Duazary / Vol. 20, No. 4 – 2023 / 273 - 282
DOI: https://doi.org/10.21676/2389783X.5396

Article of scientific and technological research

Imaging analysis of odontogenic lesions: Ameloblastoma, dentigerous cyst and keratocyst

Análisis imagenológico de lesiones odontogénicas: ameloblastoma, quiste dentígero y queratoquiste

Eliana Dominguez-Romero[1], Eilien Tovío-Martínez[2], Samuel Urbano-Del-Valle[3]

1. Institución Universitaria Visión de las Américas. Medellín, Colombia. Correo: eliana.dominguez@uam.edu.co - https://orcid.org/0009-0006-7380-6226
2. Institución Universitaria Visión de las Américas. Medellín, Colombia. Correo: eilien.tovio@uam.edu.co - https://orcid.org/0000-0003-3702-2791
3. Universidad de Antioquia. Medellín, Colombia. Correo: samuel.urbano@udea.edu.co - https://orcid.org/0000-0002-5773-8642

How to cite this article: Domínguez-Romero E, Tovío-Martínez E, Urbano-del-Valle S. Análisis imagenológico de lesiones odontogénicas: ameloblastoma, quiste dentígero y queratoquiste. Duazary. 2023;20(4):273-282. https://doi.org/10.21676/2389783X.5396

Received on July 22, 2023
Accepted on January 04, 2024
Posted online February 29, 2024

ABSTRACT

Introduction: In oral cavity there are many findings that are only detected in routine radiographic examination, among the frequent ones are dentigerous cyst, keratocyst and ameloblastoma. **Objective:** To carry out a comparative imaging analysis of the radiographic findings of odontogenic lesions including ameloblastoma, dentigerous cyst and keratocyst. **Method:** A retrospective study between 2018 and 2023 was conducted with a sample of 146 diagnostic aids of patients between the ages of 13 and 66 years attending private consultation in the city of Medellin-Colombia, divided into sociodemographic, pathological and anatomical variables. **Results:**The study included 98 males and 48 females, with an average age of 36 ± 5. 46% of the diagnosed cases were of dentigerous cyst confirmed by histopathology study, most of them were in the posterior mandibular region with 50% and 58% of the cases were related to third molars. **Conclusions:** Although the imaging characteristics are widely described in the literature, it is relevant to have clarity regarding the most predominant in the population, without neglecting the clinical and histopathological characteristics necessary to determine the definitive management.

Keywords: Dentigerous cyst; Ameloblastoma; Radiography panoramic; Odontogenic cysts; Tomography X-Ray Computed; Diagnostic imaging.

RESUMEN

Introducción: en la cavidad oral existen muchos hallazgos que solo son detectados en el examen radiográfico rutinario, entre los frecuentes se encuentran el quiste dentígero, queratoquiste y ameloblastoma. **Objetivo:** realizar un análisis imagenológico comparativo de los hallazgos radiográficos de lesiones odontogénicas entre ellas el ameloblastoma, el quiste dentígero y el queratoquiste. **Método:** se realizó un estudio en el periodo 2018 – 2023, llevado a cabo con una muestra de 146 ayudas diagnósticas de pacientes entre los 13 y 66 años que acuden a consulta privada en la ciudad de Medellín-Colombia, divididos en variables sociodemográficas, patológicas y anatómicas. **Resultados:** el estudio incluyó a 98 hombres y 48 mujeres, con un promedio de edad de 36 ± 5 años. El 46% de los casos diagnosticados fueron de quiste dentígero confirmados mediante estudio de histopatología, la mayoría se localizaron en la región mandibular posterior con un 50% y un 58% de los casos fueron relacionados a terceros molares. **Conclusiones:** a pesar de que se encuentran ampliamente descritas las características imagenológicas en la literatura, se hace relevante tener claridad con respecto a las de mayor predomino en la población, sin dejar de lado a las características clínicas e histopatológicas necesarias para determinar el manejo definitivo.

