandibular structures, condyles and possible nearby pathologies[16]. Despite the above, one of the disadvantages of the panoramic radiography is that it provides information only in two dimensions, so the absence of the cortical bone of the mandibular canal may not be evident with two-dimensional methods, and it would be complex to determine whether its direction is buccal or lingual to the roots. Consequently, it brings the attention to the presence of more accurate alternatives such as the Cone Beam Computed Tomography (CBCT), which is accepted for its high sensitivity in predicting exposure of the neurovascular bundle. CBCT is an effective method to locate the canal and its relationship with the roots of the lower third molars since it can generate images through the mandibular body in different planes. However, it should be mentioned that due to its high cost and limited availability, CBCT is not usually the radiographic technique of first choice for a pre-surgical evaluation of lower third molars in contrast to the

panoramic radiography[17]. Additionally, thanks to digitalization, panoramic radiographs are an alternative that takes less time, reduces the radiation dose, and offers the possibility of improving the image by means of the computer[18].

It is important to mention that there are several? classifications to evaluate the anatomical location of the third molars. The Pell and Gregory classification is based on the relationship between the level of this dental piece and the occlusal plane of the contiguous second molar. Therefore, it allows determining its relative depth as well as the relation it has with the ascending branch and the distal surface of the second molar[19].On the other hand, the classification of Langlais et al. uses the IAC and its proximity to the roots of third molars as a reference point and it defines the presence of three types of images based on this relationship: dark band phenomenon, constriction of the diameter of the IAC, and discontinuity of the IAC[20]. However, due to the great variability observed in function to the IAC, it allowed the researchers of the academic section of Buccomaxillofacial Imaging of the Faculty of Stomatology at Universidad Peruana Cayetano Heredia, to postulate a modification of the mentioned classification, where besides appreciating the already known variants independently, two more signs were added: intact and change of direction of the IAC. It is important to mention that the latter is highly frequent in radiographic findings[21].

The evidence refers to multiple investigations related to third molars and their complications; however, there are few studies about their location, especially in Latin America[15,22]. Therefore, the objective of this research was to determine the depth and proximity to IAC of third molars in panoramic radiographs of Latin American population.

METHODS

The present investigation was a cross-sectional study, with a sample, selected by convenience, and composed of a database of 6488 records of lower molars from digital panoramic radiographs, from patients between 18 and 65 years of age and of both sexes. This database belongs to the records of thesis research, carried out by 11 students of the second Professional Specialty international program in Oral and Maxillofacial Radiology of the Universidad Peruana Cayetano Heredia, from Bolivia (La Paz), Colombia (Bogotá and Nariño), Costa Rica (Guanacaste), Ecuador (Cuenca, Loja, Macas and

Tungurahua), Mexico (State of Mexico) and Peru (Ayacucho and Lima), within the period 2010 to 2015.

The students of the specialization program collected the information after an inter-examiner calibration process, having as a gold standard a professor specialized in oral and maxillofacial radiology with more than 20 years of experience, obtaining as a result a Kappa Index greater than 0.80 in all cases. The variables of the study were the depth of the lower third molar according to the classification of Pell and Gregory[19] (figure 1), whose categories consisted of Position A when the highest point of the lower third molar is at or above the occlusal surface of the second molar, Position B when the highest point of the lower third molar is below the occlusal line but above the cervical line of the second molar, and Position C when the highest point of the lower third molar is at or below the cervical line of the second molar.

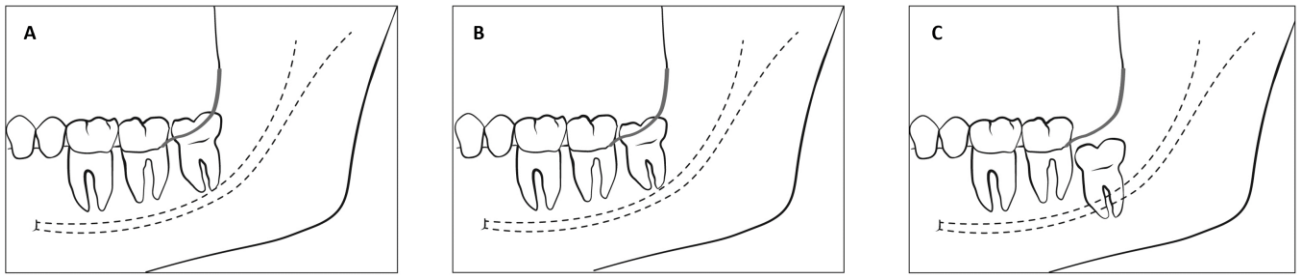

Figure 1. Aranda L.[32]

A. The highest point of the included tooth is at or above, the occlusal surface of the second molar. B. The highest point of the tooth is below the occlusal line, but above the cervical line of the second molar. C. The highest point of the tooth is, at or below, the cervical line of the second molar.

