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ODONTOGENIC SINUSITIS: CURRENT CONCEPTS IN DIAGNOSIS AND MULTIDISCIPLINARY MANAGEMENT

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ABSTRACT

Background: Odontogenic sinusitis (ODS) is an increasingly recognized subtype of maxillary sinusitis caused by dental infections or dental procedures. It accounts for approximately 25–40% of chronic maxillary sinusitis cases and up to 70% of unilateral sinonasal disease. Despite its high prevalence, ODS remains underdiagnosed because of its nonspecific clinical presentation and the frequent absence of overt dental symptoms.
Objective: This narrative review summarizes current evidence regarding the etiology, microbiology, diagnosis, and multidisciplinary management of ODS, with particular emphasis on the role of advanced imaging modalities and collaboration between dental and otolaryngology specialists.
Methods: A narrative literature review was conducted using PubMed and Google Scholar. English-language studies involving human subjects, including systematic reviews, retrospective studies, and prospective studies, were included. Additional information was obtained from authoritative textbooks in oral surgery, otolaryngology, and head and neck anatomy.
Results: The available evidence indicates that ODS most commonly results from periapical and periodontal infections or iatrogenic dental procedures, including implant placement and maxillary sinus augmentation. Accurate diagnosis requires correlation of clinical findings with nasal endoscopy and radiological imaging, particularly cone-beam computed tomography (CBCT). Successful management depends on elimination of the underlying odontogenic source combined with appropriate medical therapy and, when indicated, functional endoscopic sinus surgery (FESS). Current evidence supports a multidisciplinary approach as the cornerstone of effective treatment.
Conclusions: ODS represents a common yet frequently overlooked cause of sinonasal disease. Early recognition, comprehensive radiological assessment, and close cooperation between dentists and otolaryngologists are essential for accurate diagnosis and optimal patient outcomes. Further prospective studies are needed to establish standardized diagnostic and therapeutic protocols.

KEYWORDS

Odontogenic Sinusitis; Chronic Rhinosinusitis; Cone-Beam Computed Tomography; Functional Endoscopic Sinus Surgery; Dental Implants; Multidisciplinary Management

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Introduction

Odontogenic sinusitis (ODS) is a form of sinonasal mucosal inflammation resulting from dental infection or dental procedures (Craig et al., 2021). It accounts for approximately 25–40% of all cases of chronic maxillary sinusitis (Craig, 2022) and 48–70% of all unilateral paranasal sinus diseases (Ly & Hellgren, 2018; Matsumoto et al., 2015), making it an increasingly important clinical challenge.

The close anatomical relationship between the floor of the maxillary sinus and the apices of the maxillary posterior teeth provides a direct pathway for the spread of odontogenic infections. The most common causes of ODS include periapical lesions, periodontal disease, tooth extraction, maxillary sinus augmentation (sinus lift) procedures, and peri-implant inflammation (peri-implantitis) (Craig, 2022). Furthermore, the growing popularity of dental implant therapy has contributed to an increased incidence of ODS (Kim et al., 2022).

Despite growing awareness, the diagnosis of ODS remains challenging because its clinical presentation frequently overlaps with that of chronic rhinosinusitis (CRS). Although unilateral symptoms, cacosmia (perception of an unpleasant odor), purulent nasal discharge, and dental pain may suggest an odontogenic origin, many patients present without characteristic symptoms or a recent history of dental treatment (Little et al., 2018).

The aim of this review is to summarize the current evidence regarding the etiology, diagnosis, and contemporary management of ODS while emphasizing the importance of a multidisciplinary approach and close collaboration between dentists and otolaryngologists throughout the diagnostic and therapeutic process.

The aim of this narrative review is to summarize and critically evaluate the current evidence on odontogenic sinusitis, with particular emphasis on the importance of a multidisciplinary approach to its diagnosis and management. In addition, this review discusses the growing role of advanced imaging modalities, particularly cone-beam computed tomography (CBCT), in the diagnostic work-up of ODS and provides an overview of the clinical presentation and contemporary management of this increasingly recognized condition.

