Stomatologija. Baltic Dental and Maxillofacial Journal, 27: 33-42, 2025

Prevalence of Sinus Pathology in Dentistry: Retrospective Observational Pilot Study

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SUMMARY

Background. Changes in the sinus membrane in the form of thickening or opacification often pose challenges in the differential diagnosis between rhinological and odontogenic causes. Due to their clinical similarities, the development of a radiological diagnosis, with Cone Beam Computed Tomography (CBCT) being the technique of choice, will be crucial for achieving an accurate diagnosis.

Materials and Methods. A descriptive retrospective study was designed, comprising a pilot sample of 20 patients from the Faculty of Dentistry, Complutense University of Madrid, who had previously undergone a maxillary cone beam computed tomography (CBCT). The research applies Di Girolamo's classification to categorize radiological findings and assesses the relationship between sinus pathology and factors such as age, gender, and odontogenic causes.

Results. A total of 20 CBCT scans and health surveys from patients (14 males and 6 females), with mean age of 60 ± 8.14years were studied. Some type of sinus pathology was observed in 30 sinuses (75%) and no pathology in 10 sinuses (25%). Regarding potential etiology, dental pathology was the most prevalent (63.6%), followed by implants (18%) and oroantral communications (9%).

Conclusion. There is a high incidence of sinus pathology. Sinus pathology is diagnosed more frequently in men and smokers. The most common types of sinus pathology are thickening of the sinus membrane, followed by opacification of the maxillary sinus.

Keywords: cone-beam computed tomography, Di Girolamo´s classification, maxillary sinusitis, Schneiderian membrane, sinus pathology.

INTRODUCTION

The maxillary sinuses, also known as the antra of Highmore, are pneumatic cavities located bilaterally in the body of the maxilla and communicating with the nasal passages at the level of the middle meatus through the ostium (1). They are the first paranasal sinuses to develop, beginning their formation during the fetal period. Their growth continues in parallel with maxillary and facial development, and following the eruption of the second permanent molar, the sinus reaches nearly its final size, completing maturation with third molar eruption between 18 and 25 years (2).

The sinus is lined with a respiratory mucosa known as the Schneiderian membrane, which is tightly adhered to the periosteum and normally measures 0.8-2 mm in thickness (1). This membrane may undergo thickening secondary to various inflammatory, infectious, allergic, cystic, or neoplastic processes (3), and such alterations are typically identifiable through radiographic examination.

Sinus pathology is characterized by a reactive hyperplasia of the antral mucosa, leading to impaired drainage, mucus retention, and a microenvironment that promotes bacterial proliferation (4). Obstruction of the ostium may result in symptoms involving the eye, nose, and oral cavity, including pain and swelling (5). Importantly, when sinus disease is not accurately identified or diagnosed before maxillofacial procedures, it may contribute to intraoperative and postoperative complications such as sinus membrane perforation, oroantral communication, chronic sinusitis, implant failure, or exacerbation of existing inflammatory conditions.

Radiological findings such as sinus membrane thickening or opacification often pose diagnostic

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challenges, particularly when distinguishing between rhinogenic and odontogenic etiologies. Given the considerable overlap in clinical presentation, establishing an accurate differential diagnosis depends heavily on imaging, with cone-beam computed tomography (CBCT) being the modality of choice due to its high spatial resolution and ability to characterize subtle mucosal changes (3). Correctly identifying the underlying cause is essential, as odontogenic sinusitis requires a different therapeutic approach compared with rhinogenic pathology.

As surgical interventions in the posterior maxilla – such as implant placement, sinus augmentation, and other maxillofacial procedures – have become increasingly common, accurate preoperative evaluation of the maxillary sinus has become critical. Maxillary ridge atrophy can bring the alveolar crest into close proximity with the sinus floor, making it particularly important to assess membrane thickness and detect sinus pathology prior to surgery. Knowledge of the presence, etiology, and severity of sinus alterations helps prevent complications, improves treatment prognosis, and enhances the predictability and long-term success of surgical procedures.

The aim of this study is to investigate the prevalence of sinus pathology by observing CBCT scans conducted at the Faculty of Dentistry, Complutense University of Madrid, from September 2022 to September 2023. The classification used for identifying changes in the Schneiderian membrane will be Di Girolamo *et al.*'s classification.

Secondary Objectives:

- Evaluate possible etiological causes of sinus pathology.
- Classify selected cases with the presence of sinus pathology according to the classification provided by Di Girolamo and colleagues in 2022.
- Determine factors associated with each of the classes of radiological sinus findings.

MATERIALS AND METHODS

Data and patient selection

This study was approved by the Ethics Committee of the San Carlos Clinical Hospital with code 24/029-E. A descriptive retrospective study was designed, comprising a pilot sample of 20 patients from the institution, who had previously undergone a maxillary cone beam computed tomography (CBCT) study at the institution during the period from September 2022 to September 2023.