Palabras clave: quiste dentígero; ameloblastoma; radiografía panorámica; quistes odontogénicos; tomografía computarizada por rayos x; diagnóstico por imagen.

INTRODUCTION

Diagnostic aids as a non-invasive method are highly supportive for professionals in decision-making when articulated with clinical correlation[1]. Panoramic radiography and cone beam computational tomography (CBCT) are complementary tests that allow the diagnosis of lesions of the facial mass[2]. Within these are various cystic and tumor lesions, such as odontogenic lesions formed from dental tissues and their supporting structures; some are ameloblastoma, dentigerous cyst, and keratocyst[3].

Radiolucent lesions of the jaws are detected in routine radiographic examinations, which CBCT corroborates, and it is always necessary to consider the differential diagnoses related to said pathology before diagnosing the lesion. The location, relationship with the dental organs, and the dimension of the lesion must be described to determine a radiolucent lesion at the maxillofacial level. With this, characteristics such as the margin of the lesion, its growth pattern, its perilesional halo, and the extension can be better detailed of the injury, among others[4].

Ameloblastoma

Ameloblastoma (AB) is a benign, asymptomatic tumor originating from the remains of the dental lamina. It is slow-growing and asymptomatic, and its principal location is in the jaw. AB constitutes 11% of odontogenic tumors[5], and it is more common in men than in women[6]. Clinically, it presents as a swelling with the expansion of bone cortices, sometimes accompanied by dental mobility and displacement[7,8].
Radiographically, BA appears as an unilocular or multilocular radiolucent lesion with well-defined borders and the appearance of soap bubbles or honeycombs. It is also expected to observe that adjacent teeth may present mobility due to root resorption due to the pressure of the neoplasia. In CBCT, the extension of the lesion and its relationship with neighboring structures can be observed, in addition to observing an osteolytic image with mixed characteristics of internal and heterogeneous hypodensity[9,10].

Dentigerous cyst

The dentigerous cyst (DK) is a cyst covered with epithelium formed by the accumulation of fluid between an impacted tooth's anatomical crown and the enamel's reduced epithelium with the consequent expansion of the dental follicle[11]. They commonly occur in Caucasian males. The highest incidence rates occur between the second and fourth decades of life. The dentigerous cyst represents between 14% and 20% of all odontogenic cysts. Furthermore, it is known to be the most common cyst in childhood[12]. They are associated with lower third molars, followed by upper canines. QD is related to an included dental organ and to the obstruction of dental eruption. In addition, cortical expansion can be clinically found, facial asymmetry when large, and tooth displacement, which are usually asymptomatic[13].

At a radiographic level, it appears as a rounded radiolucent unilocular bone cavity delimited by a radiopaque edge without peri coronary space with a fibrous capsule on its periphery and with the presence of a compromised included tooth surrounding the crown, which may be displaced or generate resorption to adjacent dental organs with an expansive tendency of the bone tables[14]; however, in this examination, it is not possible to make an accurate diagnosis due to the similarity of this lesion with other odontogenic lesions[15], which is why the use of CBCT is helpful due to It provides additional diagnostic information, such as precise measurements of cystic diameter and volume, proximity to critical anatomical structures, and location of the involved tooth. The QD is evident as a hypodense lesion with a thin wall that separates it from the tooth with defined edges and preservation of the bone cortex[16,17].

Keratocyst

The keratocyst (KR) is a developmental odontogenic cyst originating from odontogenic cells. It is not very nice and has a high recurrence rate. It constitutes approximately 10% of jaw cysts and can occur at any age[18]. It is found mainly in the region of the mandibular angle and ramus. It can manifest as a firm, expansive swelling, which generates facial asymmetry and pain, in some cases paresthesia, and even pathological fracture[19,20].

Among the radiographic characteristics, RK presents as a unilocular or multilocular, rounded or oval radiolucent image with well-defined but irregular borders and a thick and peripheral radiopaque wall. Multilocularity can be observed in large lesions, although most lesions are unilocular[21]. Tomographically, hypodense lesions are observed with calcification and cloudy density, respecting the mandibular basal area, with rhizolysis in some cases. It has also been observed that more than 40% of lesions are adjacent to the crown of an unerupted tooth[20,22].

