Brazilian Dental Science

unesp
UNIVERSIDADE ESTADUAL PAULISTA
"JÚLIO DE MESQUITA FILHO"
Instituto de Ciência e Tecnologia
Campus de São José dos Campos

ORIGINAL ARTICLE

DOI: https://doi.org/10.4322/bds.2025.e4540

Prevalence of maxillary sinusitis attributed to odontogenic causes in a chilean subpopulation: a cross sectional study

Prevalência de sinusite maxilar atribuída a causas odontogênicas em uma subpopulação chilena: um estudo transversal

Fernando PEÑA-BENGOA[1], Juan DÍAZ[2], Sven Eric NIKLANDER[3], Constanza GUERRERO[1], Carolina CÁCERES[1], Macarena RODRÍGUEZ-LUENGO[4], Patricio MELÉNDEZ[5,6]

1 - Universidad Andres Bello, Facultad de Odontología, Departamento de Endodoncia. Viña del Mar, Chile.
2 - Práctica Privada. Viña del Mar, Chile.
3 - Universidad Andres Bello, Facultad de Odontología, Unidad de Patología y Medicina Oral. Viña del Mar, Chile.
4 - Universidad Andres Bello, Facultad de Medicina, Departamento de Morfología. Viña del Mar, Chile.
5 - Universidad Andres Bello, Facultad de Odontología, Departamento de Imagenología Oral y Maxilofacial. Viña del Mar, Chile.
6 - Universidad Viña del Mar, Escuela de Ciencias de la Salud, Odontología. Viña del Mar, Chile.

How to cite: Peña-Bengoa F, Díaz J, Niklander SE, Guerrero C, Cáceres C, Rodríguez-Luengo M, et al. Prevalence of maxillary sinusitis attributed to odontogenic causes in a chilean subpopulation: a cross sectional study. Braz Dent Sci. 2025;28(1):e4540. https://doi.org/10.4322/bds.2025.e4540

ABSTRACT

Background: Odontogenic maxillary sinusitis is a condition caused by dental infections attributed to the close anatomical proximity that maxillary posterior teeth have with the maxillary sinus. Distinguishing odontogenic sinusitis from other types of sinusitis is crucial for its accurate treatment, avoiding improper treatments and multiple consultations. **Objective:** To analyze the prevalence of maxillary sinusitis attributed to odontogenic causes in a Chilean Subpopulation using cone-beam computed tomography (CBCT) scans. **Material and Methods:** One hundred and thirty-nine CBCT scans from patients with a previous radiological diagnosis of maxillary sinusitis were evaluated. Using a multiplanar and panoramic reconstruction, the thickening of one or both maxillary sinus mucosa was evaluated. The thickness of the sinus mucosa, together with the presence of associated dental pathologies and/or conditions were also evaluated using sagittal and coronal sections. **Results:** Of the 139 cases, 54.6% presented a unilateral thickening of the sinus membrane. Of those, 72.4% were associated with odontogenic factors, indicative of odontogenic sinusitis. The most frequent cause was apical periodontitis (23.4%), followed by endodontically treated teeth (21.1%). Bilateral mucosal thickening was observed in 45.4% of all cases. Within this subset, 46% displayed symmetrical mucosal thickening, while 54% showed disparities exceeding 2 mm. Among these, 44.1% had a superimposed dental pathology attributable to uneven increased mucosal thickness. **Conclusion:** Odontogenic etiology is a common cause of maxillary sinusitis, mainly associated with apical lesions and endodontically treated teeth. The overlay of dental pathology onto bilateral mucosal thickening patients can result in an exacerbation of the inflammatory state within the affected sinus membrane.

KEYWORDS

Chronic sinusitis; Cone beam computed tomography; Maxillary sinus; Odontogenic sinusitis; Schneider's membrane.

RESUMO

Contexto: A sinusite maxilar odontogênica é uma condição causada por infecções dentárias, atribuída à proximidade anatômica dos dentes posteriores superiores com o seio maxilar. Distinguir a sinusite odontogênica de outros tipos de sinusite é crucial para um tratamento adequado, evitando tratamentos incorretos e múltiplas consultas. **Objetivo:** Analisar a prevalência de sinusite maxilar atribuída a causas odontogênicas em uma subpopulação chilena, utilizando exames de tomografia computadorizada de feixe cônico (TCFC). **Material e Métodos:** Foram avaliados 139 exames de TCFC de pacientes com diagnóstico radiológico prévio de sinusite maxilar. Através de