Inclusion criteria encompassed both male and female individuals over 18 years old with a complete and accurate medical history. Furthermore, patients who did not have a CBCT scan that clearly showed the antral region were excluded from the study, as well as those who had undergone nasal or paranasal surgery or who had been previously diagnosed and treated for sinusitis according to their medical history.

Radiological Data Evaluation

After obtaining our sample of 20 patients, the study is conducted by two previously calibrated and trained examiners (EGM and PPM) to detect changes in the antral mucosa. Additionally, these examiners will be completely blinded, unaware of the systemic condition or dental history of the patients. The CBCTs will be coded individually for each patient to preserve anonymity.

This assessment will be performed using the classification by Di Girolamo *et al.* 20226, categorizing patients into four groups:

- Class I. Mucosal thickness <2 mm in panoramic radiography and CBCT with thickness <2 mm (Fig. 1).
- Class IIA. Mucosal thickness >2 mm <5 mm in panoramic radiography and CBCT. No treatment is necessary as the mucosa is considered suitable for sinus lift (Fig. 2).
- Class IIB. Mucosal thickness >5 mm in panoramic radiography and CBCT. The root is within the sinus floor, causing local inflammation. Treatment is necessary (Fig. 3).
- Class III A. Panoramic and CBCT of a patient with concentric thickening of the mucosa >5 mm. Minimal maxillary antrostomy is required (Fig. 4).
- Class III B. Panoramic and CBCT of a patient with a retention cyst >5 mm. Endoscopic surgery (ESS) is required (Fig. 5).
- Class IV. Oroantral fistula: Panoramic and CBCT showing an oroantral fistula. The affected maxillary sinus is virtually obliterated due to a foreign body reaction. (Fig. 6)

Statistical Analysis

The variables to be assessed include age and gender, the localization of pathology (left, right, or bilateral), classification of pathology based on the measurement of the thickness of the antral mucosa, and possible etiology (apical periodontitis, endodontics, implants, extractions, iatrogenic causes, etc.).

Methodology

Cone Beam Computed Tomographies (CBCTs) conducted at the Faculty of Dentistry, Complutense University of Madrid, between September 2022 and

Fig. 1. I CLASS: Mucosal thickening <2 mm CBCT of a patient. The arrow indicates the maximum mucosal thickness.

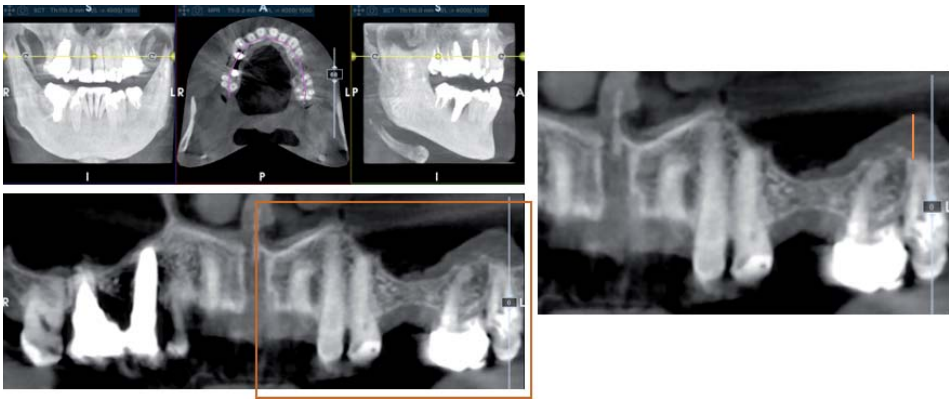

Fig. 2. IIA CLASS: Mucosal thickening >2 mm <5 mm CBCT of a patient. The arrow indicates the maximum mucosal thickness. The mucosa is considered adequate for sinus lift so there is no need for treatment.

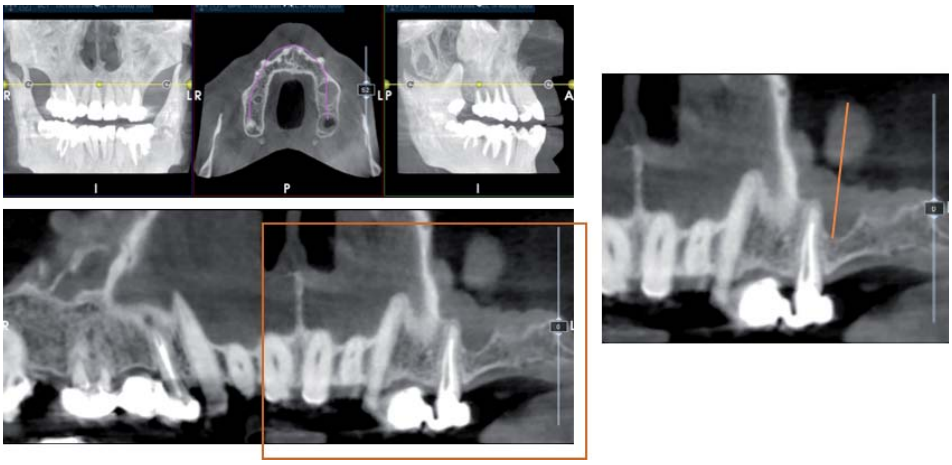

Fig. 3. IIB CLASS: Mucosal thickening >5 mm CBCT of a patient. The arrow indicates the maximum mucosal thickness. Dental root protrudes inside the maxillary sinus floor. There is a need for dental treatment.

