

ORIGINAL ARTICLE

Dental Pathology and Maxillary Sinus Function: A Clinical Study

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Abstract

Purpose: This study aimed to investigate potential changes in the maxillary sinus associated with dental and periapical pathologies regarding a clinical and radiological assessment.

Materials and Methods: A group of 200 patients, presenting with various upper posterior dental pathologies (periapical granuloma, periodontitis, pyogenic infections, and odontogenic cysts), was included over a 6-year period (2015-2021). Patients with oro-antral fistula, patients with dental implants excluded because defects can be created as a result of other factors like surgeon skills or dental implant complications.

Totally edentulous maxillae or malignant tumors were excluded. Clinical and radiological assessments, including Panoramic Radiograph and Cone Beam CT scan, were conducted in the Maxillofacial Departments of Al-Kindy Teaching Hospital and the College of Dentistry at the University of Baghdad. Comprehensive dental treatment and follow-up were administered to all patients.

Results: The study group comprised 60 male patients (30%) and 140 female patients (70%) with an age range of 20-60 years and an average age of 40 years. Among the 200 cases, only 18 (9%) exhibited sinus effects, indicative of chronic maxillary sinus disease. Notably, 5 cases (2.5%) displayed pathological alterations in the maxillary antrum (Max An).

Conclusion: Within this group, maxillary sinus diseases arising from dental pathologies accounted for approximately 2.5% of cases. Dental pathologies extending into the sinus elicited diverse radiographic changes, often without overt symptoms. Dental treatment emerged as a primary approach for managing such cases, effectively addressing associated sinus alterations.

Keywords: Maxillary Sinus; Dental Pathology; Odontogenic Infections; Sinus Complications.

1. Introduction

The complex interconnection between dental and periapical pathologies and their potential repercussions on the maxillary sinus has been a subject of interest in the field of Oral and Maxillofacial Surgery for several decades. Important investigations, such as those initiated by Bauer in 1943 [1], laid the groundwork for understanding the dynamic interplay between these pathologies and the subsequent development of maxillary sinusitis. The inflammatory cascade triggered by these pathologies resonates through the sinus floor, an area influenced by inflammatory mediators and the consequential presence or absence of sinus perforation [2, 3].

Of paramount importance is the concept of Odontogenic Sinusitis (Odo Sin), a condition that stands out due to its rarity compared to rhinosinusitis [4]. Despite its infrequent occurrence, Odo Sin is a clinical entity that demands vigilant diagnosis and management to mitigate potentially severe complications [5]. Nevertheless, the distinctive clinical features, often expressed through dental pain, underscore the crucial role of accurate clinical history and examination in establishing a precise diagnosis [6, 7]. Current investigations suggest a growing prevalence of Odo Sin attributed to dental causes, where factors like iatrogenic interventions, dental implants, ridge augmentation, and periapical lesions contribute to its emergence [8-10].

When comparing the prevalence of Odontogenic infections (Od. In) to the relatively low incidence of sinusitis resulting from these infections, a contrast becomes apparent [11]. The intricate architecture of the maxilla, reinforced by the cortical bone between the oral cavity and the sinus floor, acts as a protective barrier [4]. This cortical bone plays a pivotal role in preventing infections from directly entering the maxillary sinus, directing them instead toward the lateral wall of the maxilla [7]. However, the phenomenon of Od. In contributing to sinus involvement is not uniform, depending on the proximity of dental roots to the sinus floor and the extent of sinus pneumatization [12].

Enhancing diagnostic accuracy, Cone-Beam Computed Tomography (CBCT) has emerged as the benchmark for identifying sinus diseases, allowing meticulous evaluation of the sinus relationship with posterior maxillary teeth [13]. Within this framework, the

significance of the mesiobuccal root of the upper second molar, positioned closely to the sinus, becomes prominent [14]. Moreover, the radiological perspective illuminated by CBCT unveils the distinct indications of Odo Sin, characterized by thickening of the mucosa proximal to teeth with pathological changes [15, 16]. A collaborative synergy between ENT specialists and adept dentists is essential in deciphering these intricacies, underscoring the indispensable role of definitive dental intervention in managing Odo Sin [17].

The present study undertakes a detailed investigation into the intricate correlation between dental pathologies and their impact on the maxillary sinus. Leveraging advanced imaging methods and a comprehensive clinical approach, the study aims to elucidate the diverse spectrum of odontogenic sinusitis, its impact on the sinus, and the crucial role of interdisciplinary collaboration in effectively diagnosing and managing this complex clinical entity.