Fuente: por los autores

The proximity of the third molar to IAC was evaluated according to the proposed classification in this study that is based on a modification of Langlais et al's classification[20] (figure 2). This establishes the following categories: Intact, when the roots of the third molar show no signs of proximity to the IAC; dark band phenomenon, when a radiolucent band is observed crossing the roots of the third molars; change of direction of the IAC, when it describes a marked curve close to the apical zone of the roots of the third molars; discontinuity of the IAC, when it is interrupted or non-existent when it crosses the roots of the third molars; constriction of the diameter of the IAC, when there is a decrease in its diameter that crosses the roots of the third molars; additionally, it is contemplated to include their different combinations. Furthermore, the variable was dichotomized into Intact and Proximal (in the

latter, all other categories were grouped). Likewise, factors such as country, age, sex, and molar were considered as descriptive co-variables. With the database cleaned, the descriptive and bivariate analyses were performed; the tests used were Chi-square and Chi-square of linear trend for the associations of qualitative variables. For the mean differences, the Mann Whitney U and Kruskal Wallis tests were used, due to the absence of normality presented by the age variable, the Kolmogorov-Smirnov test was used. The analysis was developed in the STATA 17.0 program. Lastly, a confidence level of 95% and a $p<0.05$ was used.

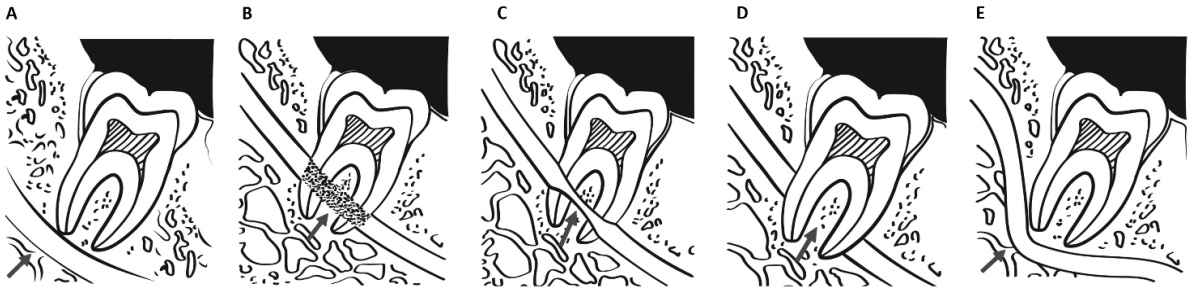

Figure 2. Aranda L.[32]

A. Intact: The roots of the third molar do not show signs of proximity to the IAC. B. Dark band phenomenom: we observe a radiolucent band that crosses the roots of the third molars. C. Constriction of the diameter of the IAC. There is a decrease in the diameter of the IAC that crosses the roots of the third molar. D. IAC discontinuity: the IAC is interrupted or non-existent when it crosses the roots of the third molar. E. Change of direction of the IAC: the IAC describes a marked curve close to the apical zone to the roots of the third molars.

Fuente: por los autores

All the information collected, since it originated from research thesis, was approved by the Institutional Ethics Committee of the Universidad Peruana Cayetano Heredia with SIDISI registration No. 63901.