Currently, scientific information provides imaging aspects and criteria to be evaluated in odontogenic pathologies; however, the results of the clinic allow us to elucidate an evident lack of knowledge related to the reading of panoramic radiographs or computed tomography scans, so the present study aims to provide tools such as anatomical characteristics to the described pathologies that allow them to be identified, and therefore, establish a more accurate treatment regimen.

This article compared the radiographic and tomographic findings of the most common odontogenic lesions, including AB, DC, and KR.

METHOD

Studt design

This is a retrospective study in which 146 diagnostic aids of panoramic radiographs and computed tomography were evaluated and compared. The aids had to provide adequate density, contrast, and sharpness. They were taken from private stomatology, oral, and maxillofacial surgery clinics from 2018 to 2023.

Participants

The population comprised patients between 13 and 66 years old who attended a private consultation in Medellín, Colombia. The variables studied were divided into sociodemographic, among which age and gender were analyzed, pathological variables according to the type of odontogenic lesion (AB, DC, and KR) and finally, anatomical variables such as infiltrative growth, type of lesion, shape, wall, septum, calcification in the septum, expansion of tables, resorption of tables, erosion of tables, state of the cortex, rhizolysis, location of the lesion and impacted tooth.

Instrument

Raosoft®[23] program was used, which, through the online calculator, allows calculating the sample size required for survey studies, obtaining representative and reliable results, taking into account the size of the initial population of 160; the sample size calculation yielded a result of 114 images to determine significant differences in the comparison between groups, with a confidence level of 95% and an alpha error margin of 5%, however, to obtain greater statistical power 72 images increased the study sample to a total of 234. In this way, 146 diagnostic aids were analyzed.

Data analysis

Data processing was carried out with the SPSS statistical program, v.27.0, following three sequential steps: initially, the intraobserver variability was estimated as the difference between the analyses of each of the images from 10 panoramic and tomographic images evaluated by the same researchers that were selected from the weighted Kappa statistics for polytomous variables and Cohen's Kappa for dichotomous variables such as gender, AB, DC and KR, in this way it was possible to design the frequency tables relating variables. The interpretation of the results was based on the definitions of excellent reproducibility >0.8, fair to reasonable between 0.4 and 0.8, and poor <0.4; statistical significance was set at $p<0.05$. The results were recorded in a data collection table on a Microsoft Excel® sheet.

Statement on ethical aspects

Resolution 008430 of October 4th of 1993 was considered, which established the scientific, technical, and administrative standards for health research. It was categorized as work without risk for patients since it used diagnostic aids obtained from private consultations. For the publication of this project, the informed consent of each patient was required for the use of data for research purposes; however, personal information that allows the identification of the patients is not included, so

respect for confidentiality has been guaranteed—and personal data.

RESULTS

In the study, 146 diagnostic aids were evaluated and compared, distributed among 98 male participants (67%) and 48 female participants (33%), with an average age of 36 years ± 5, of which four are presented. Representative panoramic radiographs show the most prevalent odontogenic lesions in the premaxillary region, maxillary tuberosity, and mandibular angle. See Figure 1.