reconstruções multiplanares e panorâmicas, foi avaliada a espessamento da mucosa de um ou ambos os seios maxilares. A espessura da mucosa sinusal, juntamente com a presença de patologias e/ou condições dentárias associadas, também foi avaliada por meio de cortes sagitais e coronais. **Resultados:** Dos 139 casos, 54,6% apresentaram espessamento unilateral da membrana sinusal. Desses, 72,4% estavam associados a fatores odontogênicos, indicativos de sinusite odontogênica. A causa mais frequente foi a periodontite apical (23,4%), seguida por dentes tratados endodonticamente (21,1%). O espessamento bilateral da mucosa foi observado em 45,4% de todos os casos. Dentro desse subconjunto, 46% apresentaram espessamento mucoso simétrico, enquanto 54% mostraram diferenças superiores a 2 mm. Entre estes, 44,1% apresentavam uma patologia dentária sobreposta, atribuível ao aumento desigual da espessura da mucosa. **Conclusão:** A etiologia odontogênica é uma causa comum de sinusite maxilar, principalmente associada a lesões apicais e dentes tratados endodonticamente. A sobreposição de patologias dentárias em pacientes com espessamento bilateral da mucosa pode resultar na exacerbação do estado inflamatório dentro da membrana sinusal afetada.

PALAVRAS-CHAVE

Sinusite crônica; Tomografia computadorizada de feixe cônico; Seio maxilar; Sinusite odontogênica; Membrana de Schneider.

INTRODUCTION

Maxillary sinusitis is a pathological condition classically defined as the inflammation of the maxillary sinus mucosa [1]. It can present itself with a variety of clinical presentation and can be classified according to different criteria. Etiologically, it can be classified as viral, bacterial, or fungal sinusitis [2]. According to the duration of symptoms, sinusitis can be classified as acute, subacute, and chronic [3], and in relation to triggering factors, it can be categorized as rhinosinusal or odontogenic sinusitis [2]. Furthermore, other contributing factors include anatomical abnormalities, immunodeficiency conditions, foreign bodies, and drug intolerance [4].

Odontogenic maxillary sinusitis (OMS) is a disease produced by odontogenic infections that affect the maxillary sinuses, leading to inflammation of the sinus membrane (SM), better known as the Schneider´s membrane [5]. OMS is a consequence of the close anatomical relationship between the apices of posterior maxillary teeth and the maxillary sinus floor [6]. It is commonly associated with infections originated from the second and first molars, but infections originated from premolars, although less commonly, are also associated [7,8].

The Schneider´s membrane plays a fundamental role in the health of the maxillary sinus, acting as a protective barrier against pathogens and foreign particles [9]. It produces mucus, facilitating the clearance of sinus secretions toward the nasal fossa [10], while also contributing to the filtration, heating, and purification of inspired air [5]. Given the anatomical closeness between maxillary posterior tooth apices and the maxillary sinuses, it is essential to have a detailed understanding of their relationship.

OMS usually presents with non-specific symptoms and the usual pattern of the disease is a focal and unilateral SM thikening overlying the apices of the affected tooth [11]. The sign and symptoms can include nasal obstruction, purulent rhinorrhea, fatigue, hyposmia, halitosis and dental pain [2], which is described in only 29% of cases [11]. The most frequently associated causes are apical periodontitis, periodontal disease, maxillary surgical complications, and untreated endodontic infections [12]. Iatrogenic surgical and endodontic procedures are also a cause of OMS [10].

The diagnosis of OMS requires a thorough clinical and imaging examination. Intraoral and extraoral radiographs, particularly orthopantomography, offer suboptimal assessment of the posterior maxillary teeth [11]. The use of cone beam computed tomography (CBCT) provides three-dimensional images with low radiation and excellent resolution [13,14], allowing an accurate assessment of the changes occurring in the maxillary sinuses, minimizing distortion and overprojection of structures [14]; a common issue with 2-D images. Considering the potential exacerbation of unresolved sinusitis by dental conditions, CBCT scans emerge as a useful

tool for evaluating dental factors associated with the manifestation of sinusitis [15].

The correlation between sinusitis and dental problems is often underestimated by clinicians, leading to erroneous diagnosis, and consequently, ineffective treatments [5]. This is primarily attributed to the variability in diagnostic criteria, compounded by a lack of comprehensive information. Over the past decade, there has been a concerted effort to establish recommendations and guidelines for diagnosing and managing OMS. These guidelines underscore the importance of collaborative assessments involving both otolaryngologists and dentists [16]. Embracing a multidisciplinary approach not only helps to avoid multiple consultations, but also optimizes resources and reduces healthcare costs [5,11].

The available literature provides diverse information regarding the frequency of OMS attributed to dental causes in South America, making it difficult to extrapolate data to the Chilean population. The aim of this study was to determine, the frequency and causes of OMS in a Chilean subpopulation.

METHODOLOGY

This cross-sectional study was approved by the ethical-scientific committee of the Faculty of Dentistry of Andres Bello University (Approval number:158/23).

Sample selection

The sample size was obtained using the known population formula, applied to the population of the Valparaíso Region, Chile, using data obtained from the National Registry of Statistics of Chile [17], with a confidence of 95% and a significance of 5%. The expected frequency of maxillary sinusitis was of 12.3% [18], while the estimated frequency of OMS was of 50% [5]. The sample size was of 139 CBCT scans.