Methodology

This study was designed as a narrative literature review focused on the etiology, microbiology, diagnosis, and management of ODS.

A literature search was conducted using PubMed, Google Scholar databases. In addition to peer-reviewed journal articles retrieved from electronic databases, selected academic textbooks in otolaryngology, oral surgery, and head and neck anatomy were consulted to supplement background information regarding maxillary sinus anatomy and the terminology used in implantology procedures.

A targeted search was performed using combinations of the following keywords: “odontogenic sinusitis”, “odontogenic maxillary sinusitis”, “dental sinusitis”, “CBCT”, “FESS”, “dental implants”, “maxillary sinusitis”, “chronic rhinosinusitis”, “odontogenic sinusitis and treatment”.

Publications were included if they addressed: English-language articles, human studies, systematic reviews, retrospective studies, prospective studies. Exclusion criteria included animal studies, duplicate articles.

Articles were screened based on title, abstract, and full-text relevance.

Anatomy and pathophysiology

The maxillary sinus is the largest of the paranasal sinuses and represents an important anatomical structure in oral and maxillofacial surgery due to its close relationship with the maxilla and the posterior teeth of the upper dental arch. The maxillary sinus should be considered not only as an air-filled cavity of the facial skeleton but also as a structure directly involved in numerous dental surgical procedures and odontogenic pathological processes.

The maxillary sinus is located within the body of the maxilla and has a pyramidal shape. Its superior wall forms the orbital floor, while the medial wall is adjacent to the nasal cavity and contains the natural opening of the sinus into the middle nasal meatus. The anterior wall corresponds to the facial surface of the maxilla, whereas the posterior wall is related to the infratemporal region. The inferior wall, known as the sinus floor, is formed by the alveolar process of the maxilla and has the greatest clinical significance in relation to odontogenic infections.

The anatomical proximity between the maxillary sinus and the roots of maxillary posterior teeth represents a key factor determining the possibility of odontogenic spread. The roots of the second premolar, first molar, and second molar are frequently located close to the sinus floor. In some anatomical variations, the apices of these teeth may extend into the sinus cavity or may be separated from the Schneiderian membrane only by a very thin layer of bone.

The distance between the dental roots and the sinus floor is highly variable and depends on individual anatomical conditions, age, degree of sinus pneumatization, and changes associated with tooth loss or alveolar bone resorption. Increased pneumatization of the maxillary sinus may lead to thinning of the bony separation between the oral cavity and the sinus, increasing the risk of communication between dental tissues and the sinonasal cavity.

ODS develops as a consequence of the anatomical continuity between the structures of the oral cavity and the maxillary sinus. The close relationship between the apices of maxillary posterior teeth and the sinus floor creates a pathway through which infection originating from dental tissues can spread to the sinus mucosa.

The most common dental sources include periapical infections, complications of endodontic treatment, periodontal disease, dental extraction, implant placement, and procedures involving augmentation of the maxillary sinus. In particular, infections associated with maxillary molars are clinically significant due to their frequent anatomical proximity to the sinus floor.

The Schneiderian membrane, which lines the maxillary sinus, plays an important role in maintaining sinus function. When exposed to microorganisms originating from dental infections, this mucosa undergoes an inflammatory response characterized by edema, increased mucus secretion, and impairment of mucociliary clearance.

The development of ODS begins with the penetration of microorganisms and inflammatory mediators from infected dental tissues into the adjacent maxillary sinus. The inflammatory process initially affects the mucosa near the sinus floor and may subsequently involve larger areas of the sinus cavity.

Inflammation of the Schneiderian membrane results in mucosal thickening, disruption of normal mucociliary transport, and impaired drainage through the natural maxillary ostium. Because the maxillary sinus ostium is located superiorly on the medial wall, spontaneous drainage of inflammatory secretions is limited, which promotes persistence of infection.

Unlike primary rhinosinusitis, ODS is usually associated with bacterial flora originating from the oral cavity. The infection is commonly polymicrobial and includes anaerobic microorganisms characteristic of dental infections. Persistent exposure to these pathogens may result in chronic inflammatory changes, unilateral maxillary sinus disease, and recurrent symptoms if the dental source is not eliminated.