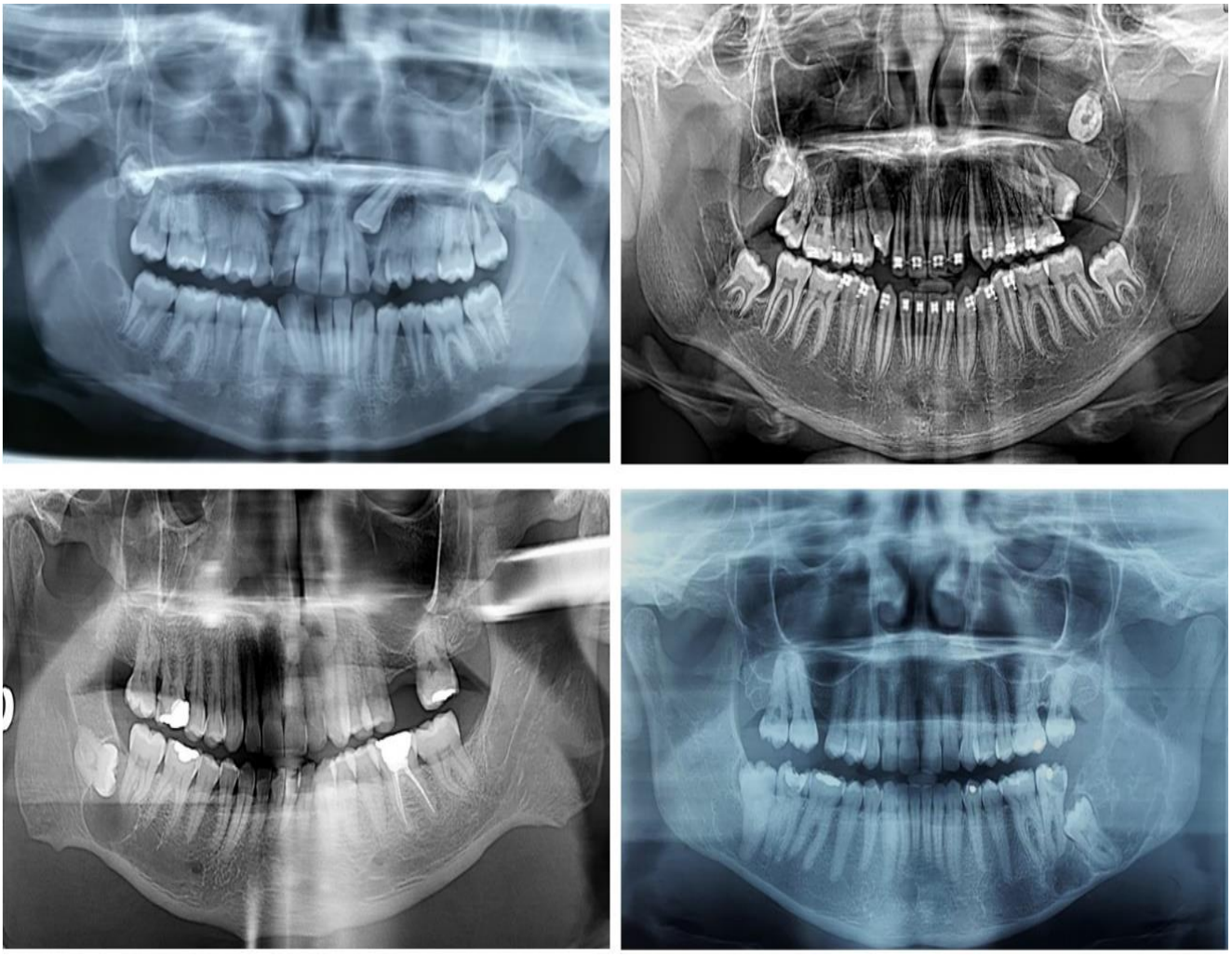

Figure 1. Panoramic radiographs show the most prevalent odontogenic lesions in this study.

Likewise, five specimens of evaluated computed tomography scans are presented in which lesions of dental origin are observed at the mandibular angle, maxillary sinus, or mandibular body level—details in Figure 2.

A histopathology study confirmed the greater predominance of the dentigerous cyst in the distribution by type of injury (Figure 3).