RESULTS

Regarding the proximity of the lower third molar to the IAC, according to the modified Langlais et al. classification, the highest frequency was Intact with 27.45% (n=1781), followed by Dark Band Phenomenon with 14.90% (n=967) and Dark Band Phenomenon + IAC Discontinuity with 12.87% (n=835). Regarding the depth of the third lower molar and according to Pell and Gregory, the most frequent were Position B with 46.90% (n=3043) and Position A with 46.75% (n=3033) and the least frequent was Position C with 6.35% (n=412). According to country, in the intact category, Peru had the highest frequency with 28.92% (n=515) and Costa Rica had the lowest frequency with 5.50%

(n=124). Additionally, the variable country was associated with all variables (p<0.001) (table 1). Likewise, the proximity and depth of the lower third molar were statistically different according to age (p<0.01) and sex (p<0.001) (table 2). The overall proximity of the lower third molar to the IAC according to depth was 37.52% (n=1766) in Position A, in Position B it was 54.51% (n=2566) and Position C was 7.97% (n=375) and had an association between the variables (p<0.001) (table 3).

Table 1. Frequency of the location of lower third molars according to countries in panoramic radiographs of Latin American population

Variables	n	%	Country												p
			Bolivia		Colombia		Costa Rica		Ecuador		México		Perú		
			n	%	n	%	n	%	n	%	n	%	n	%	
Proximity of the lower third molar to the IAC (Modified Langlais et al.[20] classification)															
Intact	1781	27.45	339	19.03	225	12.63	98	5.50	474	26.61	130	7.30	515	28.92	
Proximal	4707	72.55	395	8.39	800	17.00	210	4.46	1168	24.81	1036	22.01	1098	23.33	<0.001**
Intact	1781	27.45	339	19.03	225	12.63	98	5.50	474	26.61	130	7.30	515	28.92	
Dark band phenomenom	967	14.90	2	0.21	148	15.31	39	4.03	255	26.37	191	19.75	332	34.33	
Change of IAC address	35	0.54	4	11.43	10	28.57	2	5.71	11	31.43	1	2.86	7	20.00	
Discontinuity of IAC	877	13.52	28	3.19	152	17.33	39	4.45	203	23.15	2	0.23	453	51.65	
Constriction of the IAC diameter	237	3.65	10	4.22	32	13.50	14	5.91	166	70.04	1	0.42	14	5.91	
Dark band phenomenom + Change of IAC address	89	1.37	2	2.25	16	17.98	1	1.12	33	37.08	2	2.25	35	39.33	
Dark band phenomenom + Discontinuity of IAC	835	12.87	133	15.93	144	17.25	41	4.91	132	15.81	261	31.26	124	14.85	
Dark band phenomenom + Constriction of the IAC diameter	147	2.27	16	10.88	25	17.01	5	3.40	44	29.93	46	31.29	11	7.48	
Change of IAC address + Discontinuity of IAC	89	1.37	19	21.35	17	19.10	3	3.37	14	15.73	0	0.00	36	40.45	
Change of IAC address + Constriction of the IAC diameter	99	1.53	34	34.34	18	18.18	1	1.01	40	40.40	0	0.00	6	6.06	
Discontinuity of IAC + Constriction of the IAC diameter	302	4.65	64	21.19	49	16.23	31	10.26	135	44.70	6	1.99	17	5.63	<0.001*
Dark band phenomenom + Change of IAC address + Discontinuity of IAC	106	1.63	22	20.75	38	35.85	5	4.72	11	10.38	12	11.32	18	16.98	
Dark band phenomenom + Change of IAC address + Constriction of the IAC diameter	48	0.74	8	16.67	15	31.25	1	2.08	7	14.58	10	20.83	7	14.58	
Dark band phenomenom + Discontinuity of IAC + Constriction of the IAC diameter	535	8.25	37	6.92	71	13.27	14	2.62	49	9.16	355	66.36	9	1.68	
Change of IAC address + Discontinuity of IAC + Constriction of the IAC diameter	117	1.80	13	11.11	28	23.93	8	6.84	43	36.75	3	2.56	22	18.80	
Dark band phenomenom + Change of IAC address + Discontinuity of IAC + Constriction of the IAC diameter	224	3.45	3	1.34	37	16.52	6	2.68	25	11.16	146	65.18	7	3.13	
Depth of lower third molar (Pell and Gregory[19])															

Position A	3033	46.75	412	13.58	397	13.09	172	5.67	737	24.30	490	16.16	825	27.20	
Position B	3043	46.90	258	8.48	514	16.89	124	4.07	744	24.45	657	21.59	746	24.52	<0.001**
Position C	412	6.35	64	15.53	114	27.67	12	2.91	161	39.08	19	4.61	42	10.19	
Total	6488	100.00	734	11.31	1025	15.80	308	4.75	1642	25.31	1166	17.97	1613	24.86	