From a clinical perspective, understanding the anatomical relationship between the maxillary sinus and teeth is essential for correct diagnosis and treatment planning. Elimination of the dental cause represents a fundamental component of therapy, while treatment directed only toward sinonasal symptoms may lead to incomplete resolution of the disease.

In conclusion, the anatomical proximity of the maxillary sinus to the posterior maxillary teeth constitutes the primary anatomical prerequisite for the development of ODS. Variations in sinus anatomy, root position, and thickness of the bony separation determine individual susceptibility to the spread of odontogenic infection into the sinonasal region (Craig, 2022; Rahnama, 2024).

Etiology

Iatrogenic

In the majority of cases, ODS results from iatrogenic disruption of the sinus periosteum or the Schneiderian membrane, the thin mucosal lining of the maxillary sinus. Among dental procedures, dental implant placement and tooth extraction are associated with the highest risk of such injuries. Maxillofacial surgical procedures that may contribute to the development of ODS include orthognathic surgery, maxillary sinus floor augmentation (sinus lift) performed to improve bone volume before implant placement, and cleft palate repair (Little et al., 2018; Steinbacher, 2019; Yamamichi et al., 2011).

Periodontal disease and periapical lesion

Another major group of etiological factors comprises bacterial infections involving the dental and periodontal tissues, particularly periodontitis and periapical inflammatory lesions (Lechien et al., 2014). Bacteria colonize the necrotic pulp and root apex, leading to the formation of periapical granulomas or radicular cysts. The inflammatory process subsequently activates osteoclasts, resulting in resorption of the thin bony layer separating the root apex from the floor of the maxillary sinus. Once inflammation reaches the periosteum, the Schneiderian membrane, which is firmly attached to it, also becomes involved. Bacterial toxins impair ciliary function, thereby disrupting mucociliary clearance and reducing the active removal of mucus from the sinus. The retained mucus creates a favorable environment for bacterial proliferation, directly contributing to the development of maxillary sinus infection (Craig, 2022; Fokkens et al., 2020).

Others

Less common causes of ODS include odontogenic cysts, odontomas, ectopic teeth, and peri-implantitis (Lechien et al., 2014).

Table 1. The main etiological factors associated with ODS, based on (Craig, 2022; Fokkens et al., 2020; Lechien et al., 2014; Little et al., 2018; Steinbacher, 2019; Yamamichi et al., 2011).

Etiological group	Pathophysiological mechanism	Common examples
Iaotrogenic causes	Disruption of the Schneiderian membrane or sinus periosteum leading to bacterial contamination of the maxillary sinus	Dental implants, tooth extractions, sinus lift procedures, orthognathic surgery, cleft palate surgery
Periodontal and periapical disease	Spread of odontogenic infection through the thin bone separating dental roots from the maxillary sinus floor, resulting in inflammation of the Schneiderian membrane	Apical periodontitis, periodontal disease, periapical abscesses
Others	Direct or indirect inflammatory irritation of the maxillary sinus mucose	Odontogenic cysts, ectopic teeth, odontoma, peri-implantitis

Microbiology

Studies have demonstrated that the bacterial flora associated with ODS differs significantly from that observed in chronic rhinosinusitis (CRS). The prevalence of *Peptostreptococcus* and *Prevotella* species tends to be higher in ODS than in CRS, although these differences have not always reached statistical significance. In contrast, *Fusobacterium* species are isolated significantly more frequently in ODS, whereas *Staphylococcus aureus* is more commonly associated with CRS.

Recognition of these microbiological differences may facilitate more effective patient management, particularly with regard to selecting antimicrobial therapy targeting aerobic or anaerobic pathogens. Furthermore, differences in bacterial virulence and antimicrobial resistance profiles may influence disease progression and treatment outcomes (Kwiatkowska et al., 2026; Lu et al., 2024).

Diagnostics

The diagnosis of ODS is established through a combination of otolaryngological and dental assessment. Nasal endoscopy performed by an otolaryngologist should be complemented by identification of concomitant maxillary dental pathology by a dentist using appropriate imaging techniques described below (Craig, 2022).

