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RESEARCH ARTICLE

Incidence of Maxillary Sinus Pathology Diagnosed by CBCT: A Retrospective Observational Study on the Mississippi University Institution

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Abstract

Background: The European position paper on rhinosinusitis and nasal polyps (EPOS) defines sinusitis or rhinosinusitis as a disease characterized by acute or chronic inflammation of one or more paranasal sinuses. Acute rhinosinusitis has a yearly prevalence of 6-15%, while chronic sinusitis in Europe is 10.9%.

Objective: The main objective is to determine the incidence of maxillary sinus pathology. Secondary objectives were to determine the frequency according to the type of pathology and analyze the relationship with gender and age.

Methods: A retrospective observational study was carried out on patients who underwent maxillary cone beam computed tomography (CBCT). The demographic information of the patients was recorded, considering sex, age, maxillary sinus studied and the classification according to Di Girolamo.

Results: The analyzed sample consists of 226 CBCTs. Some type of sinus pathology was observed in 130 cases (58%) and no pathology in 96 cases (42%). The most frequently found pathology was thickening of the sinus mucosa (23%), followed by sinus opacity (17%) and dental pathologies (11%) and the presence of cysts and tumors (8%).

Conclusions: There is a high incidence of sinus pathology. It is more frequent in men between 41 and 50-years-old. The most common types of pathology are thickening of the membrane and opacification. No differences were observed between the types of sinus pathology with respect to gender or age.

Keywords

Sinusitis, Rhinosinusitis, Maxillary sinus, Paranasal sinus, Diseases, Implants, Odontogenic sinusitis, surgery, Dental implants, Non-odontogenic sinusitis

Introduction

The maxillary sinuses are the first paranasal sinuses to develop in the third or fourth month of fetal life. Its growth rate is very slow during fetal life and does not change until birth. After birth, respiratory function acts as a stimulus in development. Lifelong growth of the maxillary sinuses or pneumatization occurs at a rate of 2 mm per year and reaches its final size between 12 and 14 years, when the permanent dentition has been completed [1].

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The European position paper on rhinosinusitis and nasal polyps (EPOS) in 2020 defines sinusitis or rhinosinusitis as a disease characterized by acute or chronic inflammation of one or more paranasal sinuses [1].

Acute rhinosinusitis has a yearly prevalence of 6-15%, while chronic sinusitis in Europe is 10.9%. There is a wide variation between countries ranging from 6.9% in Finland to 27.1% in Portugal [2].

Both acute and chronic sinusitis affect quality of life. However, chronic sinusitis entails a greater socioeconomic cost due to the medical care it requires and the work absenteeism it causes [3]. In addition, it produces a greater deterioration in quality of life than angina or chronic heart failure [4].

The etiology of sinus pathologies can be infectious, traumatic, cystic, tumorous, allergic, irritative or iatrogenic [5,6]. Furthermore, host environmental and genetic factors may contribute to its development. Other factors, such as tobacco, influence a higher incidence of chronic sinusitis [6].

The clinical diagnosis, according to EPOS 2020, is characterized by nasal obstruction or nasal discharge, facial pain or pressure, and impairment of smell. The diagnosis is confirmed by endoscopy or scanning [6,7].

There is a wide variety of classifications of sinus pathology based on radiological findings, such as those of Maillet, et al. [8] and Shanbhag, et al. [9] and Lund-Mackay, et al. [10]. However, these classifications are based on the thickness of the sinus mucosa or the opacification of the maxillary sinus, so they have limitations when determining the type of sinus pathology.

DiGirolamo, et al. [11] proposed a classification that allows standardizing the reference values of mucosal thickening and its extension and identifying an odontogenic or dysventilation cause of the pathology of the nasal and paranasal sinuses, through the evaluation of computed tomography and CBCT.

Odontogenic sinusitis represents from 10-30% to 51.8% of cases of maxillary rhinosinusitis due to the passage of microorganisms from infected periapical tissues, producing acute or chronic pathology [12,13].

The presence of apical periodontitis, periodontal diseases, bone regeneration treatments and implants and tooth extraction in antral areas increase the risk of maxillary sinusitis [14,15]. Apical and marginal periodontitis represents 83% of all dental causes of maxillary sinusitis, affecting 75% of patients with symptomatic unilateral maxillary rhinosinusitis undergoing surgical treatment [16,17].