September 2023 will be studied. Consecutively, 250 CBCTs that meet the inclusion criteria and do not exhibit any exclusion criteria will be analyzed.

CBCTs from the selected sample will be independently reviewed by two calibrated and trained examiners (E.G.M and P.P.M), who will be blinded to each other's assessments. In case of discrepancies, a third investigator (C.C.V) will determine the classification of the pathology. Examiner training and calibration will involve reviewing 30 randomly selected CBCTs from the sample, conducting a duplicated evaluation.

Patients will be categorized into those with or without sinus pathology. In the presence of sinus pathology, they will be classified based on the thickness of the sinus membrane into the four groups represented in Di Girolamo *et al.*'s classification (6).

Di Girolamo *et al.*'s classification (6), allows for the assessment of the health status of the paranasal sinus mucosa based on a radiographic diagnosis with CBCTs. The mucosa is considered thickened when it exceeds 2 mm, and the classification addresses its extension within the sinus cavity. It defines pathology as localized when restricted to the region involving up to two adjacent teeth in contact with the floor of the maxillary sinus. It is considered concentric and diffuse when thickening affects the other walls of the sinus.

- Class I. Mucosal thickness less than 2 mm.
- Class II A. Mucosal thickness between 2 and 5 mm.
- Class II B. Mucosal thickness greater than 5 mm from the floor of the sinus.
- Class III A. Mucosal thickness greater than 5 mm with concentric thickening and excessive accumulation of fluid considered opacification of the nasal sinuses.
- Class III B. Presence of nasal polyps, retention cysts, pseudocysts, mucoceles, dental foreign bodies.
- Class IV. Oroantral fistula and foreign bodies.

The coronal and sagittal sections of the CBCTs will be studied to enable the visualization of the maxillary sinus with a thickness of 0.1 mm. To determine

the maximum thickness of the mucosa, measurements will be taken in the most caudal area of the maxillary sinus.

Researchers will identify probable etiologies based on radiological findings and obtain the required information through anonymized Health Forms that each patient completes during their first visit prior to the radiological study.

Study variables

The demographic variables to be recorded include age, gender, tobacco use (more than 20 cigarettes daily), DiGirolamo classification of radiological findings, affected sinus (left, right, or bilateral), and probable etiology.

Microsoft Excel® will be used for the registration of these variables.

Statistical analysis

To measure the agreement between examiners, the Kappa coefficient (κ) will be utilized, considering a minimum valid value of 0.50.

A descriptive analysis of all variables was first performed to summarize the distribution of demographic and clinical characteristics. Categorical variables were expressed as absolute and relative frequencies, while continuous variables were reported as mean and standard deviation.

To evaluate the association between demographic factors (age, sex, smoking status) and clinical variables (etiology and laterality of sinus involvement) with the radiological classification of maxillary sinus pathology, a multinomial logistic regression model was applied. The Di Girolamo classification was used as the dependent outcome, with Class I set as the reference category. Independent variables included age (continuous), sex, smoking

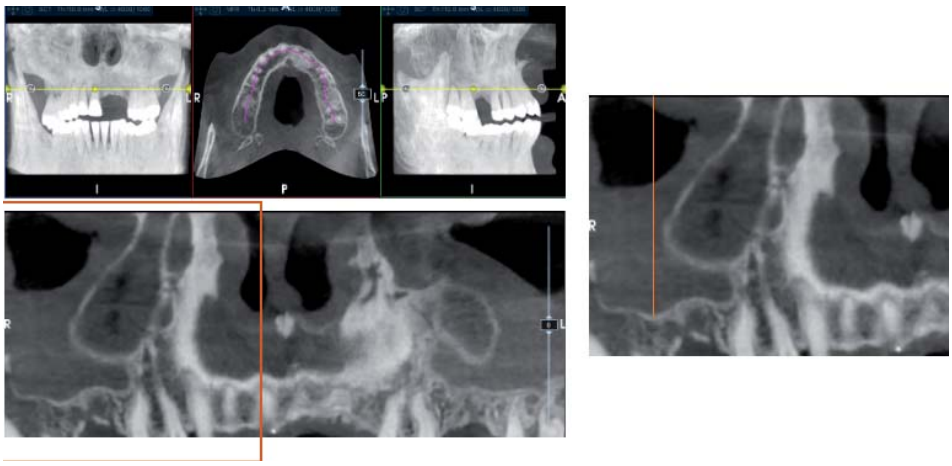

Fig. 1. I CLASS: Mucosal thickening <2 mm CBCT of a patient. The arrow indicates the maximum mucosal thickness.