2. Materials and Methods

2.1. Study Design

This prospective study was conducted over a span of six years, from 2015 to 2021, and was carried out at both the Maxillofacial Department of Al-Kindy Teaching Hospital and the Maxillofacial Department of the College of Dentistry, University of Baghdad (both are governmental institutions). Ethical approval for the study was obtained from the College of Dentistry, University of Baghdad. There is a special case sheet containing all the information regarding patient medications, systemic diseases, or previous hospitalization.

2.2. Patient Selection and Examination

The study encompassed a carefully selected cohort of 200 patients who presented with documented cases of odontogenic infections affecting maxillary molars and premolars. Any patients with uncontrolled systemic diseases were excluded.

The central objective of the study was to systematically investigate the potential effects of various dental pathologies on the maxillary sinus. To achieve this, a thorough evaluation was undertaken, which involved both clinical assessments and

radiological examinations (regardless of other factors like nutrition, and education).

Clinical evaluations were designed to identify any sinus-related symptoms or abnormalities. Special attention was given to symptoms such as unilateral nasal discharge, headaches, tenderness in the affected area, and foul odor. This step was crucial in establishing a comprehensive clinical baseline and in ensuring that the sinus conditions were appropriately scrutinized.

Radiological examinations were a pivotal component of the study's methodology. A combination of periapical, panoramic (the same type of OPG machine was used for all patients), and CBCT scans was employed to gain comprehensive insights into the nature and extent of the dental pathologies. These imaging modalities allowed for a detailed examination of the pathological conditions, including periapical granulomas, periodontitis, abscesses, and odontogenic cysts. The radiological assessments not only provided a visual representation of the lesions but also facilitated an in-depth analysis of their relationship with the maxillary sinus.

2.3. Treatment Approaches and Case Examples

The study encompassed a diverse range of treatment approaches that were tailored to the specific pathologies identified in each case. Notably, cases involving radicular cystic lesions underwent a meticulous enucleation process, with a paramount emphasis on preserving the integrity of the sinus membrane. This approach aimed to prevent any potential breach or damage to the sinus membrane during the surgical intervention. It is worth highlighting that such meticulous surgical procedures were selected to maintain the sinus's function and health.

To provide a practical context for the study's findings, select case examples were presented. These case examples underscored the intricate interplay between various dental pathologies and the health of the maxillary sinus:

Case 1: An impacted upper second premolar demonstrated sinus membrane thickening, even in the absence of apparent symptoms. The surgical retrieval of the impacted tooth was executed with utmost care

to ensure the sinus membrane's integrity and functionality were retained (**Figure 1a**).

Case 2: A case involving the surgical removal of an impacted canine for orthodontic reasons illustrated the sinus's resilience against certain dental conditions (**Figure 1b**). This example emphasized the sinus's inherent capacity to withstand certain pathologies without undergoing adverse effects.

Case 3: The study examined a case wherein chronic periapical abscess and periodontitis had led to bone resorption within the sinus floor (**Figure 1c**). This specific case highlighted the complex interaction between dental pathologies and the sinus' structural integrity.



Figure 1. Case examples of pathological lesions of impacted upper second premolar (a), impacted canine (b), and bone resorption within the sinus floor (c)

3. Results

3.1. Patient Demographics

A comprehensive evaluation of patient demographics was conducted concerning Oral and Maxillofacial Surgery, no statistical relation was done between the results of the two institutions. The study encompassed a cohort of 200 patients, consisting of 60 male participants (30%) and 140 female participants (70%) as illustrated in Figure 2. In terms of age distribution, the participants were categorized into distinct groups. Notably, the age group of 31-40 years accounted for the highest proportion, comprising 63 cases (31.5%). The subsequent age groups of 41-50 years, 21-30 years, and 51-60 years consisted of 61 cases (30.5%), 45 cases (22.5%), and 31 cases (15.5%), respectively (Figure 3).