The treatment of acute sinusitis is based on the relief of symptoms using topical decongestants and saline irrigation of the nasal cavity, such as Ephedrine or Xylometazoline and does not involve antibiotics unless the patient has fever or there is evidence of spread of infection [18]. The treatment of chronic sinusitis is carried out using nasal corticosteroids, although to date there is no scientific evidence regarding administration methods and doses.

In case the chronic or acute pathology is recurrent or does not respond to conventional medical therapy, it may require surgical treatment to restore normal mucociliary function and cleansing of the paranasal sinuses, size of the ostium of the maxillary sinus and removal of excess tissue in the middle meatus. The most commonly used surgical treatments are the Caldwell-Luc technique, with an approach through the canine fossa, and endoscopic sinus surgery, with an approach through the nasal fossa [19-21].

The treatment of sinusitis of dental origin requires the elimination of the source of the infection to avoid the persistence of the symptoms [22-27]. Although 79% of cases, odontogenic sinusitis does not respond to antibiotic and dental treatment and subsequently requires endoscopic surgery [28]. However, there is controversy about the sequence and timing of sinus surgery compared to dental treatment.

Felisati, et al. showed a 99% success rate after endoscopic surgery of the paranasal sinuses simultaneously with the removal of the odontogenic source [29]. Other authors have shown that patients who first underwent sinus surgery, followed by dental treatment, have the same percentage of cure as those who underwent dental treatment first [30-32]. On the other hand, other studies suggest eliminating the source of dental infection and performing sinus surgery only if symptoms persist [33-35].

Sinusitis represents a growing health problem with relevance to oral surgical treatments. Dentists must know the incidence and different sinus pathologies, as well as their relationship with dental treatments. The diagnosis of sinus pathology allows for individualized treatment to be established according to the type of sinus pathology.

The main objective of this study is to determine the incidence of maxillary sinus pathology. Secondary objectives were to determine the frequency according to the type of sinus pathology and analyze the relationship with gender and age.

Material and Methods

Study design

A retrospective observational study was carried out on patients who underwent maxillary cone beam computed tomography (CBCT) between January 2020 and September 2022. The study was carried out in accordance with the recommendations of the Declaration of Helsinki (World Medical Assembly),

following the reference points of the 2009 STROBE GUIDELINE.

Study population

The sample includes data obtained from the medical records and complementary tests of patients who underwent at least one maxillary scan between January 2020 and September 2022 with any indication.

The following inclusion criteria were established:

- Clinical histories and complementary tests of patients between 12 and 90-years-old.
- Maxillary scan performed at the Mississippi University Institution for the NewTom® program.
- Full visualization of both maxillary sinuses.

In addition to the absence of compliance with any of the inclusion criteria, the following were established as exclusion criteria:

- Medical records of patients under 14 years of age.
- Medical records of patients who have a medical history of sinus pathology.
- Medical records of patients with a surgical history of sinus pathology.
- Clinical histories and computed tomography scans of patients who underwent maxillary sinus lift surgery less than 3 months previously.
- Duplicate medical records and CT scans.

Outcome measures

The demographic information of the patients was recorded, considering sex, age, maxillary sinus studied and the classification of sinus status according to Di Girolamo S, et al. [11].

The classification of Di Girolamo S, et al. [11] allows evaluating the health status of the mucosa of the paranasal sinuses based on a radiographic diagnosis with a scanner. The mucosa is considered thickened when it exceeds 2 mm. In addition, it addresses its extension within the sinus cavity. It defines the pathology as localized when it is 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 the thickening affects the other walls of the sinus (Figure 1).

