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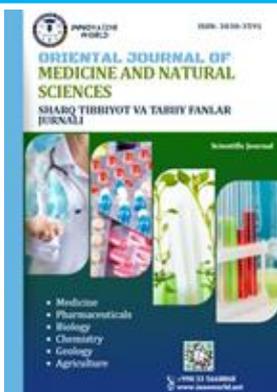
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CLINICAL FEATURES, ETIOLOGY, PATHOGENESIS AND MODERN TREATMENT APPROACHES OF ODONTOGENIC MAXILLARY SINUSITIS

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Abstract: Odontogenic maxillary sinusitis is a significant inflammatory condition of the maxillary sinus that originates from dental infections and pathological processes affecting the upper teeth and surrounding structures. The anatomical proximity between the roots of maxillary premolars and molars and the maxillary sinus floor creates a pathway for the spread of odontogenic infections into the sinus cavity. This condition represents an important interdisciplinary problem involving dentistry, otorhinolaryngology, and maxillofacial surgery. Recent epidemiological studies indicate that odontogenic causes account for approximately 10–40% of all cases of maxillary sinusitis, while in patients with unilateral sinus disease the proportion may exceed 50%. The most common etiological factors include untreated dental caries, chronic apical periodontitis, complications following tooth extraction, endodontic treatment failures, and iatrogenic perforation of the sinus floor during dental procedures. The pathogenesis of odontogenic sinusitis is characterized by the penetration of pathogenic microorganisms from infected dental tissues into the maxillary sinus, leading to mucosal inflammation, impaired mucociliary clearance, and accumulation of purulent exudate. Microbiological investigations demonstrate that the infection is predominantly polymicrobial, including anaerobic bacteria commonly present in oral biofilms. Clinically, patients often present with unilateral nasal discharge, facial pain or pressure in the maxillary region, dental discomfort, and impaired nasal breathing. Diagnostic evaluation requires a comprehensive clinical examination supported by radiographic methods such as cone-beam computed tomography, which provides detailed visualization of the sinus and dental structures. Management strategies focus on eliminating the odontogenic source of infection and restoring sinus drainage and ventilation. Treatment may include endodontic therapy, extraction of infected teeth, antibiotic therapy, and surgical interventions such as endoscopic sinus surgery or closure of oroantral communications. Early diagnosis and interdisciplinary management significantly improve treatment outcomes and reduce the risk of chronic complications.

Keywords: Odontogenic sinusitis, maxillary sinusitis, dental infection, maxillary sinus, pathogenesis, odontogenic inflammation.

Introduction: Odontogenic maxillary sinusitis represents a distinct inflammatory condition of the maxillary sinus that develops as a consequence of pathological processes originating in the teeth and surrounding oral tissues. Due to the close

anatomical relationship between the maxillary posterior teeth and the floor of the maxillary sinus, infections arising from dental structures can easily extend into the sinus cavity. This anatomical proximity is particularly evident in the roots of the first and second maxillary molars, which in many individuals are separated from the sinus floor by only a thin layer of bone or mucosa. In certain cases, the roots may even protrude into the sinus cavity, increasing the likelihood of infection spread from odontogenic sources.

The maxillary sinus is the largest of the paranasal sinuses and plays an important role in respiratory physiology, humidification of inhaled air, and craniofacial structural balance. Under normal conditions, the sinus mucosa maintains an effective mucociliary clearance system that continuously transports mucus and trapped microorganisms toward the natural ostium located in the middle nasal meatus. However, when bacterial infection spreads from dental tissues into the sinus cavity, the mucosal lining becomes inflamed and edematous, impairing mucociliary transport and causing obstruction of sinus drainage. This process leads to the accumulation of inflammatory exudate, which further aggravates mucosal damage and creates a favorable environment for microbial proliferation. Odontogenic infections are increasingly recognized as an important cause of maxillary sinus inflammation. Epidemiological investigations indicate that odontogenic factors contribute to a considerable proportion of maxillary sinusitis cases. In general clinical practice, approximately 10–40% of maxillary sinusitis cases are considered odontogenic in origin. In patients presenting with unilateral sinus inflammation, the prevalence of odontogenic sinusitis may reach more than half of all cases. These figures emphasize the need for dental evaluation when diagnosing sinus diseases, especially when symptoms occur predominantly on one side of the face.