Clinical symptoms

One of the most important clinical indicators suggestive of ODS is pain involving the maxillary teeth. Other common manifestations include unilateral facial pain or pressure, with unilateral presentation representing one of the strongest clinical features supporting an odontogenic origin. Additional symptoms include postnasal drainage, nasal mucosal congestion, anterior purulent nasal discharge, and unpleasant odor or taste (Fokkens et al., 2020).

However, clinicians should be aware that dental pain is frequently absent in patients with ODS or may occur without accompanying sinonasal symptoms, making the diagnosis considerably more challenging. Furthermore, fewer than half of patients diagnosed with ODS report a recent dental procedure at presentation. This observation is probably explained by the prolonged latency between the causative dental intervention and the onset of sinonasal symptoms, which averages approximately one year following sinus lift procedures and up to four years after implant-related ODS (Little et al., 2018).

Radiological findings

Both two-dimensional and three-dimensional imaging modalities are used in the diagnosis of ODS. Two-dimensional techniques include periapical radiography, panoramic radiography, and Waters' view radiography. Three-dimensional imaging comprises computed tomography (CT), cone-beam computed tomography (CBCT), and magnetic resonance imaging (MRI).

Two-dimensional imaging techniques are inexpensive, widely available, and easy to perform; however, they have important limitations. Superimposition of anatomical structures may obscure pathological findings, and periapical lesions generally need to reach a considerable size or perforate the cortical bone before becoming radiographically visible.

Three-dimensional imaging modalities, particularly CT and CBCT, provide a comprehensive assessment of the maxillary sinus by eliminating the problem of anatomical superimposition. These techniques allow evaluation of both osseous structures and the sinus mucosa, thereby increasing diagnostic accuracy, especially in complex cases. Particular attention has been directed toward CBCT because of its superior spatial resolution compared with other imaging modalities. Nevertheless, its principal limitation remains the relatively poor visualization of soft tissues. Additional studies specifically investigating the role of CBCT in the assessment of maxillary sinus disease are still required (Shahbazian & Jacobs, 2012; Vidal et al., 2017; Whyte & Boeddinghaus, 2019).

Importantly, the diagnosis of ODS should neither be established nor excluded solely on the basis of radiological findings, as studies have shown that pathological dental changes may remain undetected on computed tomography in as many as 60–70% of cases (Craig, 2022).

Table 2. Imaging modalities used in the diagnosis of ODS, based on (Shahbazian & Jacobs, 2012; Vidal et al., 2017; Whyte & Boeddinghaus, 2019).

Method	Advantages	Disadvantages	Clinical usefulness
Periapical radiography	Low cost, availability	Limited field of view	Initial dental evaluation
Panoramic radiography	Broad overview	Low sensitivity	Screening
CT	Appropriate sinus assessment	Higher radiation dose	Sinonasal evaluation
CBCT	Higher spatial resolution	Limited soft tissue assessment	Preferred modality in ODS

Nasal endoscopy

Nasal endoscopy is a valuable diagnostic tool in patients with suspected ODS. Typical endoscopic findings include mucopurulent discharge and mucosal edema within the middle nasal meatus, into which the maxillary sinus drains, as well as inflammatory secretions originating directly from the affected sinus (Kwiatkowska et al., 2024).

Treatment

Management of ODS requires a multidisciplinary approach involving close collaboration between an otolaryngologist and a dentist or oral and maxillofacial surgeon. Successful treatment depends on addressing both the sinonasal inflammation and the underlying dental source of infection. Therefore, pharmacological therapy should be combined with appropriate dental and, when indicated, surgical intervention.

Pharmacotherapy

Antibiotic therapy remains an important component of ODS management. However, evidence from small clinical studies indicates that antibiotic treatment alone results in complete resolution in only 15–20% of patients (Newsome & Poetker, 2020). In a retrospective study conducted by Zirk et al., treatment outcomes were analyzed in 121 patients with ODS who underwent both surgical intervention and antibiotic therapy. The highest rates of bacterial susceptibility were observed for piperacillin/tazobactam (93.9%), followed by

moxifloxacin (86.2%), trimethoprim-sulfamethoxazole (83.3%), ampicillin/sulbactam (80.0%), cefotaxime (78.1%), cefuroxime (69.4%), ampicillin (68.0%), tetracycline (62.9%), ciprofloxacin (62.2%), and clindamycin (50.0%) (Zirk et al., 2017).