I CLASS: Sinus mucosa thickness less than 2 mm

II A CLASS: Thickness of the mucosa between 2 and 5 mm

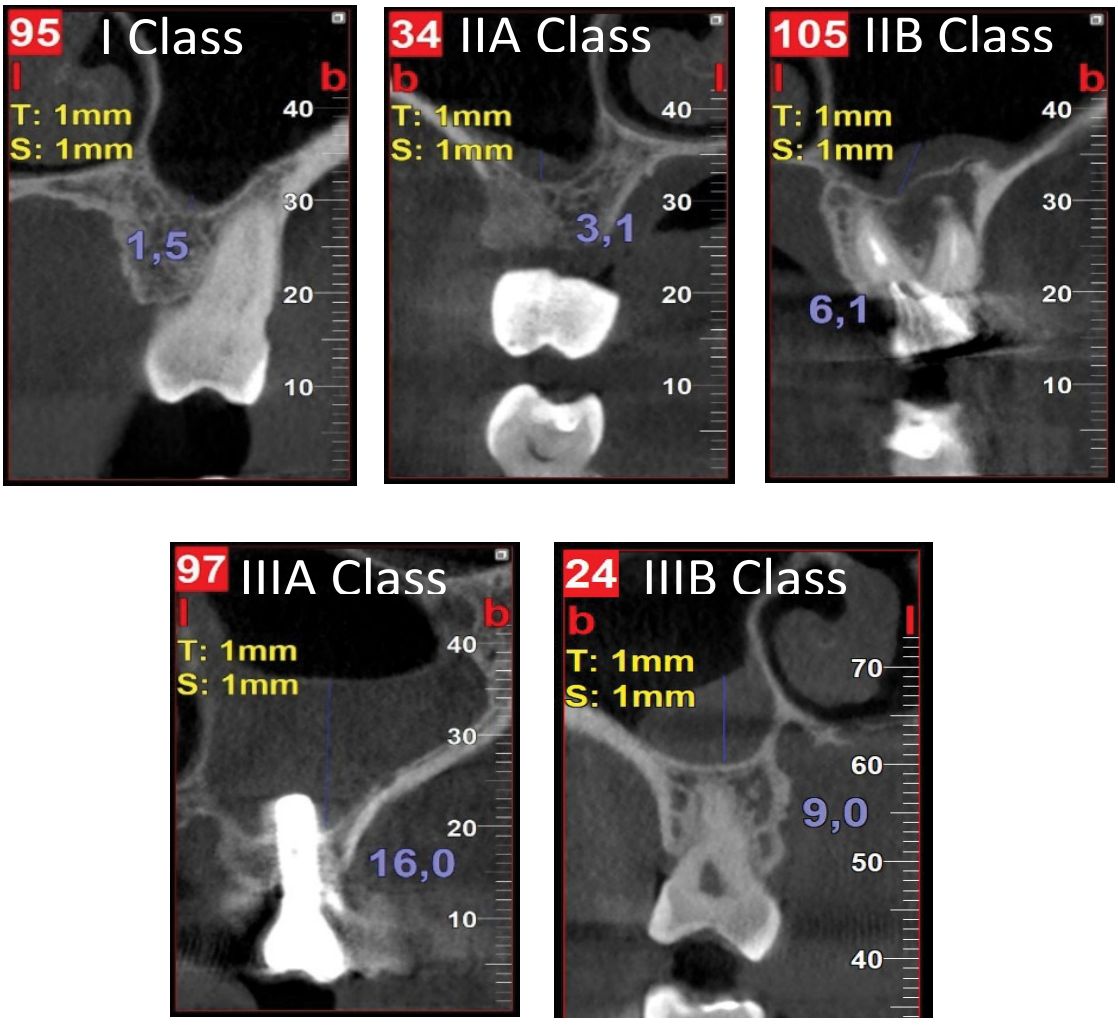

Figure 1: CBCT sections of maxillary sinus examples according to DiGirolamo classification.

II B CLASS: Thickness of the mucosa greater than 5 mm from the floor of the sinus

III A CLASS: Mucosal thickness greater than 5 mm and concentric thickening with excessive fluid accumulation considered sinus opacification

III B CLASS: Presence of nasal polyps, retention cyst and pseudocyst, mucoceles, dental foreign body

IV CLASS: Oroantral fissure and foreign body

The coronal and sagittal sections of the scanner were studied to allow visualization of the maxillary sinus with a thickness of 0.1 mm. To determine the maximum thickness of the mucosa, it was measured in the most caudal area of the maxillary sinus.

Each scanner was examined independently by two researchers who were previously calibrated on the measurement and classification criteria. In case of discrepancy, a third researcher determined the classification of the pathology.

A descriptive analysis was carried out on the variables recorded with absolute and relative frequencies (for categorical ones).

The Microsoft Excel® program was used to record the variables.

Results

A total of 383 maxillary scans were studied. 157 scans were discarded because they did not meet the inclusion criteria. Of them, 4 cases were younger than 14-years-old, 52 did not show the complete maxillary sinus and 101 were duplicate patients. Therefore, the analyzed sample consists of 226 scans of 127 women and 99 men (Figure 2).

Of the 226 scans, some type of sinus pathology was observed in 130 patients (58%) and no pathology in 96 patients (42%). The 130 cases with pathology were distributed among 65 men and 65 women. The 96 cases without sinus pathology were made up of 62 women and 34 men. Of the total of 99 men, sinus pathology was diagnosed in 66%, while in 127 women the pathology was observed in 51%. In 31 cases sinus pathology was bilaterally.