*Chi-square linear trend test
**Chi-square test
Source: by the authors

Table 2. Frequency of location of lower third molars according to age, sex and molar in panoramic radiographs of Latin American population

Location	n	%	Age		p	Sex				p	Molar				p
			X	SD		Male		Female			Left		Right		
						n	%	n	%		n	%	n	%	
Proximity of the lower third molar to the IAC (Modified Langlais et al.[20])															
Intact	1781	27.45	29.56	9.29	<0.001**	889	49.92	892	50.08	<0.001***	909	51.04	872	48.96	0.177***
Proximal	4707	72.55	26.53	7.02		1878	39.90	2829	60.10		2314	49.16	2393	50.84	
Intact	1781	27.45	29.56	9.29		889	49.92	892	50.08		909	51.04	872	48.96	
Dark band phenomenom	967	14.90	27.58	7.46		366	37.85	601	62.15		491	50.78	476	49.22	
Change of IAC address	35	0.54	26.51	5.27		17	48.57	18	51.43		20	57.14	15	42.86	
Discontinuity of IAC	877	13.52	27.12	7.21		407	46.41	470	53.59		414	47.21	463	52.79	
Constriction of the IAC diameter	237	3.65	26.59	6.62		91	38.40	146	61.60		111	46.84	126	53.16	
Dark band phenomenom + Change of IAC address	89	1.37	27.24	7.76		26	29.21	63	70.79		47	52.81	42	47.19	
Dark band phenomenom + Discontinuity of IAC	835	12.87	26.05	7.36		349	41.80	486	58.20		428	51.26	407	48.74	
Dark band phenomenom + Constriction of the IAC diameter	147	2.27	26.25	6.52		66	44.90	81	55.10		70	47.62	77	52.38	
Change of IAC address + Discontinuity of IAC	89	1.37	25.63	5.75		25	28.09	64	71.91		55	61.80	34	38.20	
Change of IAC address + Constriction of the IAC diameter	99	1.53	25.29	5.72		36	36.36	63	63.64		44	44.44	55	55.56	
Discontinuity of IAC + Constriction of the IAC diameter	302	4.65	25.83	6.16	<0.001*	134	44.37	168	55.63	<0.001***	143	47.35	159	52.65	0.052***
Dark band phenomenom + Change of IAC address + Discontinuity of IAC	106	1.63	24.84	5.49		40	37.74	66	62.26		44	41.51	62	58.49	
Dark band phenomenom + Change of IAC address + Constriction of the IAC diameter	48	0.74	27.94	7.36		8	16.67	40	83.33		19	39.58	29	60.42	
Dark band phenomenom + Discontinuity of IAC + Constriction of the IAC diameter	535	8.25	25.36	6.56		202	37.76	333	62.24		278	51.96	257	48.04	
Change of IAC address + Discontinuity of IAC + Constriction of the IAC diameter	117	1.80	26.91	6.59		38	32.48	79	67.52		48	41.03	69	58.97	
Dark band phenomenom + Change of IAC address + Discontinuity of IAC + Constriction of the IAC diameter	224	3.45	26.34	6.79		73	32.59	151	67.41		102	45.54	122	54.46	
Depth of lower third molar (Pell and Gregory[19])															
Position A	3033	46.75	28.59	8.67		1334	43.98	1699	56.02		1538	50.71	1495	49.29	
Position B	3043	46.90	26.06	6.66	<0.001*	1240	40.75	1803	59.25	0.008***	1494	49.10	1549	50.90	0.172***
Position C	412	6.35	27.92	7.74		193	46.84	219	53.16		191	46.36	221	53.64	
Total	6488	100.00	27.36	7.83		2767	42.65	3721	57.35		3265	50.32	3223	49.68	

*Kruskal Wallis Test
**Mann Whitney U Test
*** Chi-square test
Source: by the authors

Table 3. Proximity of the location of the lower third molars according to depth in panoramic radiographs of the Latin American population