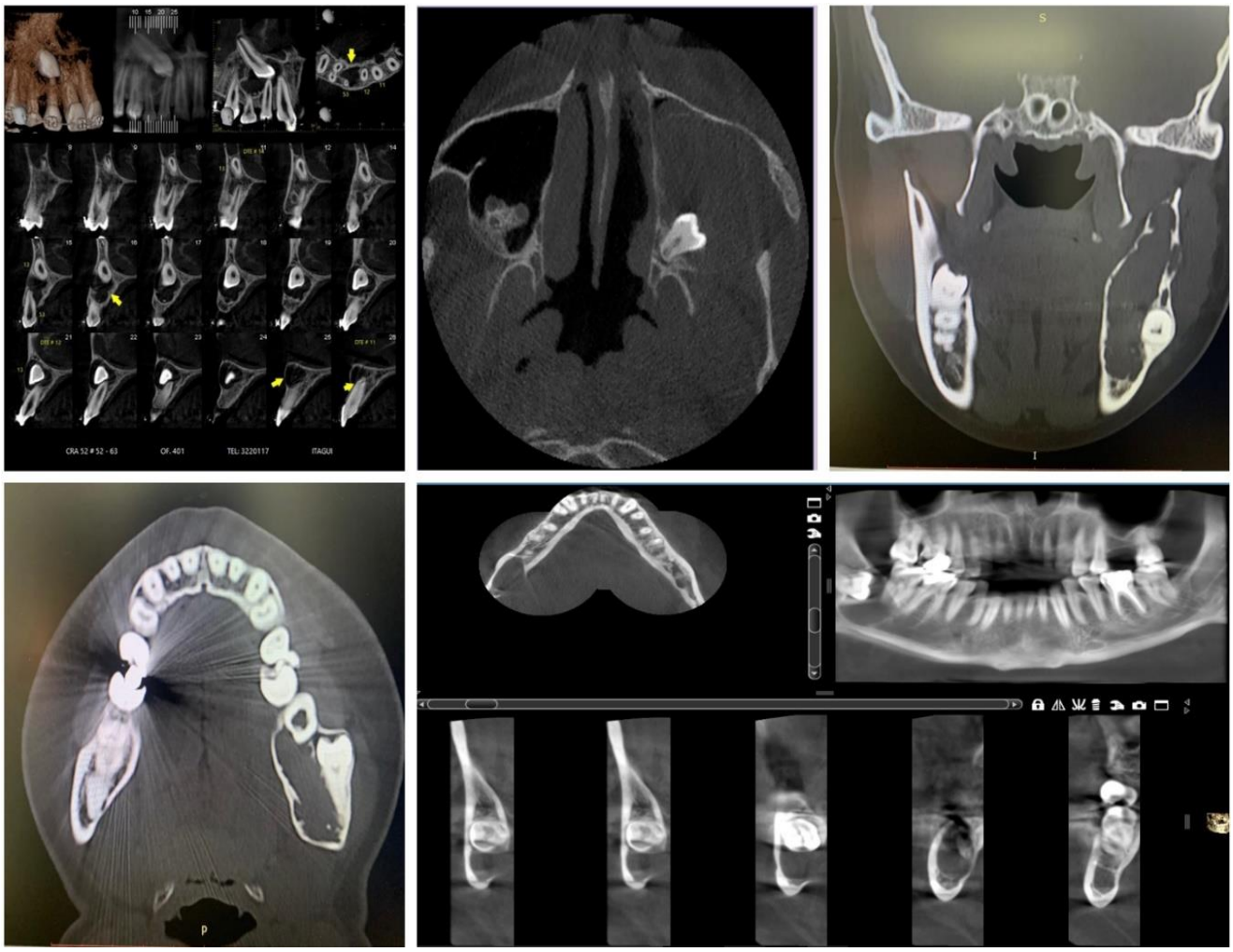

Figure 2. Cone beam computed tomography with odontogenic lesions was studied in this investigation.