Current recommendations advocate amoxicillin or amoxicillin-clavulanate as first-line antimicrobial therapy. In patients with penicillin allergy, moxifloxacin or levofloxacin should be considered as alternative treatment options (Albu & Roman, 2025).

Adjunctive pharmacological management includes intranasal corticosteroids, topical nasal decongestants, and saline nasal irrigation to improve mucosal function and facilitate drainage of inflammatory secretions (Rangics et al., 2023).

Dental treatment

Dental management aims primarily at eliminating the odontogenic source of infection. Depending on the underlying pathology, treatment may include endodontic therapy, apicoectomy, or extraction of the affected tooth. Oroantral fistulas are managed either by closure with local mucosal flaps or by surgical excision of the pathological tissue followed by primary closure of the defect. In contrast, peri-implantitis is generally managed conservatively (Martu et al., 2022; Newsome & Poetker, 2020).

Whether dental treatment alone is sufficient in ODS remains controversial. Although isolated dental intervention may be adequate when inflammation is confined to the periapical region or surrounding periodontal tissues, combined sinonasal surgery is recommended in patients presenting with oroantral fistulas, foreign bodies within the maxillary sinus (e.g., retained tooth roots or fractured endodontic instruments), or odontogenic cysts (Martu et al., 2022; Newsome & Poetker, 2020).

Surgical treatment

Oroantral fistulas are typically repaired using a buccal flap or by surgical excision of the pathological tissue followed by primary closure of the defect.

Functional Endoscopic Sinus Surgery (FESS) is currently regarded as the standard surgical treatment for ODS. During the procedure, the otolaryngologist introduces an endoscope into the nasal cavity and identifies the natural maxillary ostium within the middle nasal meatus. An antrostomy is subsequently performed to enlarge the natural sinus opening by removing inflamed mucosa and, when necessary, adjacent pathological bone. The widened opening allows insertion of microsurgical instruments to evacuate retained purulent secretions and remove inflammatory polyps or foreign bodies, including retained root fragments (Craig, 2022; Martu et al., 2022).

Current evidence suggests that the greatest therapeutic benefit may be achieved by performing FESS simultaneously with the necessary dentoalveolar surgical procedure. Nevertheless, further prospective studies are required to establish standardized protocols for this combined treatment strategy (Rangics et al., 2023).

One study evaluating ODS following sinus lift procedures suggested that removal of the dental implant responsible for the inflammatory process may not always be necessary. Conservative management combined with FESS may be sufficient in selected patients (Jiam et al., 2017).

Dental or surgical treatment first?

The optimal sequence of treatment remains a matter of debate.

One study suggested that primary dental treatment should be considered in patients with ODS secondary to periapical abscesses or dental caries. In contrast, patients who smoke or present with extensive sinonasal disease on computed tomography may benefit from FESS as the initial therapeutic intervention (Yoo et al., 2021).

Conversely, other authors have proposed that surgical management should constitute the first-line treatment for ODS (Wang et al., 2015).

Because both recommendations are based on studies with relatively small patient populations, further well-designed prospective investigations are required to determine the optimal treatment sequence and develop evidence-based management algorithms.

Discussion

ODS has emerged as a distinct clinical entity that accounts for a substantial proportion of unilateral maxillary sinus disease. The available evidence indicates that ODS is considerably more common than previously recognized, yet it remains frequently underdiagnosed due to its nonspecific clinical presentation and the overlap of symptoms with chronic rhinosinusitis (CRS). Consequently, accurate diagnosis requires not only awareness of its dental origin but also close collaboration between otolaryngologists and dental specialists.