Location	n	%	Depth of lower third molar (Pell and Gregory[19])						*p*
			Position A		Position B		Position C		
			n	%	n	%	n	%	
Proximity of the lower third molar to the IAC (modified Langlais et al.[20])									
Intact	1781	27.45	1267	71.14	477	26.78	37	2.08	<0.001**
Proximal	4707	72.55	1766	37.52	2566	54.51	375	7.97	
Intact	1781	27.45	1267	71.14	477	26.78	37	2.08	
Dark band phenomenom	967	14.90	427	44.16	469	48.50	71	7.34	
Change of IAC address	35	0.54	7	20.00	24	68.57	4	11.43	
Discontinuity of IAC	877	13.52	395	45.04	450	51.31	32	3.65	
Constriction of the IAC diameter	237	3.65	98	41.35	120	50.63	19	8.02	
Dark band phenomenom + Change of IAC address	89	1.37	15	16.85	58	65.17	16	17.98	
Dark band phenomenom + Discontinuity of IAC	835	12.87	344	41.20	435	52.10	56	6.71	
Dark band phenomenom + Constriction of the IAC diameter	147	2.27	46	31.29	88	59.86	13	8.84	
Change of IAC address + Discontinuity of IAC	89	1.37	30	33.71	53	59.55	6	6.74	
Change of IAC address + Constriction of the IAC diameter	99	1.53	36	36.36	46	46.46	17	17.17	
Discontinuity of IAC + Constriction of the IAC diameter	302	4.65	105	34.77	156	51.66	41	13.58	<0.001*
Dark band phenomenom + Change of IAC address + Discontinuity of IADC	106	1.63	26	24.53	69	65.09	11	10.38	
Dark band phenomenom + Change of IAC address + Constriction of the IAC diameter	48	0.74	8	16.67	28	58.33	12	25.00	
Dark band phenomenom + Discontinuity of IAC + Constriction of the IAC diameter	535	8.25	165	30.84	347	64.86	23	4.30	
Change of IAC address + Discontinuity of IAC + Constriction of the IAC diameter	117	1.80	26	22.22	68	58.12	23	19.66	
Dark band phenomenom + Change of IAC address + Discontinuity of IAC + Constriction of the IAC diameter	224	3.45	38	16.96	155	69.20	31	13.84	
Total	6488	100.00	3033	46.75	3043	46.90	412	6.35	

*Chi-square linear trend test
**Chi-square test
Source: by the authors

DISCUSSION

Exodontia of mandibular third molars is a routine procedure in dental practice that, in case of complications, could lead to multiple scenarios. One of them is the injury to the lower dental nerve. In this sense, it is necessary to use diagnostic imaging methods such as the panoramic radiography, which provides with greater precision, a complete view of the number, location, and proximity of the roots to other adjacent structures that may be compromised such as the IAC16,[23]. However, due to its limitation of only providing two-dimensional information, CBCT is still the most accurate imaging alternative[17].

As part of the findings of this investigation, in terms of the proximity of the mandibular third molars, we found that more than three-quarters of the third molars were found close to the IAC. These results coincide with those previously published by Huang et al., who determined that more than 80% of the mandibular third molars contacted or were superimposed on the IAC by using panoramic radiographs of 120 patients from a hospital in Taiwan[24]. However, there is limited scientific evidence using a standardized classification to identify the proximity of lower third molars to the IAC such as that presented by Langlais et al. and its modification, which is proposed in this paper.

On the other hand, according to Pell and Gregory's classification, the most frequent depth levels in this sample were A and B, together representing almost all the data. Regarding the type A depth level, Jaron et al. evaluated the depth of impaction of third molars with an indication for surgical extraction in the panoramic radiographs of 1585 patients from countries located east of the Baltic Sea, reporting that more than half of the cases showed this depth[25]. This result is essential for our research because it coincides with the present study findings. Contrary to our study, an analysis carried out on Turkish people showed that, in the lower jaw, the C classification was the most common according to impaction depth. These findings differ from our study's; this could be related to certain factors like the objective population ethnicity, which is relevant when considering the type of treatment for the patients. Additionally, the auxiliary examinations for the Turkish study belonged to individuals with the indication for exodontia and acute symptomatology such as pain, pericoronaritis, lymphadenopathy, and trismus[26].