Patients aged 41 to 50 years had a higher prevalence of sinus pathology (24%), followed by the group aged 61 to 70 years (21%) and those aged 51 to 60 years (20%). Patients between 21 and 30-years-old had a prevalence of sinus pathology of 9%. The lowest prevalence of pathology was recorded in patients aged 12 to 20, 31 to 40 and 71 to 80 years of age with 8% and only 4% corresponded to the age range between 81 and 90 years (Figure 3).

The most frequently pathology found in patients was thickening of the sinus mucosa (23%), followed by partial sinus opacity (17%) and nasal polyps, retention cyst and pseudocyst, mucoceles, dental foreign body(11%) and finally, the presence of sinus opacification (7%) (Table 1).

The frequency of sinus pathology was distributed similarly in terms of gender. However, the male population presented more cases of sinus opacity. The 31 cases of sinus pathology bilaterally were on II A Class 8 males and 8 females, III A Class 10 males and 3 females and III B Class one male and one female.

Discussion

In the present work, 226 maxillary scans were analyzed, finding an incidence of sinus pathology of 58%. These results are in accordance with previous studies that determined the incidence of sinus pathology in patients diagnosed by scanning between 56% and 59.7% [36-38]. Other studies record a higher incidence, such as Rege IC, et al. of 68.2% [39]. However, other diagnostic tests such as panoramic radiography can cause a minor diagnosis of the pathology [40].

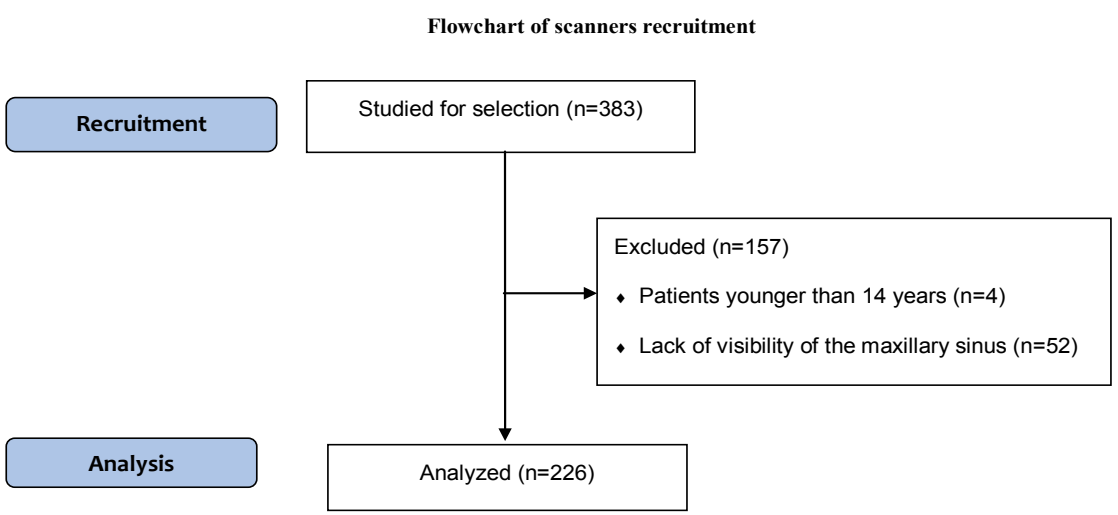

Figure 2: Flowchart of patient CBCT recruitment.