Image analysis

Image analysis was conducted by a single operator previously calibrated. Intraoperative calibration was done analyzing 15 CBCT´s in 2 different occasions by the same operator resulting in a kappa value was of =0.87.

CBCT scans were obtained from the database of the Oral and Maxillofacial Imaging Center of Andres Bello University, Viña del Mar, Chile. CBCT´s acquired between the years 2020 and 2022 with a resulting diagnosis of "maxillary sinusitis" in the imaging report were considered for evaluation. Maxillary sinusitis was diagnosed when a thickening greater than 2 mm of the sinus membrane was observed, regardless of whether they occur unilaterally or bilaterally [12]. Inclusion criteria were patients over 18 years of age, and complete visualization of both maxillary sinuses. CBCT´s that presented hydro-aerial levels, images compatible with retention pseudocysts and/or polyps, metal or motion artifacts that prevented visualization of the maxillary sinuses, were excluded. After the application of the inclusion/exclusion criteria, a simple random sampling approach was employed to attain the predetermined sample size of 139 CBCT scans.

All CBCT scans were acquired using a GENDEX GXCB-500 equipment (Gendex Dental Systems, Pennsylvania, USA) and analyzed through iCAT Vision software (Imaging Sciences International, Hatfield, United States) in a dark room with regulated brightness and contrast. The scans were conducted with settings of 120 kV, 5 mA, an exposure time ranging from 12.6 s to 23 s, and an isotropic voxel size of 0.125 mm.

Through multiplanar and panoramic reconstruction, CBCT scans were systematically categorized based on the presence of thickening in the maxillary SM, either unilaterally or bilaterally. In cases of unilateral SM thickening, an analysis of the adjacent teeth in the thickened region was conducted. Utilizing sagittal sections, the presence of dental pathologies associated with pathological thickening was determined. Similarly, in situations where thickening of the SM was observed in both maxillary sinuses with a discrepancy exceeding 2 mm in membrane thickness between the two sinuses, an analysis of the dental component was undertaken to identify dental pathologies that could account for this difference.

For the purposes of this study, a modification of the diagnostic criteria for maxillary sinusitis proposed by Maillet et al. [15] was applied whose classification is based on the unilateral diagnosis of the maxillary sinuses. Given that our study's methodology analyzed both maxillary sinuses in each CBCT exam and due to the absence

of clinical history, the category of "sinusitis of undetermined origin" was replaced with "sinusitis from apparent rhinogenous origin" for cases presenting bilateral sinus membrane thickening without an associated odontogenic component, resulting in four categorized groups (Figure 1):

1. *Normal sinus:* no mucosal thickening or uniform mucosal thickening (<2 mm). The adjacent teeth may be healthy, carious, pulp exposed, restored, extracted, and with or without radiographically evident periapical lesion.
2. *Sinusitis of odontogenic origin (OMS):* SM thickening >2 mm associated with caries, mismatched restoration, or extraction site with or without periapical lesion and mucosal thickening limited to the area of the tooth or extraction site.
3. *Sinusitis of nonodontogenic origin (NOMS):* SM thickening >2 mm not limited to any tooth. Adjacent teeth are non-carious, present good quality coronal and/or endodontic restorations without periapical lesion or if extracted, healthy healing socket.
4. *Sinusitis of apparent rhinogenous origin (RMS):* Uniform thickening of the sinus mucosa (>2 mm) observable in both maxillary sinuses, without a dental cause observable on imaging, suggesting RMS. Adjacent teeth are non-carious, present good quality coronal and/or endodontic restorations without periapical lesion or if extracted, healthy healing socket.

An exploratory data analysis was conducted to obtain the descriptive statistics, and a proportions test was performed to compare the frequency of different causes. The data were analyzed using Stata 11.2 statistical software (StataCorp LLC, Texas, United States) with a significance level of 5%.

RESULTS

Out of the 139 CBCT scans, 54.7% (n= 76) exhibited unilateral MS thickening, whereas 45.3% (n= 63) demonstrated SM thickening in both maxillary sinuses. Among the subjects, 56.1% were female, and 43.9% were male, with an average age of 53 ± 11 years.

Among the 76 CBCT scans exhibiting unilateral thickening of the SM, 72.4% (n= 55) were associated with dental pathologies (classified as OMS), while 27.6% (n= 21) had no observable dental cause (classified as NOMS). Within the OMS subgroup, periapical lesions were identified as the most frequent associated cause (22.37%), followed by endodontically treated teeth (21.05%) (Figure 2) without significant differences between them (Table I).