However, due to the lack of evidence, it has not been possible to identify articles that associate proximity and depth using the same classifications used in this study. Regarding depth, Deshpande et al. demonstrated that digital orthopantomographies are a reliable tool to evaluate depth in third molars impacted with IAC. In addition, they observed that impactions with closer distances to the IAC presented radiographic signs indicating risk and compromising that structure; radiographic findings associated with the proximity between the tooth and the IAC, known as "interruption of the white line," are mentioned[27]. Similarly, the radiographic analysis allows classifying and determining that those mandibular third molars that maintain close contact with the IAC are linked to a high risk of nerve tissue injury as postoperative sequelae due to their proximity[28].

It is important to mention that in this study the proximity to IAC and depth of the lower third molar presented significant differences in their distribution according to age and sex. Similarly, some authors previously state that women present third molars closer and more superimposed to the IAC in comparison to men. In addition, they express specific factors such as age and sex and they present a greater risk of injury to the IAC, according to the location of the structures involved[29,30].

Among the limitations observed in this study, we highlight its cross-sectional design, which only allows us to describe the behavior of the variables, but not to infer causal relationships between them. Likewise, the lack of randomization to select the sample, in addition to the presence of non-homogeneous values for each country that allowed us to expose that these findings lack the power to be extrapolated, being only applicable to the sample of this research. In contrast, thanks to technological advances, the use of CBCT is recommended because the location of the mandibular lower third molar can be determined with greater precision.

In this regard, it is important to highlight the contribution that this research makes to the correct pre-surgical diagnosis, due to the high frequency of lower third molars that have close contact with the IAC, which could lead to postoperative complications that, if not considered, are detrimental to the

patient. Although panoramic radiographs are widely used in specific contexts, such as countries under evaluation, it is essential to mention that when there is a proximity finding, it would be advisable to complement the diagnosis with a CBCT scan for greater certainty in the localization[31]. In addition, the findings of this study can be taken as the basis for the generation of further research using panoramic radiographs and the same parameters stablished in this study, including the modified Langlais et al. and Pell and Gregory classifications. Moreover, this is the first published research that modifies the Langlais classification to propose its own classification based on the theory applied to radiographic evidence.

CONCLUSION

According to the modified classification of Langlais et al, the majority of lower third molars in the Latin American population are close to the inferior alveolar canal; and according to the depth classification of Pell and Gregory, the most frequent depths are Positions A and B. In addition, proximity to IAC and depth were associated with each other and with the co-variables country, age, and sex.

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CONFLICTS OF INTEREST

The authors state that they have no conflict of interest.

CORRESPONDING AUTHOR

María Claudia Garcés-Elías
Universidad Peruana Cayetano Heredia
(+511) 319 0000
maria.garces@upch.pe
Av. Honorio Delgado 350, San Martín de Porres
Lima, Perú

REFERENCES

1. Santiago BM, Almeida L, Cavalcanti YW, Magno MB, Maia LC. Accuracy of the third molar maturity index in assessing the legal age of 18 years: a systematic review and meta-analysis. Int J Legal Med. 2018; 132(4): 1167-84. DOI: https://doi.org/10.1007/s00414-017-1766-4

2. Hasan KM, Sobhana CR, Rawat SK, Singh D, Mongia P, Fakhruddin A. Third molar impaction in different facial types and mandibular length: a cross-sectional study. Natl J Maxillofac Surg. 2021; 12(1): 83-7. DOI: https://doi.org/10.4103/njms.njms_111_20

3. Candotto V, Oberti L, Gabrione F, Scarano A, Rossi D, Romano M. Complication in third molar extractions. J Biol Regul Homeost Agents. 2019; 33(3 Suppl. 1): 169-72.