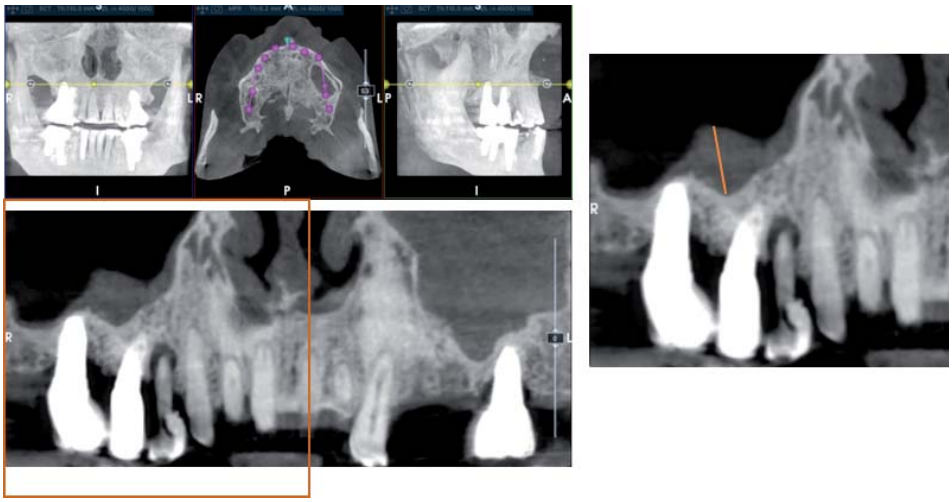

Fig. 2. IIA CLASS: Mucosal thickening >2 mm <5 mm CBCT of a patient. The arrow indicates the maximum mucosal thickness. The mucosa is considered adequate for sinus lift so there is no need for treatment.

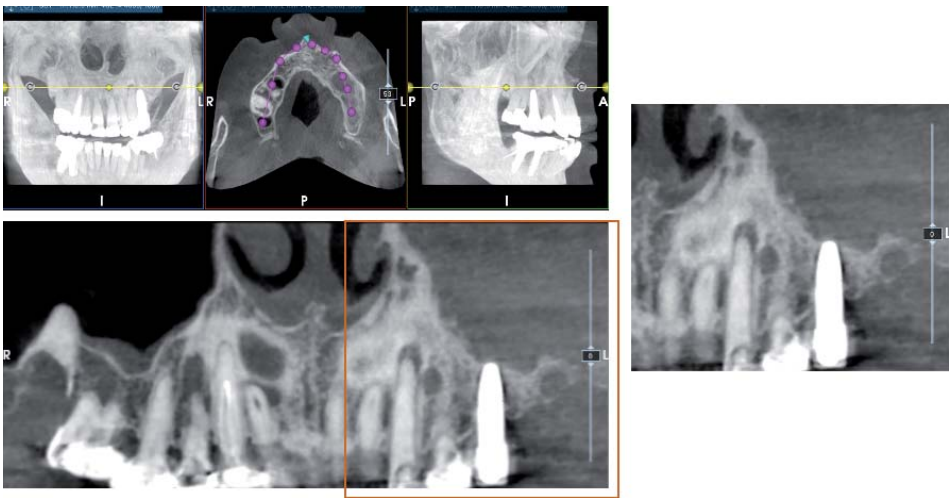

Fig. 3. IIB CLASS: Mucosal thickening >5 mm CBCT of a patient. The arrow indicates the maximum mucosal thickness. Dental root protrudes inside the maxillary sinus floor. There is a need for dental treatment.

status, etiology, and type of sinus involvement (categorical). Odds ratios (ORs) and their corresponding 95% confidence intervals (95% CIs) were obtained for each predictor.

Model significance and the contribution of each independent variable were assessed through Likelihood Ratio Tests, and statistical significance was defined as $p<0.05$. All analyses were performed using IBM SPSS Statistics (version 30).

Calculation of the sample size

The final sample size is determined based on the sample size table by Krejcie and Morgan, along with similar previous studies such as those by Al-Zahrani MS, *et al.*, and Akbari S, *et al.* It is established that the minimum sample size is 178 CBCTs. Considering a population of 700 patients undergoing maxillary tomographic studies over an academic year, the decision is made to analyze 250 CBCTs to enhance the statistical power of the findings.

The initial sample size for the pilot study phase will be 20 CBCTs, selected from consecutively registered cases that meet the inclusion criteria.

Ethical Considerations

This research is based on adherence to the principles of the Declaration of Helsinki, the standards of good clinical practice (Order SCO 256/2007, BOE 13-II-2007), and the Organic Law on the Protection of Personal Data (Organic Law 3/2018, of December 5).

Patients will be identified through a code, with no other system allowing their identification. The data will be subsequently entered into databases and stored with restricted access, accessible only for inspection by authorized authorities (Organic Law 3/2018, of December 5, on the Protection of Personal Data and Guarantee of Digital Rights).