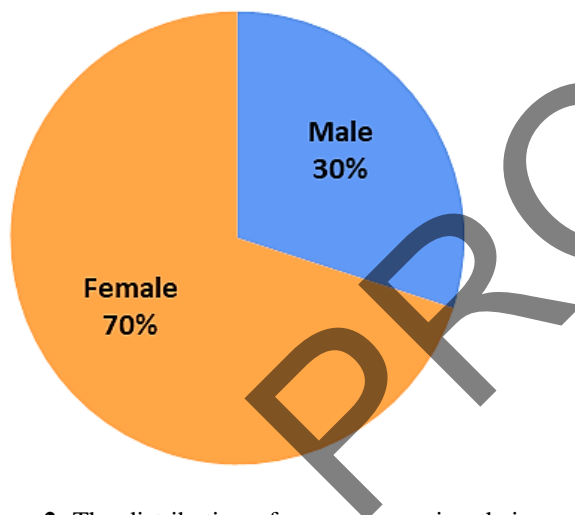


Figure 2. The distribution of cases concerning their gender

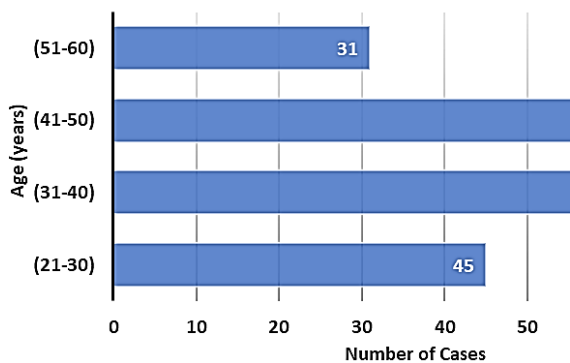


Figure 3. The distribution of cases concerning their age

3.2. Tooth Involvement Patterns

To gain insight into the distribution of dental pathologies, a meticulous analysis of tooth involvement was undertaken. Among the various dental components studied, the 2nd molar emerged as the most frequently affected tooth, with 63 cases (31.5%). Following closely, the 1st molar exhibited a prevalence of 53 cases (26.5%). The subsequent analysis encompassed other dental components, including 2nd premolars (21 cases, 10.5%), 3rd molars (37 cases, 18.5%), 1st premolars (14 cases, 7%), and canines (12 cases, 6%).

3.3. Distribution of Dental Pathologies

A thorough exploration of dental pathologies and their distribution in relation to specific teeth types was conducted (Table 1). Among the spectrum of pathologies, abscesses were notably prevalent, constituting 76 cases (38% of total cases). This pathology exhibited a significant presence in the 2nd molar (20 cases) and 1st molar (20 cases). Chronic periodontitis emerged as another significant pathology, with a representation of 33 cases (16.5%). The highest instances were associated with the 2nd molar (15 cases) and 1st molar (13 cases). Periapical granuloma, a distinct pathology, was identified in 60 cases (30%). This condition primarily affected the 2nd molar (28 cases) and 1st molar (20 cases). Notably, odontogenic cysts were observed in 10 cases (5%), predominantly impacting the 3rd molar (3 cases).

Table 1. Distribution of the lesions in relation to the teeth

Type of disease	Periapical granuloma	Chronic periodontitis	Abscess	Cysts	Impaction
No. of cases	60	33	76	10	21
Percentage %	30.0	16.5	38.0	5.0	10.5
Upper canine	0	0	5	3	4
1st premolar	3	0	5	1	5
2nd premolar	7	3	8	3	0
1st molar	20	13	20	0	0
2nd molar	28	15	20	0	0

Tooth impaction contributed to 21 cases (10.5%), primarily involving the 2nd molar.

3.4. Impact of Dental Pathologies on Maxillary Sinus

The relationship between dental pathologies and their potential impact on the maxillary sinus was thoroughly investigated. Starting with the canine, the presence of periodontitis and periapical granuloma exhibited no discernible effect on the sinus. Similarly, abscesses in this tooth type did not lead to any observable sinus pathology. However, a notable case of odontogenic cyst involving the canine resulted in chronic sinusitis, as evident by sinus membrane thickening and CBCT imaging that showcased sinus perforation.

In the context of the 1st premolar, both periodontitis and periapical granuloma displayed no noticeable impact on the sinus. Abscesses in this tooth type did not contribute to sinus pathology. Moving to the 2nd premolar, the effects of dental pathologies were more varied. Periodontitis and periapical granuloma were associated with focal and localized thickening of the Schneiderian membrane in two cases. Conversely, abscesses involving the 2nd premolar did not present any sinus pathology. Of interest, an odontogenic cyst case led to the pushing of the sinus membrane and mild thickening.