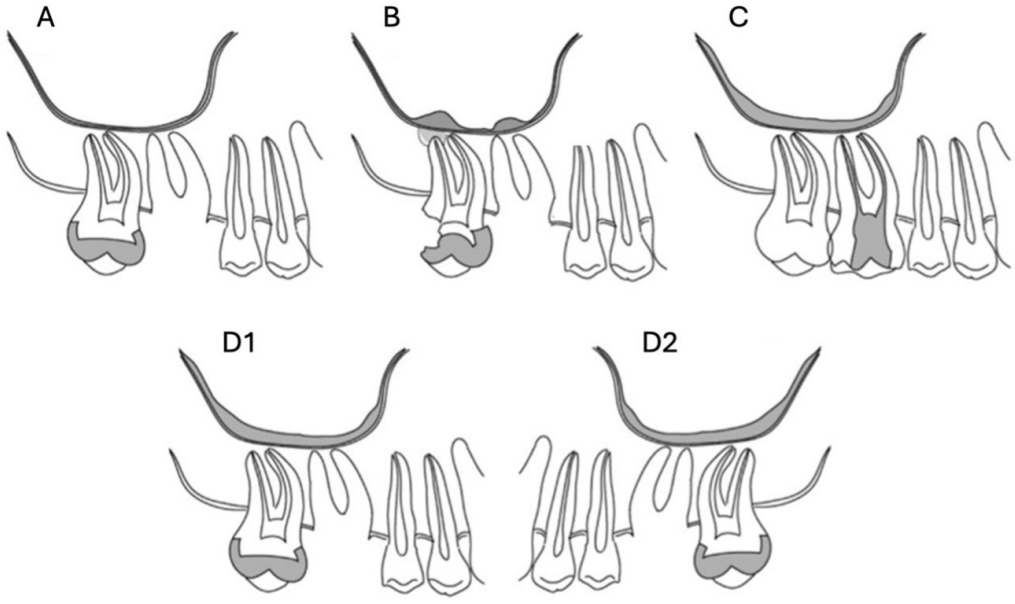

Figure 1 - Modification of the diagnostic criteria for maxillary sinusitis proposed by Maillet et al. [15]. A: Normal sinus; B: Sinusitis of odontogenic origin (OMS); C: Sinusitis of nonodontogenic origin (NOMS); D1-D2: Sinusitis from rhinogenous origin (RMS). (Figures obtained and adapted from Maillet et al. [15]).

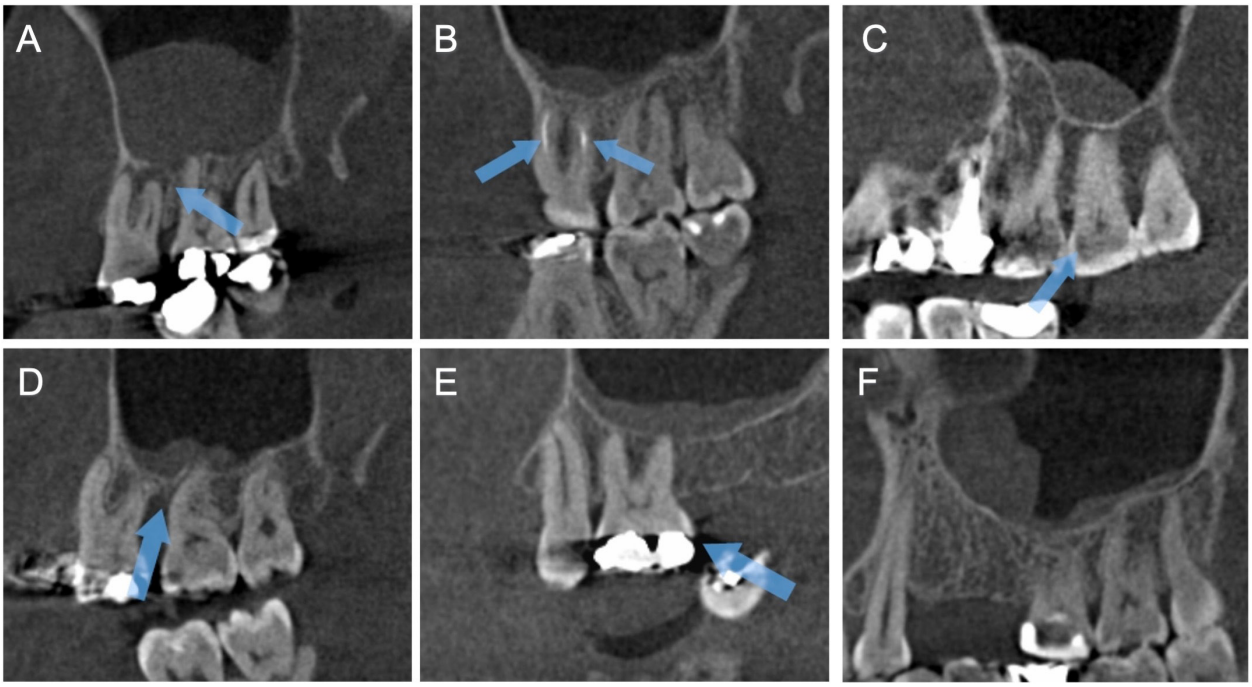

Figure 2 - CBCT sample images showing dental causes associated with OMS. Arrows indicate: A: apical lesion, B: Endodontic treatment, C: caries, D: periodontal bone resorption, E: mismatched restoration, and F: undetermined non odontogenic.