Table 1. Total patients with or without sinus pathology

Total (sinus)	With sinus pathology	Without sinus pathology
40	30 (75%)	10

Table 2. Smoker patients according to gender

SMOKERS	Female	Male
Gender	9.1%	90.9%

Table 3. Smoker patients according to localization

SMOKERS	Left	Right	Bilateral
Localization of pathology	9.09%	27.3%	63.6%

Table 4. Smoker patients according to potential etiology

SMOKERS	Dental patology	Implants	Communications	Without sinus patology
Ethiology	63,6%	18%	9%	9,4%

RESULTS

A total of 20 CBCT scans and health surveys from patients were analyzed, encompassing observations of both maxillary sinuses. Among them, 14 were males and 6 were females, with an age range of 46-74 years and a mean age of 60±8.14 years. The patients were retrospectively evaluated. Out of the total 20 patients, 40 maxillary sinuses were examined, with 75% displaying some form of thickening or retention (Table 1).

Out of the total number of patients (20), 11 were smokers (55%), and 9 were non-smokers (45%). Next, we will assess the prevalence of smoking habits concerning gender, the localization of pathology, and its potential etiology. It was found that among smoker patients, 9.1% were women, and 90.9% were men (Table 2). The predominant location of sinus pathology in smokers was bilateral (63.6%), followed by right unilateral (27.3%), and finally left unilateral (9.09%) (Table 3).

Regarding potential etiology, dental pathology was the most prevalent (63.6%). Implants (18%), communications (9%), and no sinus pathology (9.4%) followed the previously mentioned (Table 4).

Bivariable analyses revealed strong associations for two variables. Smoking was exclusively observed in moderate and severe groups, indicating a robust link with increasing severity. Etiology was the most influential factor: periapical lesions concentrated the highest severity classes (IIIA–IV), while cases without pathology or with alternative etiologies were almost always mild. Age showed only a minimal difference between severe and non-severe cases and was unlikely to act as a meaningful predictor. Unilateral involvement initially appeared associated with severity, but this effect disappeared after adjusting for etiology, indicating it was not an independent factor.

The multivariate model identified dental aetiology and smoking status as the strongest predictors of radiological severity according to the Di Girolamo classification. Periapical pathology showed the highest independent association with advanced radiological changes, with an estimated odds ratio between 10 and 18 compared with patients without dental.pathology, remaining the only factor consistently linked to Class III and IV findings. Smoking also maintained an independent effect (OR≈2.5–3.5), in-

creasing the likelihood of higher severity classes after adjustment for age, aetiology, and laterality.

Age did not demonstrate a significant association with radiological severity in the adjusted model. Although unilateral involvement appeared related to increased severity in the bivariate analysis, this relationship disappeared after adjustment, indicating that laterality is mediated by the underlying dental pathology rather than acting as an independent predictor. Other etiologies (endodontic, sinus lift, extraction, or unspecified causes) showed weaker and non-significant associations with severity.

Overall, periapical disease and smoking were the only independent variables significantly associated with more severe radiological sinus changes (Table 5).

Interpretation of the statistical model must be approached with caution due to the small sample size, which reduces statistical power, increases the risk of

Table 5. Statistical analysis multinomial logistic regression *(continued on next page)*

Parameter estimates									
Di Girolamo classa		**B**	**Desv. Error**	**Wald**	**gl**	**Sig.**	**Exp(B)**	**95% confidence interval for Exp(B)**	
								Lower limit	**Upper limit**
IIA	Intersection	-0.30	2.02	0.02	1	0.88			
	Age	-0.04	0.05	0.82	1	0.36	0.96	0.87	1.05
	Male	-12.479	803.353	0	1	0.99	3.80E-06	0	-[b]
	Female	0[c]	-	-	0	-	-	-	-
	Smoker	0.13	1.79	0.01	1	0.94	1.14	0.03	37.74
	No-smoker	0[c]	-	-	0	-	-	-	-
	No-ethiology	0[c]	-	-	0	-	-	-	-
	Periapical pathology	15.56	1059.03	0	1	0.99	5.75E+06	0	-[b]
	Root-canal treatment	0.88	2.41	0.13	1	0.72	2.40	0.02	272.89
	Bone loss	-12.50	993.537	0	1	0.99	3.74E-06	0	-[b]
	Sinus lift	2.56	2.18	1.38	1	0.24	12.95	0.18	934.35
	Tooth extraction	0.34	5653.79	0	1	1.00	1.40	0	-[b]
	Other	0[c]	-	-	0	-	-	-	-
	Right	0.71	1.84	0.15	1	0.70	2.04	0.06	74.97
	Left	0[c]	-	-	0	-	-	-	-
IIB	Intersection	-1.932	2.091	0.85	1	0.36			
	Age	0	0.04	0	1	0.99	1	0.92	1.09
	Male	-12.364	654.929	0	1	0.99	4.27E-06	0	-[b]
	Female	0[c]	-	-	0	-	-	-	-
	Smoker	-11.648	477.164	0.00	1	0.98	8.73E-06	0	-[b]
	No-smoker	0[c]	-	-	0	-	-	-	-
	No-ethiology	0[c]	-	-	0	-	-	-	-
	Periapical pathology	4.28	1161.57	0	1	1.00	72.36	0	-[b]
	Root-canal treatment	-11.44	477.167	0.00	1	0.98	1.08E-05	0	-[b]
	Bone loss	-24.952	983.937	0.00	1	0.98	1.46E-11	0	-[b]
	Sinus lift	-24.815	1634.54	0	1	0.99	1.67E-11	0	-[b]
	Tooth extraction	4.89	2480.255	0	1	1.00	133.44	0	-[b]
	Other	0[c]	-	-	0	-	-	-	-
	Right	12.70	477.165	0.00	1	0.98	3.26E+05	0	-[b]
	Left	0[c]	-	-	0	-	-	-	-
IIIA	Intersection	-6.34	4.49	1.99	1	0.16			
	Age	0.09	0.08	1.24	1	0.27	1.10	0.93	1.283
	Male	-13.531	836.125	0	1	0.99	1.33E-06	0	-[b]
	Female	0[c]	-	-	0	-	-	-	-
	Smoker	-14.144	679.764	0	1	0.98	7.20E-07	0	-[b]
	No-smoker	0[c]	-	-	0	-	-	-	-
	No-ethiology	0[c]	-	-	0	-	-	-	-
	Periapical pathology	15.081	1430.176	0	1	0.99	3.55E+06	0	-[b]