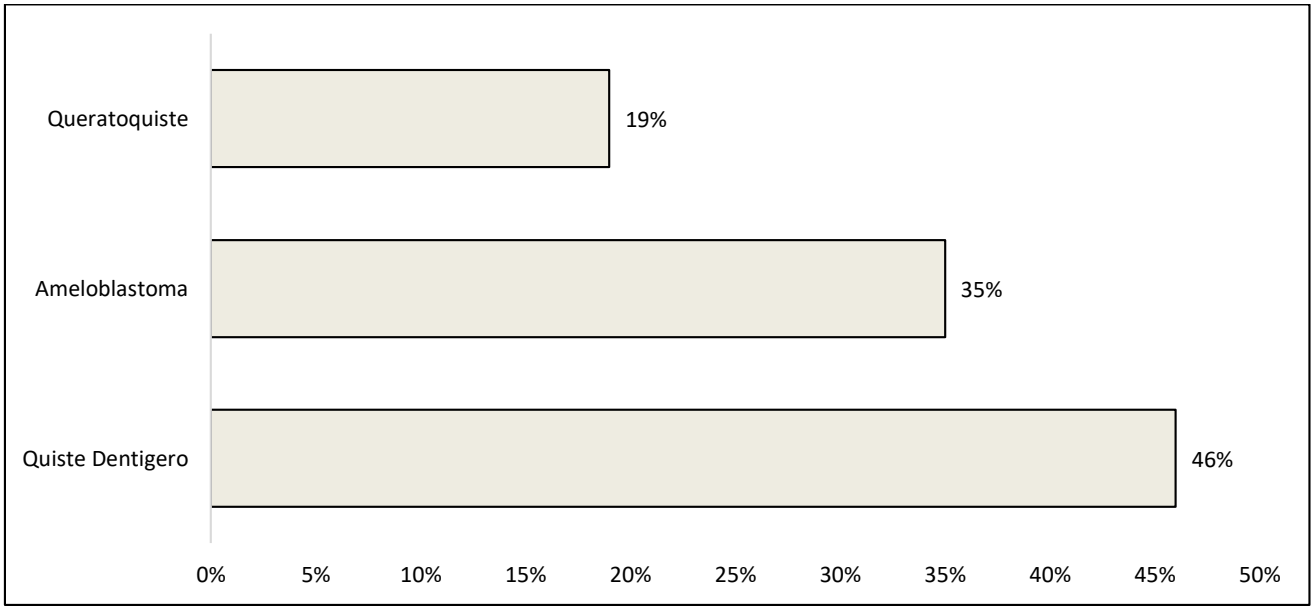

Figure 3. Distribution by type of injury.

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After analyzing the diagnostic aids about anatomical variables such as infiltrative growth, type of lesion, shape, wall, septums, calcification in the septums, expansion of tables, resorption of tables, erosion of tables, state of the cortex, rhizolysis, location of the lesion and included tooth, absence of infiltrative growth was found in the DC and KR compared to AB, which is also observed irregularly unlike the KR and DC that are seen rounded or oval without perforation of tables in contrast to ameloblastoma whose tables appear ill-defined and irregular until perforating, in all three cases related to rhizolysis or impacted teeth. See Table 1.

Both in the panoramic radiography and the computed tomography, these characteristics could be evaluated; it is noteworthy that the latter is more accurate in the visualization of these variables within which were infiltrative growth, the detailed shape of the structures, the integrity of the walls and partitions, the presence and characteristics of calcifications, the expansion, resorption, and erosion of bone tables, as well as the specific state of the cortex (Table 1).

Depending on the location of the lesions of dental origin, a more excellent distribution is observed in the posterior mandibular region (Figure 4).

Table 1. Comparative table between odontogenic lesions according to the anatomical variables studied.

Anatomical Variables	**Pathological variables**		
	Ameloblastoma	**Dentigerous cyst**	**Keratocyst**
Infiltrative Growth	Yes	No	No
Type of injury	Uni/Multi	Uni	Uni/Multi
Shape	Lobed/Irregular	Rounded	Oval/Rounded
Wall	Irregular/Ill-defined	Regular/Fine	Acceptable/Fair/Absent
Partitions	Yes	No	Yes
Calcification in the septum	Yes	No	No
Table expansion	Yes	Yes	Yes
Table resorption	Yes	No	No
Board erosion	No	Yes	No
Cortical state	Perforated	Complete	Full/Thin
Rhizolysis	Yes	Yes	Yes
Included tooth	Yes	Yes	Yes