Table I - Unilateral Maxillary Sinusitis causes

Causes	N	%	p-value
Undetermined (non odontogenic)	21	27.6	0,3135
Apical lesion	17	22.4	0,4328
Endodontically treated teeth	16	21.1	0,4680
Caries	8	10.5	0,8689
Periodontal bone resorption	8	10.5	0,8689
Mismatched Restoration	6	7.9	0,9587

Of the 63 CBCT scans that exhibited bilateral MS thickening, 46% (n= 29) presented symmetrical thickening of the sinus membrane (<2 mm) between both maxillary sinuses, suggesting RMS on imaging in the absence of associated dental pathology. 54% (n= 34) exhibited disparities exceeding 2 mm, of which 44.1% (n= 15) displayed an additional superimposed dental pathology. In these cases, the thickness of SM increased in average a 184.6% in compared to the contralateral maxillary sinus lacking of this overlay of conditions. In these cases, apical lesions were the most frequently associated pathology.

DISCUSSION

Studies investigating the correlation between pathologies affecting the maxillary sinuses and the oral cavity become relevant due to the anatomical proximity of dental apices to the maxillary sinuses. A recent study reported that 35.4% of posterior upper teeth either maintain direct contact with or have protruding roots into the maxillary sinus [19]. The integration of CBCT in clinical practice has streamlined the identification of direct causal associations among these pathologies [14], thereby enhancing the precision of diagnoses. This advancement enables the formulation of treatment strategies that target the etiological factors rather than merely addressing the symptomatic manifestations [20]. In this study, we found that 72.4% of the analyzed CBCT scans that presented unilateral thickening of the sinus membrane were associated with odontogenic factors. The most frequent causes were apical periodontitis and endodontically treated teeth. Bilateral mucosal thickening without an associated dental component was observed in 45.4% of cases, suggesting RMS on imaging.

When analyzing the studied sample, a slight predisposition of OMS toward the female gender (56%) was observed. This predisposition has been previously reported in the literature [10,14,21], and according to Arias-Irimia et al. [7], OMS shows a predilection for the female gender over the male gender in a ratio of 1/1.3. In contrast, the average age observed in this study diverges from the observations made by Arias-Irimia et al. [7],

Kuligowski et al. [12] and Estrela et al. [21], who reported lower mean ages of 42.7, 46.6 and 49.4 years respectively. Nevertheless, it is crucial to note that the limited sample size employed in our study precludes the formulation of robust conclusions pertaining to this variable.

OMS is a pathology characterized by a significant variability in its prevalence, with reported values ranging from 10% to 86% [22,23], depending on the methodology and the population under investigation. A recent study conducted by Vitali et al. [5], reported that half of all maxillary sinusitis they observed, were originated from odontogenic sources. In this respect, we found a lower frequency of OMS (39.6%). However, upon analyzing the RMS cases, we observed that a significant percentage of these (23.8%) exhibited an odontogenic component superimposed on this condition, which may be easily mistaken for OMS. These outcomes underscore the importance of considering the odontogenic component, even in cases of bilateral mucosal thickening, given that OMS and RMS differ in etiology, microbiology, and treatment [24]. Failing to recognize this distinction can pose a risk to the efficacy of treatment interventions [20].

Periapical lesions have been consistently reported as the most common cause of OMS [6,14,21,25-27], which agrees with our findings. Peñarrocha-Oltra et al. [6], reported that the presence of periapical lesions increases the likelihood of OMS by 1.7 times. It is essential to underscore that the mere presence of periapical lesions should not be construed as a definitive predictor of OMS. Anatomical considerations, such as the positioning of the apex in relation to the floor of the maxillary sinus, exhibit a direct correlation with an elevated likelihood of OMS [11,21].

In the context of endodontic therapy as a potential causal factor of OMS, it is noteworthy that both, initial endodontic treatment and endodontic retreatment, can lead to an increase in sinus membrane thickness, followed by a subsequent decrease observed after a 1-year follow-up period [9]. Consequently, in the absence of a comprehensive clinical history, endodontic treatment alone should not be categorically considered as a causative factor for OMS. Within our study, 27.63% of cases lacked discernible dental causes and were consequently classified as NOMS. The observational nature of our study precludes the exclusion of early-stage pulp pathologies that may be associated with sinus pathology [28]. Therefore, several authors agree that the precise diagnosis of OMS should combine the CBCT scan with a routine dental examination [29,30].