[a]. the reference category is DiGirolamo Class I.
[b]. a floating-point overflow occurred while calculating this statistic. Therefore, its value is defined as lost from the system.
[c]. This parameter is set to zero because it is redundant.

unstable estimates, and may limit the generalizability of the findings.

Established or probable etiological factors

Dental Factors

The absence of dental factors was notable in the CBCT scans bilaterally. On the other hand, we can emphasize periapical pathology as the primary dental etiological factor for thickening of the maxillary sinus mucosa, followed by endodontic treatment and, finally, periodontitis. Regarding their location, periapical pathology stood out for being more prevalent in the right unilateral presentation, despite observing dental etiological factors more commonly in left unilateral cases (Table 6).

Implants

The prevalence of dental implants as an etiological factor causing thickening was lower than dental

Table 5. Statistical analysis multinomial logistic regression *(continued from previous page)*

Parameter estimates									
Di Girolamo classa		**B**	**Desv. Error**	**Wald**	**gl**	**Sig.**	**Exp(B)**	**95% confidence interval for Exp(B)**	
								Lower limit	**Upper limit**
IIIA	Root-canal treatment	0.4	961.176	0	1	1.00	1.49	0	-[b]
	Bone loss	-14.689	1603.222	0	1	0.99	4.17E-07	0	-[b]
	Sinus lift	-15.824	2773.433	0	1	1.00	1.34E-07	0	-[b]
	Tooth extraction	-0.697	7088.731	0	1	1.00	0.50	0	-[b]
	Other	0[c]	-	-	0	-	-	-	-
	Right	0.573	961.174	0	1	1.00	1.77	0	-[b]
	Left	0[c]	-	-	0	-	-	-	-
IIIB	Intersection	-163.407	1044.539	0.024	1	0.88			
	Age	2.602	16.58	0.025	1	0.88	13.50	1.04E-13	1.75E+15
	Male	-33.943	557.076	0.004	1	0.95	1.81E-15	0	-[b]
	Female	0[c]	-	-	0	-	-	-	-
	Smoker	-61.691	473.182	0.017	1	0.90	1.61E-27	0	-[b]
	No-smoker	0[c]	-	-	0	-	-	-	-
	No-ethiology	0[c]	-	-	0	-	-	-	-
	Periapical pathology	-13.521	1316.279	0	1	0.99	1.34E-06	0	-[b]
	Root-canal treatment	-18.791	566.304	0.001	1	0.97	6.91E-09	0	-[b]
	Bone loss	-40.463	1190.368	0.001	1	0.97	2.67E-18	0	-[b]
	Sinus lift	-54.217	2160.147	0.001	1	0.98	2.84E-24	0	-[b]
	Tooth extraction	13.126	7045.483	0	1	1.00	5.02E+05	0	-[b]
	Other	0[c]	-	-	0	-	-	-	-
	Right	18.22	562.279	0.001	1	0.97	8.18E+07	0	-[b]
	Left	0[c]	-	-	0	-	-	-	-
IV	Intersection	39.183	424.845	0.009	1	0.93			
	Age	-1.93	11.977	0.026	1	0.87	0.145	9.27E-12	2.27E+09
	Male	-3.239	1644.327	0	1	1.00	0.039	0	-[b]
	Female	0[c]	-	-	0	-	-	-	-
	Smoker	7.373	1572.792	0	1	1.00	1.59E+03	0	-[b]
	No-smoker	0[c]	-	-	0	-	-	-	-
	No-ethiology	0[c]	-	-	0	-	-	-	-
	Periapical pathology	49.961	1920.108	0.001	1	0.98	4.99E+21	0	-[b]
	Root-canal treatment	11.177	1620.632	0	1	0.99	7.15E+04	0	-[b]
	Bone loss	45.749	2130.747	0	1	0.98	7.39E+19	0	-[b]
	Sinus lift	40.34	2740.037	0	1	0.99	3.31E+17	0	-[b]
	Tooth extraction	61.024	0	-	1	-	3.18E+26	3.18E+26	3.18E+26
	Other	0[c]	-	-	0	-	-	-	-
	Right	-6.744	1566.451	0	1	1.00	0.001	0	-[b]
	Left	0[c]	-	-	0	-	-	-	-