In the case of the 1st molar, the impact of dental pathologies on the maxillary sinus was noteworthy. Periodontitis and periapical granuloma cases exhibited focal and localized thickening of the Schneiderian membrane, indicating a sinus-related effect. Intriguingly, abscesses in this tooth type did not show an impact on the sinus, with manifestations occurring primarily in the buccal vestibule. Odontogenic cysts, however, were not observed for the 1st molar, rendering the effect on the sinus non-applicable.

The 2nd molar exhibited diverse impacts on the maxillary sinus due to dental pathologies. Periodontitis and periapical granuloma cases resulted in thickening of the sinus membrane without clinical signs. Abscesses led to a range of effects, with a significant number of cases exhibiting normal sinuses, and a minority manifesting in the palate. No odontogenic cyst cases were observed in relation to the 2nd molar, leaving the effect on the sinus unexplored.

Lastly, the 3rd molar presented varying outcomes in terms of sinus impact. Periodontitis and periapical granuloma cases did not show any discernible effect on the sinus. Abscesses primarily led to normal sinus findings. Notably, odontogenic cyst cases were associated with focal thickening of the sinus membrane in two instances. In a separate case, the presence of an odontogenic cyst pushed the sinus toward the nose, resulting in a decrease in sinus size and exhibiting signs of chronic inflammation.

4. Discussion

The present study has investigated the intricate relationship between various dental pathologies and their impact on the maxillary sinus. It is noteworthy that the high prevalence of dental infections causing sinus infections is often linked to iatrogenic causes, including root displacement, dental material introduction, implant procedures, and sinus lifts [9]. However, this study uniquely explored the effect of distinct pathological lesions originating from upper teeth on the maxillary sinus. Our research cohort comprised 200 patients whose chief complaint was dental issues, yet they displayed no clinical signs of sinus infection, such as unilateral nasal discharge, headache, tenderness, or odor. We employed a comprehensive approach, combining patient history, clinical examination, and radiological assessments including peri-apical X-rays, panoramic radiographs (OPG), and in some cases, CBCT. This comprehensive evaluation frequently revealed chronic inflammation and thickening of the sinus membrane, a sign that holds diagnostic significance [12].

Our findings substantiated the prevailing notion that odontogenic infections, particularly granulomas, tend to be localized to the apical region of the involved tooth (Simuntis, Kubilius *et al.* 2014). Furthermore, the distinct behavior of pyogenic infections and abscesses is noteworthy, as they tend to manifest in the buccal vestibule due to the thinner bone in this region. The propensity for infection to spread to areas of least resistance leads to manifestations extending to the canine fossa, periorbital region, and buccal space, rather than direct sinus involvement.

Of significant interest is the impact of odontogenic cysts on the maxillary sinus. Gradual extension of cysts, particularly radicular cysts and dentigerous cysts, results in sinus floor elevation and a dome-shaped swelling

within the sinus cavity. Notably, larger cysts have the potential to compromise sinus function by narrowing or blocking the ostium, leading to chronic sinusitis—a recurring complaint among patients [16]. A notable case in our study involved a dentigerous cyst pushing the sinus membrane medially and causing buccal plate perforation. Surgical intervention through the Caldwell-Luc procedure successfully addressed this issue.

The observed 2.5% prevalence of sinus disease attributed to dental pathology is lower than in previous studies. This discrepancy can be attributed to stringent patient selection criteria, focusing solely on diseases with a dental source, excluding cases arising from iatrogenic and implant-related procedures. The high frequency of 2nd molars affecting the sinus is in concordance with existing literature [17].

Treatment strategies for odontogenic sinusitis encompass various considerations. Dental treatment should take precedence, involving source elimination and appropriate antibiotic administration [18]. When dental interventions prove insufficient, surgical approaches and endoscopy are viable options [19-22]. Collaboration among dentists, radiologists, and rhinologists is imperative to achieving comprehensive and effective management.

5. Conclusion

This study elucidated a 2.5% prevalence of maxillary sinus diseases originating from dental pathologies in a cohort of 200 patients. The research highlighted the gradual extension of dental conditions such as abscesses and granulomas towards the maxillary sinus, leading to radiographically observable changes even in asymptomatic cases. The crucial role of dental treatment as the primary approach for managing these conditions was underscored, emphasizing collaboration between dental and medical disciplines. This study's implications extend to clinical practice, advocating for heightened awareness and interdisciplinary cooperation. By deepening the understanding of dental-maxillary sinus interactions, the study contributes to refined diagnostics and optimized treatments, ultimately enhancing patient care and well-being.

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