Regarding CBCT scans suggestive of RMS with an overlay of an odontogenic factor, several studies highlight that a significant percentage of patients with apical lesions or marginal periodontitis exhibit localized inflammation of the sinus membrane [21,31]. This reaction is construed as a natural response to a low-intensity infection [20]. The superinfection within a chronically inflamed membrane may provide insight into the observed asymmetrical thickening evident in 44.11% of the cases classified as RMS. Notably, it was observed that the thickening of the sinus mucosa exhibited a remarkable increase of 184.61% in those cases where the maxillary sinuses were concurrently affected by a dental pathology. The dysregulation induced by odontogenic infections in the maxillary sinus microflora can exacerbate chronic inflammatory diseases [32], resulting in a polymicrobial environment dominated by anaerobic bacteria originating from the oral cavity [25].

Given that the microbiology of OMS diverges from other forms of sinusitis [33] and is characterized by polymicrobial infection with a preponderance of anaerobes [26,34], it is imperative to recognize OMS as a distinct entity within the spectrum of sinusitis [33]. A multidisciplinary approach is essential for ensuring an accurate diagnosis and implementing appropriate treatment strategies [16].

A limitation of this study is the lack of clinical history, as the primary diagnosis of RMS is clinical, while images are used to consolidate the diagnosis [35]. Although the methodology used allowed us to establish direct relationships between sinus membrane thickening and dental pathology leading to the diagnosis of OMS, it may not be entirely accurate in the case of RMS. Although RMS was considered when presenting bilateral sinus mucosa inflammation, it can also, less commonly, present unilaterally [36]. This underscores the importance of managing sinus pathology by dentists, given the increasingly frequent use of CBCT as a diagnostic and treatment planning tool. Future studies may consider evaluation by more than one observer to reduce the risk of bias in the interpretation of image analysis findings.

CONCLUSION

OMS exhibits a high prevalence, showing a slight predilection for the female gender and a predominant association with apical lesions. The overlay of dental pathology onto a bilateral thickening of the sinus mucosa results in an exacerbation of the inflammatory state within the affected sinus membrane. These findings underscore the importance of comprehensive diagnostic considerations and interdisciplinary approaches in understanding and managing OMS.

Acknowledgements

None

Author's Contributions

FPB: Conceptualization, Methodology, Conceptualization, Methodology, Project Administration, Writing – Review & Editing, Project Administration. JD: Software, Investigation, Resources, Writing – Original Draft Preparation. SEN: Methodology, Validation, Formal Analysis, Investigation, Data Curation, Writing – Review & Editing. CG and CC: Validation, Investigation, Data Curation, Writing – Original Draft Preparation, Supervision, Project Administration. MRL: Validation, Formal Analysis, Resources, Data Curation, Writing – Original Draft Preparation, Funding Acquisition. PM: Methodology, Software, Validation, Investigation, Data Curation, Supervision.

Conflict of Interest

The authors declare that there is no conflict of interest

Funding

None

Regulatory Statement

This study was conducted in accordance with all guidelines and policies of the local human subjects oversight committee of the Faculty of Dentistry, Andrés Bello University. The approval code for this study is 158/23.