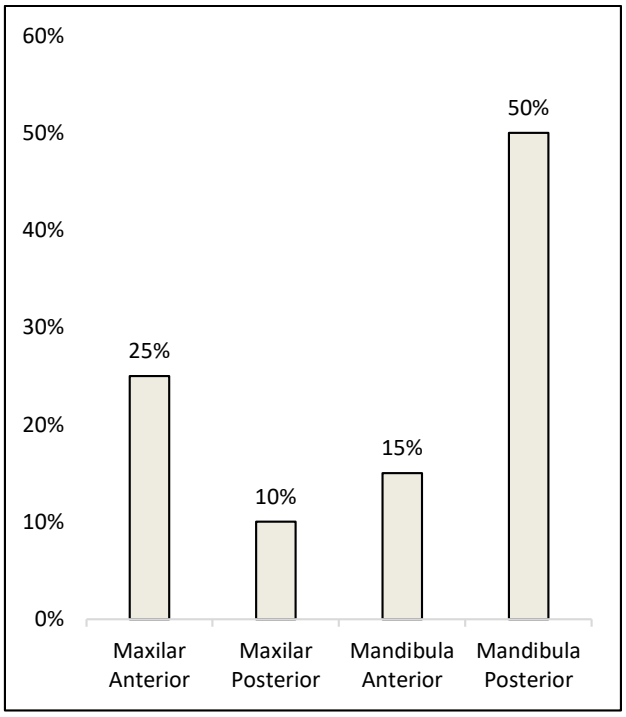

Figure 4. Distribution of odontogenic lesions by location in the jaws.

The third molar was the tooth most involved in odontogenic lesions (Figure 5).

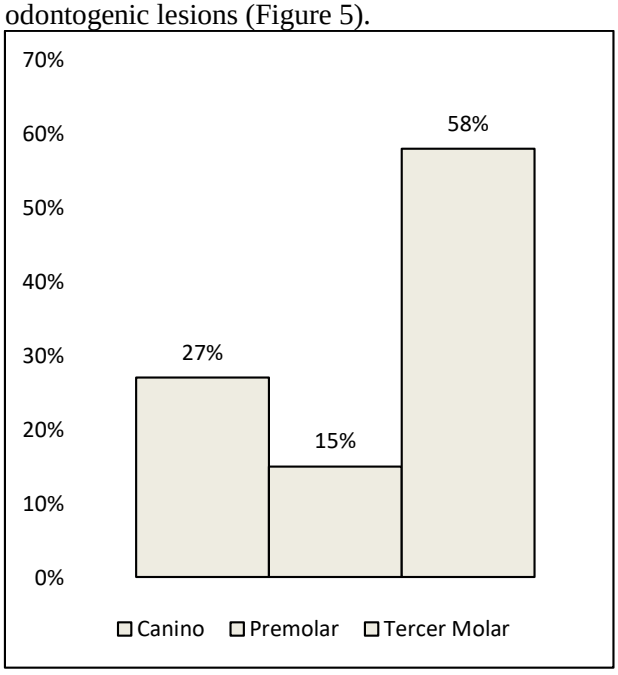

Figure 5. Distribution by dental organ involved.

Within the imaging analysis, usual characteristics were found for each pathology, in which a radiolucent lesion was found for the KR, predominantly oval, with irregular edges, multilocular, with a sclerotic halo, without cortical expansion, with less relationship to the organs. Teeth, but with root resorption; conversely, for the dentigerous cyst, the predominance was associated with included dental organs, which were related to an unilocular cavity and were well delimited by defined edges. In contrast, for AB, the stage found was related to rounded, well-defined, and multilocular contours with excellent bone separation partitions; it is worth mentioning that the gold standard for analyzing these pathologies was computed tomography.