4. Altan A, Akbulut N. Does the angulation of an impacted mandibular third molar affect the prevalence of preoperative pathoses? J Dent (Shiraz). 2019; 20(1): 48-52. DOI: https://doi.org/10.30476/dentjods.2019.44563

5. Sureshkannan P, Samthomas K, Ravikumar PT, Thangavelu A, Karthik RM, Thiruneelakanadan S. Reliability of orthopantamogram in lower third molar surgery: inter- and intra-observer agreement. J Pharm Bioallied Sci. 2020; 12(Suppl 1): S190-S193. DOI: https://doi.org/10.4103/jpbs.jpbs_57_20

6. Kaur R, Kumar AC, Garg R, Sharma S, Rastogi T, Gupta VV. Early prediction of mandibular third molar eruption/impaction using linear and angular measurements on digital panoramic radiography: a radiographic study. Indian J Dent. 2016; 7(2): 66-9. DOI: https://doi.org/10.4103/0975-962x.184644

7. Ouassime K, Rachid A, Amine K, Ousmane B, Faiçal S. The wisdom behind the third molars removal: a prospective study of 106 cases. Ann Med Surg (Lond). 2021; 68: 102639. DOI: https://doi.org/10.1016%2Fj.amsu.2021.102639

8. Hounsome J, Pilkington G, Mahon J, Boland A, Beale S, Kotas E, et al. Prophylactic removal of impacted mandibular third molars: a systematic review and economic evaluation. Health Technol Assess. 2020; 24(30): 1-116. DOI: https://doi.org/10.3310/hta24300

9. Daware SN, Balakrishna R, Deogade SC, Ingole YS, Patil SM, Naitam DM. Assessment of postoperative discomfort and nerve injuries after surgical removal of mandibular third molar: a prospective study. J Family Med Prim Care. 2021; 10(4): 1712-7. DOI: https://doi.org/10.4103/jfmpc.jfmpc_280_19

10. Alexoudi VA, Tatsis D, Zamani K, Zelkas D, Paraskevopoulos K, Vaxtsevanos K. Iatrogenic displacement of impacted mandibular third molars or their roots into adjacent soft tissues and spaces: a report of three cases. Natl J Maxillofac Surg. 2020; 11(2): 275-9. DOI: https://doi.org/10.4103/njms.njms_95_19

11. Na JY, Han SS, Jeon K, Choi YJ, Choi SH, Lee C. Prognosis in case of nerve disturbance after mandibular implant surgery in relation to computed tomography findings and symptoms. J Periodontal Implant Sci. 2019; 49(2): 127-35. DOI:

12. Elkhateeb SM, Awad SS. Accuracy of panoramic radiographic predictor signs in the assessment of proximity of impacted third molars with the mandibular canal. J Taibah Univ Med Sci. 2018; 13(3): 254-61. DOI: https://doi.org/10.1016/j.jtumed.2018.02.006

13. Yue Yi EK, Siew Ying AL, Mohan M, Menon RK. Prevalence of postoperative infection after tooth extraction: a retrospective study. Int J Dent. 2021; 2021: 6664311. DOI: https://doi.org/10.1155/2021/6664311

14. La Monaca G, Vozza I, Giardino R, Annibali S, Pranno N, Cristalli MP. Prevention of neurological injuries during mandibular third molar surgery: technical notes. Ann Stomatol (Roma). 2017; 8(2): 45-52. DOI: https://doi.org/10.11138%2Fads%2F2017.8.2.053

15. Su N, van Wijk A, Berkhout E, Sanderink G, De Lange J, Wang H, et al. Predictive value of panoramic radiography for injury of inferior alveolar nerve after mandibular third molar surgery. J Oral Maxillofac Surg. 2017; 75(4): 663-79. DOI: https://doi.org/10.1016/j.joms.2016.12.013

16. Manor Y, Abir R, Manor A, Kaffe I. Are different imaging methods affecting the treatment decision of extractions of mandibular third molars? Dentomaxillofac Radiol. 2017; 46(1): 20160233. DOI: https://doi.org/10.1259%2Fdmfr.20160233

17. Patel PS, Shah JS, Dudhia BB, Butala PB, Jani YV, Macwan RS. Comparison of panoramic radiograph and cone beam computed tomography findings for impacted mandibular third molar root and inferior alveolar nerve canal relation. Indian J Dent Res. 2020; 31(1): 91-102. DOI: https://doi.org/10.4103/ijdr.ijdr_540_18

18. Patil V, Pai KM, Vineetha R, Rajagopal KV, Dkhar W. Comparison of conventional techniques and higher imaging modalities in the evaluation of relation between the third molar and inferior alveolar nerve canal: a pilot study. Contemp Clin Dent. 2019; 10(1): 93-8. DOI: https://doi.org/10.4103%2Fccd.ccd_430_18

19. Pell GJ, Gregory GT. Impacted mandibular third molars: classification and impacted mandibular third molars: classification and modified technique for removal. Dent Dig. 1933; 39(9): 330-8.