REFERENCES

1. Rosenfeld RM, Piccirillo JF, Chandrasekhar SS, Brook I, Ashok Kumar K, Kramper M, et al. Clinical practice guideline (update): adult sinusitis. Otolaryngol Head Neck Surg. 2015;152(2, Suppl):S1-39. PMid:25832968.
2. Martu C, Martu MA, Maftei GA, Diaconu-Popa DA, Radulescu L. Odontogenic sinusitis: from diagnosis to treatment possibilities-a narrative review of recent data. Diagnostics. 2022;12(7):1600. http://doi.org/10.3390/diagnostics12071600. PMid:35885504.
3. Ahovuo-Saloranta A, Rautakorpi UM, Borisenko OV, Liira H, Williams JW Jr, Mäkelä M. Antibiotics for acute maxillary sinusitis in adults. Cochrane Database Syst Rev. 2014;(2):CD000243. PMid:24515610.
4. Rosenfeld RM, Andes D, Bhattacharyya N, Cheung D, Eisenberg S, Ganiats TG, et al. Clinical practice guideline: adult sinusitis. Otolaryngol Head Neck Surg. 2007;137(3, Suppl):S1-31. http://doi.org/10.1016/j.otohns.2006.10.032. PMid:17761281.
5. Vitali FC, Santos PS, Massignan C, Maia LC, Cardoso M, Teixeira CDS. Global prevalence of maxillary sinusitis of odontogenic origin and associated factors: a systematic review and meta-analysis. J Endod. 2023;49(4):369-81.e11. http://doi.org/10.1016/j.joen.2023.01.010. PMid:36754253.
6. Peñarrocha-Oltra S, Soto-Peñaloza D, Bagán-Debón L, Bagán-Sebastián JV, Peñarrocha-Oltra D. Association between maxillary sinus pathology and odontogenic lesions in patients evaluated by cone beam computed tomography. A systematic review and meta-analysis. Med Oral Patol Oral Cir Bucal. 2020;25(1):e34-48. http://doi.org/10.4317/medoral.23172.
7. Arias-Irimia O, Barona-Dorado C, Santos-Marino J, Martinez-Rodriguez N, Martinez-Gonzalez J. Meta-analysis of the etiology of odontogenic maxillary sinusitis. Med Oral Patol Oral Cir Bucal. 2009;15(1):e70-3. http://doi.org/10.4317/medoral.15.e70. PMid:19767698.
8. Kang SH, Kim BS, Kim Y. Proximity of posterior teeth to the maxillary sinus and buccal bone thickness: a biometric assessment using cone-beam computed tomography. J Endod. 2015;41(11):1839-46. http://doi.org/10.1016/j.joen.2015.08.011. PMid:26411520.
9. Van Den Munckhof T, Patel S, Koller G, Berkhout E, Mannocci F, Foschi F. Schneiderian membrane thickness variation following endodontic procedures: a retrospective cone beam computed tomography study. BMC Oral Health. 2020;20(1):133. http://doi.org/10.1186/s12903-020-01122-6. PMid:32375759.
10. Lechien JR, Filleul O, Costa De Araujo P, Hsieh JW, Chantrain G, Saussez S. Chronic maxillary rhinosinusitis of dental origin: a systematic review of 674 patient cases. Int J Otolaryngol. 2014;2014:465173. http://doi.org/10.1155/2014/465173. PMid:24817890.
11. Whyte A, Boeddinghaus R. Imaging of odontogenic sinusitis. Clin Radiol. 2019;74(7):503-16. http://doi.org/10.1016/j.crad.2019.02.012. PMid:30926134.
12. Kuligowski P, Jaroń A, Preuss O, Gabrysz-Trybek E, Bladowska J, Trybek G. Association between odontogenic and maxillary sinus conditions: a retrospective cone-beam computed tomographic study. J Clin Med. 2021;10(13):2849. http://doi.org/10.3390/jcm10132849. PMid:34199113.
13. Jain S, Choudhary K, Nagi R, Shukla S, Kaur N, Grover D. New evolution of cone-beam computed tomography in dentistry: combining digital technologies. Imaging Sci Dent. 2019;49(3):179-90. http://doi.org/10.5624/isd.2019.49.3.179. PMid:31583200.
14. Bisla S, Gupta A, Singh H, Sehrawat A, Shukla S. Evaluation of relationship between odontogenic infections and maxillary sinus changes: A Cone Beam Computed Tomography-based study. J Oral Biol Craniofac Res. 2022;12(5):645-50. http://doi.org/10.1016/j.jobcr.2022.08.001. PMid:36045940.

15. Maillet M, Bowles WR, McClanahan SL, John MT, Ahmad M. Cone-beam computed tomography evaluation of maxillary sinusitis. J Endod. 2011;37(6):753-7. http://doi.org/10.1016/j.joen.2011.02.032. PMid:21787483.

16. Craig JR. Odontogenic sinusitis: a state-of-the-art review. World J Otorhinolaryngol Head Neck Surg. 2022;8(1):8-15. http://doi.org/10.1002/wjo2.9. PMid:35619928.

17. BCN [Internet]. Reportes Estadísticos 2020 de Viña del Mar. Biblioteca del Congreso Nacional de Chile; 2023 [cited 2023 Oct 23]. Available from: https://www.bcn.cl/siit/reportescomunales/comunas_v.html?anno=2020&idcom=5109

18. Albu S. Chronic rhinosinusitis-an update on epidemiology, pathogenesis and management. J Clin Med. 2020;9(7):2285. http://doi.org/10.3390/jcm9072285. PMid:32708447.

19. Rodríguez M, Richa R, Valenzuela JJ, Niklander S. Relación entre el seno maxilar y ápices de dientes postero- superiores con tomografía computarizada de Haz Cónico. Int J Morphol. 2023;41(2):618-24. http://dx.doi.org/10.4067/S0717-95022023000200618.

20. Vestin Fredriksson M, Öhman A, Flygare L, Tano K. When maxillary sinusitis does not heal: findings on CBCT scans of the sinuses with a particular focus on the occurrence of odontogenic causes of maxillary sinusitis. Laryngoscope Investig Otolaryngol. 2017;2(6):442-6. http://doi.org/10.1002/lio2.130. PMid:29299521.

21. Estrela CRA, Bueno MR, Estrela MRA, Estrela LRA, Guedes OA, Azevedo BC, et al. Frequency and risk factors of maxillary sinusitis of endodontic origin evaluated by a dynamic navigation and a new filter of cone-beam computed tomography. J Endod. 2022;48(10):1263-72. http://doi.org/10.1016/j.joen.2022.07.011. PMid:35948173.