One of the major challenges in the management of ODS is the delayed recognition of its odontogenic source. Although unilateral facial pain, purulent nasal discharge, cacosmia, and maxillary tooth pain may suggest a dental etiology, these manifestations are often absent or occur long after the causative dental procedure. Previous studies have demonstrated that a considerable proportion of patients do not report recent dental treatment, particularly following implant placement or maxillary sinus augmentation, where symptom onset may be delayed by several months or even years. This latency contributes to diagnostic delays and increases the risk of chronic inflammatory changes within the sinonasal cavity.

The present review also highlights the crucial role of radiological imaging in the diagnostic work-up of ODS. Conventional two-dimensional radiographs remain useful as an initial assessment tool; however, their limited sensitivity and superimposition of anatomical structures reduce their diagnostic value. Three-dimensional imaging modalities, particularly cone-beam computed tomography (CBCT), provide superior visualization of the relationship between dental structures and the maxillary sinus while enabling detailed evaluation of periapical pathology and sinus floor anatomy. Nevertheless, imaging findings should always be interpreted in conjunction with clinical examination and nasal endoscopy, as radiological abnormalities alone are insufficient to establish or exclude the diagnosis of ODS.

Another important aspect concerns the microbiological differences between ODS and CRS. Unlike rhinogenic sinusitis, odontogenic infections are typically polymicrobial and predominantly involve anaerobic bacteria originating from the oral cavity. Recognition of these microbiological characteristics is clinically relevant because it supports the selection of appropriate empirical antibiotic therapy while emphasizing that pharmacological treatment alone is rarely curative. Elimination of the underlying odontogenic source remains the cornerstone of successful management.

The reviewed literature consistently supports a multidisciplinary treatment strategy. Depending on the underlying cause, management may include endodontic treatment, tooth extraction, surgical closure of oroantral communications, or treatment of peri-implant disease. In patients presenting with persistent sinonasal inflammation, functional endoscopic sinus surgery (FESS) effectively restores physiological drainage and facilitates removal of inflammatory tissue and retained secretions. Increasing evidence suggests that combined dental and endoscopic surgical treatment performed during the same therapeutic stage may improve patient outcomes, although standardized treatment algorithms have not yet been established.

Despite considerable advances in understanding the pathophysiology and management of ODS, several limitations remain. Most available evidence originates from retrospective studies and relatively small patient cohorts, while prospective multicenter investigations are scarce. Furthermore, no universally accepted diagnostic criteria or treatment protocols currently exist, leading to variability in clinical practice among both dental and otolaryngological specialists.

Future research should focus on the development of standardized multidisciplinary diagnostic pathways, validation of imaging protocols incorporating CBCT, optimization of antibiotic stewardship based on microbiological findings, and prospective evaluation of different treatment strategies. High-quality comparative studies are particularly needed to determine the optimal sequence and timing of dental intervention and endoscopic sinus surgery.

Overall, the available evidence indicates that successful management of ODS depends on early recognition of its dental origin, comprehensive radiological assessment, and coordinated multidisciplinary care. Greater awareness of this condition among both dentists and otolaryngologists may contribute to earlier diagnosis, more effective treatment, and improved long-term patient outcomes.

Conclusions

Odontogenic sinusitis (ODS) is being increasingly recognized among patients presenting with sinonasal symptoms, particularly those involving the maxillary sinus. Current evidence suggests that ODS may account for approximately 48–70% of all cases of unilateral paranasal sinus disease.

The diagnosis of ODS remains challenging because of the frequent absence of characteristic clinical manifestations, including dental pain, as well as the often prolonged interval between the causative dental procedure and the onset of sinonasal symptoms. Consequently, accurate diagnosis requires a multidisciplinary approach and close collaboration between otolaryngologists and dental specialists throughout the diagnostic and therapeutic process.

Advanced three-dimensional imaging techniques, particularly cone-beam computed tomography (CBCT), have the potential to improve the detection and diagnostic accuracy of odontogenic sinusitis. Nevertheless, further prospective studies and the development of standardized diagnostic and treatment protocols are required to optimize clinical decision-making and establish evidence-based management strategies for ODS.

The authors declare that they have no conflict of interest.

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All authors contributed to the study conception, literature review, and manuscript preparation. All authors read and approved the final version of the manuscript.

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