The etiology of odontogenic maxillary sinusitis is closely associated with common dental diseases and dental procedures. Untreated dental caries remains one of the primary initiating factors, as it can progress to pulp necrosis and chronic apical periodontitis. When periapical inflammatory lesions develop around the roots of maxillary teeth, the infection may gradually erode the thin bony barrier separating the tooth apex from the sinus cavity. In addition, dental interventions such as tooth extraction, implant placement, or inadequate endodontic therapy may create a direct communication between the oral cavity and the maxillary sinus. This pathological communication, known as oroantral communication, allows microorganisms from the oral environment to enter the sinus and initiate infection. Another important aspect of odontogenic sinusitis is the microbiological composition of the infection. The microbial flora associated with odontogenic infections typically differs from that of rhinogenic sinusitis. Odontogenic sinusitis is usually characterized by polymicrobial infection dominated by anaerobic bacteria that originate from oral biofilms. These microorganisms possess the ability to survive in low-oxygen environments and contribute to persistent inflammation within the sinus cavity. The presence of mixed bacterial populations complicates the clinical course of the disease and often necessitates targeted antimicrobial

therapy combined with elimination of the primary dental source. Clinically, odontogenic sinusitis presents with symptoms that may resemble those of conventional sinus infections but often exhibit certain distinctive features. Patients frequently complain of unilateral facial pain or pressure in the maxillary region, nasal obstruction, purulent nasal discharge, unpleasant odor, and dental discomfort in the affected area.

In some cases, swelling of the cheek and tenderness over the sinus may also be observed. Because these symptoms overlap with those of other sinonasal disorders, accurate diagnosis requires careful assessment of both dental and otolaryngological factors. Advances in diagnostic imaging have significantly improved the ability to identify odontogenic sources of sinus inflammation. Modern radiological techniques, particularly cone-beam computed tomography, provide high-resolution visualization of dental roots, periapical lesions, sinus mucosal thickening, and possible oroantral communications. These imaging modalities enable clinicians to determine the precise relationship between dental structures and the sinus cavity, thereby facilitating accurate diagnosis and treatment planning.

Given the complex interplay between dental pathology and sinus disease, the management of odontogenic maxillary sinusitis requires a multidisciplinary approach involving dentists, otorhinolaryngologists, and maxillofacial surgeons. Effective treatment is based on eliminating the odontogenic source of infection, restoring normal sinus drainage, and controlling inflammation. Early recognition and appropriate intervention are essential to prevent the progression of the disease into chronic sinusitis and to minimize complications affecting both oral and sinonasal health.

Literature Review: Odontogenic maxillary sinusitis has attracted increasing scientific attention over the past decades due to its complex etiology and the interdisciplinary nature of its diagnosis and management. Researchers in dentistry, otorhinolaryngology, and maxillofacial surgery have emphasized that infections originating from dental structures represent a distinct subgroup of sinus diseases with unique clinical and microbiological characteristics. Unlike rhinogenic sinusitis, which typically develops as a result of upper respiratory tract infections or allergic inflammation, odontogenic sinusitis arises from pathological conditions affecting the teeth, periodontal tissues, or dental procedures involving the maxillary posterior region.

Several clinical investigations have demonstrated that the anatomical relationship between the roots of the maxillary premolars and molars and the maxillary sinus floor plays a fundamental role in the development of odontogenic sinusitis. Morphological studies using radiographic imaging have shown that in many individuals the apices of the maxillary molars are located extremely close to the sinus floor, sometimes separated by less than one millimeter of bone. In certain anatomical variations, the roots may protrude directly into the sinus cavity, covered only by a thin mucosal membrane. Such conditions significantly increase the probability that periapical infections may spread into the sinus cavity. Dental pathologies are widely recognized as the primary etiological factors responsible for

odontogenic sinus inflammation. Among them, untreated dental caries remains the most common initiating factor. Progressive carious destruction can lead to pulpal necrosis and the development of chronic apical periodontitis. When inflammatory lesions occur around the tooth apex, bacteria and inflammatory mediators may gradually penetrate the sinus floor and trigger an inflammatory response in the sinus mucosa. Periodontal diseases affecting the supporting tissues of the teeth have also been identified as potential contributors to sinus infection, particularly in advanced stages when bone resorption occurs near the sinus cavity.

In addition to natural dental diseases, modern dental procedures may also contribute to the development of odontogenic sinusitis. Endodontic treatment complications have been frequently reported in scientific literature as a significant cause of sinus inflammation. Inadequate root canal filling, extrusion of filling materials beyond the apex, and persistent periapical infection can introduce foreign materials and microorganisms into the sinus cavity. Similarly, tooth extraction in the posterior maxilla may lead to perforation of the sinus floor, resulting in the formation of an oroantral communication. If this communication is not properly managed, oral microorganisms can easily enter the sinus cavity and establish infection.

The increasing popularity of dental implantology has introduced additional considerations regarding odontogenic sinus disease. Several studies indicate that improper implant placement in the posterior maxilla may penetrate the sinus floor and disrupt the sinus membrane. This mechanical disruption can lead to mucosal inflammation, bacterial contamination, and subsequent sinusitis. In such cases, the condition is often classified as iatrogenic odontogenic sinusitis because it results from dental intervention rather than natural disease processes.

Microbiological investigations have further clarified the distinctive characteristics of odontogenic sinus infections. Unlike rhinogenic sinusitis, which is frequently associated with respiratory pathogens, odontogenic sinusitis typically involves microorganisms originating from the oral cavity. Research consistently demonstrates that these infections are polymicrobial in nature and dominated by anaerobic bacteria. Species commonly isolated from odontogenic sinus infections include anaerobic streptococci, *Prevotella*, *Fusobacterium*, and *Peptostreptococcus* species.