22. Alghofaily M, Alsufyani N, Althumairy RI, AlSuhaibani A, Alfawzan F, AlSadhan L. Odontogenic factors associated with maxillary sinus schneiderian membrane thickness and their relationship to chronic sinonasal symptoms: an ambispective cohort study. Diagnostics (Basel). 2023;13(16):2710. http://doi.org/10.3390/diagnostics13162710. PMid:37627969.

23. Bomeli SR, Branstetter BF 4th, Ferguson BJ. Frequency of a dental source for acute maxillary sinusitis. Laryngoscope. 2009;119(3):580-4. http://doi.org/10.1002/lary.20095. PMid:19160401.

24. Workman AD, Granquist EJ, Adappa ND. Odontogenic sinusitis: developments in diagnosis, microbiology, and treatment. Curr Opin Otolaryngol Head Neck Surg. 2018;26(1):27-33. http://doi.org/10.1097/MOO.0000000000000430. PMid:29084007.

25. Psillas G, Papaioannou D, Petsali S, Dimas GG, Constantinidis J. Odontogenic maxillary sinusitis: a comprehensive review. J Dent Sci. 2021;16(1):474-81. http://doi.org/10.1016/j.jds.2020.08.001. PMid:33384837.

26. Little RE, Long CM, Loehrl TA, Poetker DM. Odontogenic sinusitis: a review of the current literature. Laryngoscope Investig Otolaryngol. 2018;3(2):110-4. http://doi.org/10.1002/lio2.147. PMid:29721543.

27. Mahasneh SA, Al-Hadidi A, Hassona Y, Sawair FA, Al-Nazer S, Bakain Y, et al. Maxillary sinusitis of odontogenic origin: prevalence among 3D Imaging—A retrospective study. Appl Sci (Basel). 2022;12(6):3057. http://doi.org/10.3390/app12063057.

28. Galler KM, Grubmüller V, Schlichting R, Widbiller M, Eidt A, Schuller C, et al. Penetration depth of irrigants into root dentine after sonic, ultrasonic and photoacoustic activation. Int Endod J. 2019;52(8):1210-7. PMid:30828819.

29. Allevi F, Fadda GL, Rosso C, Martino F, Pipolo C, Cavallo G, et al. Diagnostic criteria for odontogenic sinusitis: a systematic review. Am J Rhinol Allergy. 2021;35(5):713-21. http://doi.org/10.1177/1945892420976766. PMid:33236664.

30. Melén I, Lindahl L, Andréasson L, Rundcrantz H. Chronic maxillary sinusitis. Definition, diagnosis and relation to dental infections and nasal polyposis. Acta Otolaryngol. 1986;101(3-4):320-7. http://doi.org/10.3109/00016488609132845. PMid:3705956.

31. Ariji Y, Obayashi N, Goto M, Izumi M, Naitoh M, Kurita K, et al. Roots of the maxillary first and second molars in horizontal relation to alveolar cortical plates and maxillary sinus: computed tomography assessment for infection spread. Clin Oral Investig. 2006;10(1):35-41. http://doi.org/10.1007/s00784-005-0020-5. PMid:16362431.

32. Cho DY, Hunter RC, Ramakrishnan VR. The microbiome and chronic rhinosinusitis. Immunol Allergy Clin North Am. 2020;40(2):251-63. http://doi.org/10.1016/j.iac.2019.12.009. PMid:32278449.

33. Saibene AM, Vassena C, Pipolo C, Trimboli M, De Vecchi E, Felisati G, et al. Odontogenic and rhinogenic chronic sinusitis: a modern microbiological comparison. Int Forum Allergy Rhinol. 2016;6(1):41-5. http://doi.org/10.1002/alr.21629. PMid:26345711.

34. Yassin-Kassab A, Bhargava P, Tibbetts RJ, Griggs ZH, Peterson EI, Craig JR. Comparison of bacterial maxillary sinus cultures between odontogenic sinusitis and chronic rhinosinusitis. Int Forum Allergy Rhinol. 2021;11(1):40-7. http://doi.org/10.1002/alr.22627. PMid:32656998.

35. Kim SM. Definition and management of odontogenic maxillary sinusitis. Maxillofac Plast Reconstr Surg. 2019;41(1):13. http://doi.org/10.1186/s40902-019-0196-2. PMid:30989083.

36. Fokkens WJ, Lund VJ, Hopkins C, Hellings PW, Kern R, Reitsma S, et al. European Position Paper on Rhinosinusitis and Nasal Polyps 2020. Rhinology. 2020;58(Suppl S29):1-464. http://doi.org/10.4193/Rhin20.401. PMid:32077450.

Sven Eric Niklander
(Corresponding address)
Universidad Andres Bello, Viña del Mar, Chile.
Email: sven.niklander@unab.cl

Date submitted: 2024 Oct 07
Accept submission: 2025 Feb 06