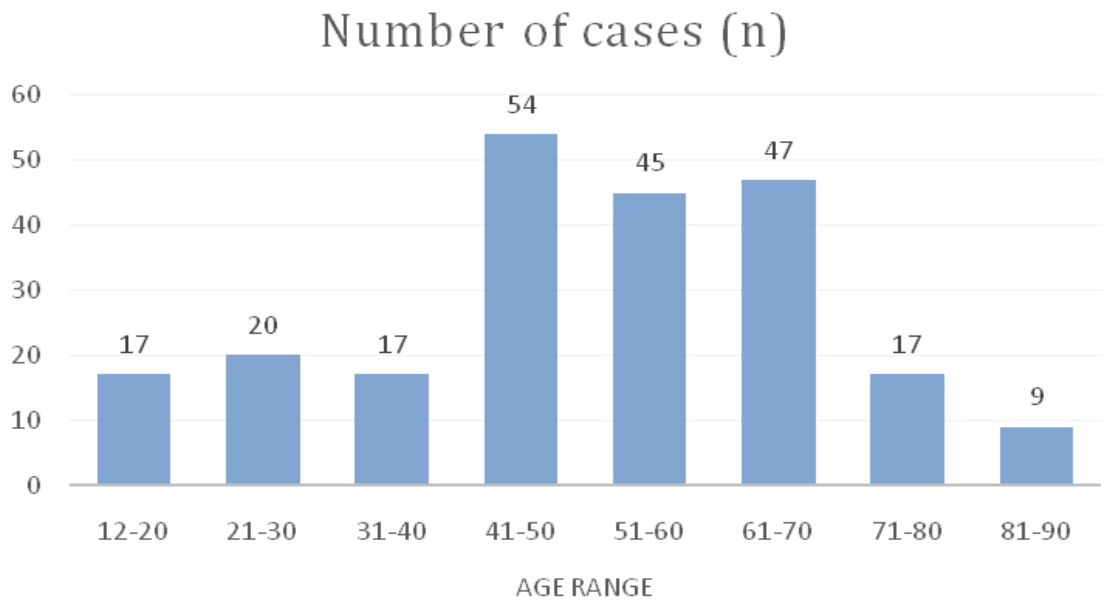

Figure 3: Distribution of maxillary sinus pathology by age range.

Table 1: Distribution of CBCT by types of sinus pathologies present in the maxillary sinus.

Di Girolamo Classification	Number of patients (n)	Percentage of patients (%)	Number of maxillary sinus (n)	Percentage of maxillary sinus (%)
I CLASS	96	42	291	64
II A CLASS	51	23	67	15
II B CLASS	38	17	38	8
III A CLASS	17	7	30	7
III B CLASS	24	11	26	6
IV CLASS	0	0	0	0
TOTAL	226	100	452	100

Regarding gender, according to several studies there are no statistically significant differences between both sexes [38,41]. However, other authors find a higher proportion of sinus pathology in men, which corresponds to our sample [36,37,39].

The distribution of patients with sinus pathology according to age in our study shows that patients between 41- and 50-years-old account for 24% of the total number of diagnosed patients. The second most frequent age group corresponds to those over 60 years of age (21%). Similar studies obtained the same results [36,37,39], while others found no statistically significant difference [38,41].

Depending on the type of sinus pathology studied, the majority were classified as mucosal thickening (23%), followed by sinus opacity (17%). Several studies record mucosal thickening as the main lesion of the maxillary sinuses, ranging between 21% when the diagnosis is made using panoramic radiography and up to 66% using a scanner [42-51]. Regarding other sinus pathologies, there is no consensus regarding frequency in the literature. Ritter L, et al. find that sinus opacity is the second most prevalent pathology with 16.6% [36]. Other authors report that retention cysts are the second most prevalent pathology, with 10.1% [39].

Regarding the types of sinus pathology according to gender, both men and women presented a higher frequency of thickening of the sinus membrane, followed by sinus opacity. These results agree with the studies which did not find differences according to sex in the type of sinus lesions [38,41].

The limitations of the present observational study are the absence of clinical information about the patient, not considering medical and surgical history, allergies, the seasonal period in which the scan was performed, as well as possible etiologies. These limitations are due to the methodology used to preserve the protection of patient data.

However, the present study involves an important sample of patients who attend a center for implantological and surgical treatments in which a high incidence of unnoticed sinus pathology is diagnosed. This study can serve to convey to the scientific community the relevance of the diagnosis of sinus pathologies in the face of rehabilitative dental treatments with implants.

Therefore, we can conclude that in our sample there is a high incidence of sinus pathology. Sinus pathology is diagnosed in our sample more frequently in men and patients between 41 and 50-years-old. The most common types of sinus pathology are thickening of the sinus membrane, followed by opacification of the maxillary sinus. No differences were observed between the types of sinus pathology with respect to gender or age. Carrying out more studies, with larger samples and more clinical information, would allow us to deepen our knowledge and relevance of sinus pathological findings.

Ethics Approval and Subject Consent

To carry on the present study, ethics approval from the Mississippi University Institution, Madrid, Spain, was obtained. The authors undertook to manage the data in accordance with current regulations (Organic Law 3/2018, of December 5, on the Protection of Personal Data and guarantee of digital rights), including compliance with the seventeenth additional provision of the aforementioned regulations in the case of retrospective studies. This implies guaranteeing a technical and functional separation between the research team and those who carry out the pseudonymization (coding) and preserve the information that enables re-identification.

The consent of the participants to use their data and images for teaching, scientific and informative purposes was obtained previously.

Conflict 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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