[a]. the reference category is DiGirolamo Class I.
[b]. a floating-point overflow occurred while calculating this statistic. Therefore, its value is defined as lost from the system.
[c]. This parameter is set to zero because it is redundant.

causes. Two cases of implants placed with sinus lift were observed, both showing pathology (thickening of the sinus mucosa), with one being left unilateral and the other right unilateral (Table 7).

Oroantral Communication

Only one oroantral communication was found, possibly related to a previous extraction at the level of tooth 2.7, which was in close proximity to the sinus (Table 8).

Di Girolamo Classification

Among the examined patients, thickening <2 mm was observed in 18 maxillary sinuses (45%), with 2 of them showing unilateral involvement (5%) and 16 showing bilateral involvement (40%) (Table 9).

Class I was the most prevalent with a total of 18 cases, followed by Class IIB, which corresponded to a total of 9 affected maxillary sinuses (22.5%), with 12.5% located unilaterally and 10% bilaterally.

As for Class IIA, characterized by mucosal thickening between 2-5 mm, its prevalence is notably low at only 10%, with an equal proportion of unilateral and bilateral cases.

Class IIIA was the third most prevalent, with a total of 5 affected sinuses. This corresponds to mucosal thickening >5 mm, predominantly observed bilaterally (10%) compared to its unilateral form (2.5%).

Regarding Class IIIB, characterized by thickening >5 mm due to a retention cyst, there were 3 cases (7.5%), with bilateral presentation being more prevalent (5%) than unilateral (2.5%).

Finally, for Class IV, where an oroantral fistula is present, and the maxillary sinus is virtually obliterated due to a foreign body, it was observed in only 1 case (2.5%), affecting the maxillary sinus unilaterally.

DISCUSSION

Chronic sinusitis is a mucosal disease characterized by reactive thickening of the Schneiderian membrane, which is readily identifiable on radiological imaging. This mucosal hyperplasia results from various inflammatory or infectious processes that impair mucociliary clearance, promote mucus retention, and create conditions favorable for bacterial proliferation (7). Both rhinological factors – such as allergies or barotrauma (8 – and dental factors, including apical lesions from pulp necrosis, periodontal bone loss, or oroantral communications, may contribute to maxillary sinus pathology (9). Among the common manifestations, mucous retention cysts often appear as well-defined, homogeneous lesions on the sinus floor and may present unilaterally or bilaterally (8).

From a clinical standpoint, the accurate diagnosis of sinusitis is essential, particularly in the context of dental and maxillofacial procedures. Misdiagnosed or overlooked sinus pathology can increase the risk of intraoperative complications, such as sinus membrane perforation, bleeding, implant displacement, or postoperative infection. In addition, persistent or untreated sinusitis may compromise the success of sinus lift procedures, implant osseointegration, and

Table 6. Etiology; dental factors and distribution based on location

Dental factors	Right unilateral		Left unilateral		Bilateral		Total	
	Nº of cases	%	Nº of cases	%	Nº of cases	%	Nº of cases	%
No pathology	2	5%	3	7.50%	7	17.50%	12	30%
Non-endodontic periapical pathology	4	10%	3	7.50%	0	0%	7	17.50%
Endodontic treatment	3	7.50%	3	7.50%	0	0%	6	15%
Radiographic bone loss	1	2.50%	1	2.50%	0	0%	2	5%
Retained tooth	0	0%	0	0%	0	0%	0	0%

Table 7. Etiology; implants and distribution based on location

Implants	Right Unilateral		Left Unilateral		Bilateral		Total	
	No. of cases	%	No. of cases	%	No. of cases	%	No. of cases	%
Implants	0	0%	0	0%	0	0%	1	0%
Sinus Lift	0	0%	1	2.50%	1	2.50%	2	5%
Peri-Implant Bone Loss	0	0%	0	0%	0	0%	0	0%

Table 8. Etiology; oroantral communication and distribution based on location

Oroantral communications	Right Unilateral		Left Unilateral		Bilateral		Total	
	No. of cases	%	No. of cases	%	No. of cases	%	No. of cases	%
Extractions	0	0%	1	2.50%	0	0%	1	2.50%
Root Displacement	0	0%	0	0%	0	0%	0	0%
Third Molar Displacement	0	0%	0	0%	0	0%	0	0%

bone regeneration. These implications highlight the relevance of distinguishing true pathological thickening from benign variations, as well as differentiating odontogenic from non-odontogenic causes.