DISCUSSION

Odontogenic lesions originate from the tissues involved in tooth development. They are characterized by a thickening of the tissue around the tooth that may contain liquid or semisolid material due to the presence of epithelial components. The DC, KR, and AB are among the most prevalent cysts and tumors; a dental organ is usually involved. The final diagnosis of these pathologies must be established through an association of clinical and imaging examination followed by histopathological confirmation[24,25].

Meng *et al*[26] developed a retrospective study with clinical histories, histopathological reports and radiographic characteristics of 191 patients with AB, DC, and KR, this research included 118 men and 73 women (age between 5 and 84 years), 72% AB and 84.3% of KR originated in the posterior maxilla, while 69.6% of DC occurred in the anterior maxilla, in addition, 98.2% (55/56) of cysts involving a supernumerary tooth were DC, while 80.9% (38/47) of the cysts surrounding the third molar turned out to be KR, a relevant coincidence with the findings of this study; Similarly, Cardoso *et al*[10] carried out a study where they selected five cases for each lesion and analyzed panoramic radiographs and tomography scans by 15 specialists, who determined that there was no statistically significant difference in the diagnostic evaluation of AB, DC, and KR when comparing the panoramic radiograph and the cone beam computed tomography; however, if there was a significant difference in the average correct diagnosis of AB using tomography compared to panoramic radiography, observers with master's and doctoral levels had a higher average correct diagnosis in the diagnosis of odontogenic KR using panoramic radiography compared to specialists, which is related to the findings of the present study in which greater

diagnostic certainty was presented in relation to AB in relation to DC, or KR.

Karabas *et al*[27] conducted a retrospective study evaluating radiolucent lesions associated with included teeth by age, sex, location, and comparison with the pathological diagnosis and using CBCT images, using 400 images of radiolucent lesions and 190 cases. The result was that 60% were dentigerous cysts and 26.3% were odontogenic KR, the most common, with a higher prevalence in men with 63.3% and their location in the left and right posterior area of the jaw, mainly associated with third molars. They concluded that tomography is a valuable tool for the differential diagnosis of these radiolucent lesions. For all of the above, there is a similarity with our study in which there was a higher prevalence of DC, and it was also diagnosed with greater certainty with CBCT. On the other hand, the present study also focuses on analyzing odontogenic lesions and their variables.

In the study carried out by Alves *et al*[28] who investigated a sample composed of nine cases of AB and nine cases of KR, the images of panoramic radiographs and tomography were analyzed according to the shape, the internal structure, the edges, the associated unerupted tooth, root resorption, expansion and perforation of cortical bones, indicated that tomography was more accurate than panoramic in evaluating the shape of the lesion, the presence of internal bone septa, root resorption, buccolingual expansion and the rupture of the cortical bone, most cases of ameloblastoma and KR presented buccolingual expansion and erosion of the cortical bone, only AB showed rhizolysis of the dental organs. After analyzing the data, it is found that the results are consistent with the aspects addressed in our study, coinciding with what was observed in the research by Alves *et al*[28].

CONCLUSIONS

Although the imaging characteristics are widely described in the literature. It is essential to have clarity regarding the most predominant lesions in the population that occur for each of the lesions, the purpose of which is based on avoiding delays in the management of these patients, without leaving aside the necessary clinical and histopathological characteristics. to determine definitive management.

Furthermore, it is worth emphasizing, according to the interpretation of the results of this research, that the use of other advanced imaging techniques, such as magnetic resonance imaging, despite not having been included in the present study, manages to provide additional detailed information on the characteristics of the injury to assist in clinical decision making and planning of surgical interventions. These non-invasive techniques provide a complementary view and detect subtle changes in the tissue, which is considered to contribute to more precise diagnoses and better therapeutic approaches. For all these reasons, studies are urged to include such diagnostic aids to provide greater certainty than what was found in this analysis.

ACKNOWLEDGMENTS

We want to express our most sincere gratitude to all the patients who participated in this study and those who helped and supported us during the development of this project. Their advice, suggestions, and comments were precious to us and contributed significantly to the quality of the work.

STATEMENT ON CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest that could influence the results of this work or their interpretation.

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