20. Langlais RP, Langland OE, Nortjé CJ. Diagnostic imaging of the jaws. 1era ed. Baltimore: Williams & Wilkins; 1995.

21. Derafshi A, Sarikhani K, Mirhosseini F, Baghestani M, Noorbala R, Kaboodsaz Yazdi M. Evaluation of the course of inferior alveolar canal and its relation to anatomical factors on digital panoramic radiographs. J Dent (Shiraz). 2021; 22(3): 213-8. DOI: https://doi.org/10.30476/dentjods.2020.87973.1304

22. Chaudhary B, Joshi U, Dahal S, Sagtani A, Khanal P, Bhattarai N. Anatomical position of lower third molar in relation to mandibular canal on cone-beam computed tomography images in a tertiary care hospital: a descriptive cross-sectional study. JNMA J Nepal Med Assoc. 2020; 58(231): 879-83. DOI: https://doi.org/10.31729/jnma.5314

23. Barone R, Clauser C, Testori T, Del Fabbro M. Self-assessed neurological disturbances after surgical removal of impacted lower third molar: a pragmatic prospective study on 423 surgical extractions in 247 consecutive patients. Clin Oral Investig. 2019; 23(8): 3257-65. DOI: https://doi.org/10.1007/s00784-018-2747-9

24. Huang CK, Lui MT, Cheng DH. Use of panoramic radiography to predict postsurgical sensory impairment following extraction of impacted mandibular third molars. J Chin Med Assoc. 2015; 78(10): 617–22. DOI: https://doi.org/10.1016/j.jcma.2015.01.009

25. Jaron A, Trybek G. The pattern of mandibular third molar impaction and assessment of surgery difficulty: a retrospective study of radiographs in East Baltic Population. Int J Environ Res Public Health. 2021; 18: 6016. DOI: https://doi.org/10.3390%2Fijerph18116016

26. Yilmaz S, Adisen MZ, Misirlioglu M, Yorubulut S. Assessment of third molar impaction pattern and associated clinical symptoms in a Central Anatolian Turkish Population. Med Princ Pract. 2016; 25(2): 169-75. DOI: https://doi.org/10.1159/000442416

27. Deshpande P, V Guledgud M, Patil K. Proximity of impacted mandibular third molars to the inferior alveolar canal and its radiographic predictors: a panoramic radiographic study. J Maxillofac Oral Surg. 2013; 12(2): 145-51. DOI: https://doi.org/10.1007/s12663-012-0409-z

28. Kang F, Sah MK, Fei G. Determining the risk relationship associated with inferior alveolar nerve injury following removal of mandibular third molar teeth: a systematic review. J Stomatol Oral Maxillofac Surg. 2020; 121(1): 63-79. DOI: https://doi.org/10.1016/j.jormas.2019.06.010

29. Rytkönen K, Ventä I. Distance between mandibular canal and third molar root among 20-year-old subjects. Clin Oral Investig. 2018; 22(7): 2505-9. DOI: https://doi.org/10.1007/s00784-018-2346-9

30. Selvi F, Dodson TB, Nattestad A, Robertson K, Tolstunov L. Factors that are associated with injury to the inferior alveolar nerve in high-risk patients after removal of third molars. Br J Oral Maxillofac Surg. 2013; 51(8): 868-73. DOI: https://doi.org/10.1016/j.bjoms.2013.08.007

31. Reia VCB, Telles-Araujo GT, Peralta-Mamani M, Biancardi MR, Rubira CMF, Rubira-Bullen IRF. Diagnostic accuracy of CBCT compared to panoramic radiography in predicting IAN exposure: a systematic review and meta-analysis. Clin Oral Investig. 2021; 25(8): 4721–33. DOI: https://doi.org/10.1007/s00784-021-03942-4

32. Aranda L. Frecuencia de la proximidad del conducto dentario inferior con las raíces de las terceras molares en pacientes de la clínica dental de la Universidad Peruana Cayetano Heredia entre los años 2008-2010. [Tesis Bachiller Estomatología]. Lima: Universidad Peruana Cayetano Heredia; 2012.