The prevalence of odontogenic sinusitis varies widely in the literature. According to the American Academy of Otolaryngology, approximately half of inflammatory sinus pathologies may have dental origin (10), while other studies report frequencies between 10% and 40% (11). Patel *et al.* (12) estimated an incidence of around 30%, noting that unilateral sinusitis is more frequently associated with odontogenic causes. A review of 674 cases revealed that most odontogenic sinusitis cases were iatrogenic (65.7%), followed by apical periodontal disease (25%) and marginal periodontitis (8.3%) (13). These findings align with reports by Shiki *et al.* (14), who associated sinus pathology with implant-related surgical procedures, and by Ren *et al.* (15), who noted that many cases arise following dental loss due to inflammatory conditions such as pulpal or periapical disease.

Dental extractions – particularly of the upper first molar and premolars – along with root displacement, are common iatrogenic causes of sinusitis. Similarly, the increasing demand for implant therapy and sinus augmentation procedures has contributed to a rise in sinus complications, underscoring the need for accurate preoperative assessment. The anatomical relationship between tooth roots and the maxillary sinus floor further complicates diagnosis. Classifications such as that proposed by De Lima *et al.* (17) help evaluate this proximity, which may predispose to sinus involvement in cases of periapical disease or surgical interventions.

The differential diagnosis between odontogenic and rhinogenic sinus pathology remains challenging because both conditions can produce similar radiological features, including mucosal thickening or opacification (9). In this context, precise clinical and radiographic examination is crucial to establish the correct etiology and guide treatment planning. Among imaging modalities, Cone Beam Computed Tomography (CBCT) has emerged as the preferred tool due to its high spatial resolution, lower radiation dose, and minimal distortion (8). CBCT enables visualization of subtle mucosal changes, partial or complete sinus opacification, and moderate to severe thickening, thereby improving diagnostic accuracy and reducing the risk of misinterpretation (10).

Table 9. Di Girolamo Classification Based on Location

Class	Unilateral		Bilateral		Total	
	Cases	%	Cases	%	Cases	%
I	2	5%	16	40%	18	45%
IIA	2	5%	2	5%	4	10%
IIB	5	12.50%	4	10%	9	22.50%
IIIA	1	2.50%	4	10%	5	12.50%
IIIB	1	2.50%	2	5%	3	7.50%
IV	1	2.50%	0	0%	1	2.50%

Various authors have proposed thresholds for defining pathological membrane thickening, ranging from >1 mm (18) to >2 mm (5) and >3 mm (19), though there is consensus that severe thickening is defined as >10 mm. These discrepancies highlight the need for standardized radiological criteria. The classification proposed by Di Girolamo *et al.* (6) in 2022 addresses this issue by offering a structured approach to differentiate ventilation-related from odontogenic causes based on thickness and distribution patterns. Their study reported the following order of prevalence: Class I > IIA > IIB > IIIA > IIIB > IV, with most cases presenting unilaterally except for Classes IIIA and IIIB (6). The classification also considers the extension of mucosal thickening – whether localized or diffuse – which provides additional diagnostic value.

Another relevant system is the Lund-Mackay classification (20), which assesses sinus opacification and is commonly used to grade the severity of paranasal sinus disease. Although originally developed for CT imaging, it has been applied to CBCT studies and contributes to a more comprehensive evaluation of sinus involvement.

Treatment of maxillary sinus pathology depends on its underlying cause, severity, and symptoms, as well as the need for ancillary surgical procedures such as sinus lifts. Dental treatment is essential when odontogenic sources are identified, but definitive management often requires a multidisciplinary approach involving both dental and otolaryngology specialists (16). Endoscopic sinus surgery (ESS), combined with medical therapy and appropriate dental treatment, remains the most widely accepted approach (21). Some authors suggest a conservative "wait-and-see" strategy in asymptomatic cases; however, when symptoms persist or additional surgical procedures are planned, drainage by puncture and aspiration, sometimes followed by bone regeneration, may be necessary (22). Comparable outcomes have been reported between this approach and traditional ESS (23, 24), though ESS remains the predominant treatment modality, particularly when coordinated between maxillofacial and ENT specialists (22).

CONCLUSION

This study shows a high prevalence of maxillary sinus pathology (75%) in CBCT scans, with dental factors – particularly periapical pathology – emerging as the primary etiological cause. Most cases corre-

sponded to Class I of the Di Girolamo classification, indicating predominantly mild mucosal thickening. Smoking was more frequent among male patients and was mainly associated with bilateral sinus involvement. Overall, the findings highlight the close relationship between dental conditions and sinus alterations and support the usefulness of CBCT and the Di Girolamo classification for the systematic evaluation of maxillary sinus pathology.

STATEMENT OF CONFLICTS OF INTEREST

The Authors declares that there is no conflict of interest.

FUNDING STATEMENT

The Authors declares that there is no funding for this study.

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Received: 02 12 2024
Accepted for publishing: 20 06 2025