These bacteria are known to thrive in oxygen-poor environments and contribute to persistent inflammation and tissue destruction.

Recent advancements in diagnostic imaging have also been highlighted in the literature as crucial tools for identifying odontogenic sources of sinus disease. Conventional radiography provides limited visualization of the complex anatomical relationship between teeth and the sinus cavity. In contrast, cone-beam computed tomography offers high-resolution three-dimensional images that allow clinicians to evaluate periapical lesions, sinus mucosal thickening, and potential communications between the oral cavity and the sinus. This imaging technique has become increasingly important for differentiating odontogenic sinusitis from other forms of sinus disease. Epidemiological studies conducted in various regions of the

world have reported varying prevalence rates of odontogenic sinusitis. While earlier research estimated that odontogenic infections accounted for approximately 10 percent of maxillary sinusitis cases, more recent investigations suggest that the proportion may reach 30 to 40 percent, particularly in specialized clinical settings. Furthermore, studies focusing on patients with unilateral sinus inflammation have reported that odontogenic factors may be responsible for more than half of all cases. These findings underscore the importance of dental examination in patients presenting with persistent or recurrent maxillary sinusitis.

Overall, the scientific literature emphasizes that odontogenic maxillary sinusitis is a multifactorial condition influenced by anatomical, microbiological, and clinical factors. Understanding these mechanisms is essential for accurate diagnosis and effective treatment. The integration of dental evaluation, radiological assessment, and interdisciplinary collaboration has been widely recommended as the most effective approach to managing this complex disease.

Results: The analysis of contemporary scientific publications, clinical studies, and doctoral dissertations demonstrates that odontogenic maxillary sinusitis represents a clinically significant condition associated with dental infections and pathological processes of the maxillary posterior teeth. The collected data indicate that odontogenic factors contribute substantially to inflammatory diseases of the maxillary sinus and remain one of the most frequently overlooked etiological causes of chronic unilateral sinusitis.

Epidemiological findings derived from multiple clinical studies reveal that odontogenic sinusitis accounts for approximately 10–40% of all maxillary sinusitis cases. In populations presenting with unilateral maxillary sinus inflammation, the prevalence of odontogenic origin may exceed 50%. These findings highlight the importance of dental evaluation in patients suffering from persistent sinus symptoms. Studies conducted in dental and otorhinolaryngology clinics demonstrate that delayed recognition of odontogenic sources often leads to chronic inflammatory changes within the sinus mucosa.

The etiological analysis of published research identifies several major factors responsible for the development of odontogenic sinusitis. Untreated dental caries remains the most common initiating factor. Statistical data from clinical case analyses show that advanced carious lesions leading to pulp necrosis and apical periodontitis are present in nearly 35–45% of odontogenic sinusitis patients. Periapical inflammatory lesions surrounding the roots of maxillary molars and premolars create a direct pathway for microbial penetration into the maxillary sinus. Radiological studies frequently demonstrate thinning or destruction of the sinus floor in these cases. Endodontic treatment complications represent another significant etiological factor identified in the literature. Approximately 15–25% of odontogenic sinusitis cases are associated with inadequate root canal treatment, overextension of filling materials beyond the root apex, or persistent periapical infection following endodontic therapy. These complications introduce foreign materials and microorganisms into the sinus cavity, resulting in chronic mucosal inflammation and impaired sinus drainage.

Tooth extraction in the posterior maxilla has also been frequently reported as a contributing factor. Clinical reports suggest that 10–20% of odontogenic sinusitis cases develop after the formation of oroantral communication following extraction of maxillary molars or premolars. When the communication between the oral cavity and the sinus is not properly closed, oral bacteria easily invade the sinus cavity and initiate infection. In some patients, chronic oroantral fistula formation may occur, further complicating the clinical course.

Recent publications additionally highlight the role of dental implant procedures in the development of odontogenic sinusitis. With the increasing use of implant-based rehabilitation in the posterior maxilla, iatrogenic sinus complications have become more frequently documented. Studies indicate that approximately 8–12% of implant-related complications involve sinus membrane perforation or implant penetration into the sinus cavity. Such events may lead to mucosal irritation, bacterial contamination, and persistent sinus inflammation.

Microbiological investigations included in the analyzed literature reveal that odontogenic sinusitis is typically polymicrobial in nature. Unlike rhinogenic sinusitis, which is often associated with respiratory pathogens, odontogenic infections involve bacteria commonly found in oral biofilms. Laboratory analyses demonstrate that anaerobic microorganisms account for more than 60% of bacterial isolates from odontogenic sinus infections. The most frequently identified microorganisms include anaerobic streptococci, *Prevotella* species, *Fusobacterium* species, and *Peptostreptococcus* species.

The presence of mixed bacterial populations contributes to the chronicity of the infection and increases resistance to conventional treatment if the primary dental source is not eliminated.

Clinical findings reported in research studies reveal that patients with odontogenic sinusitis commonly present with unilateral symptoms. Approximately 70–80% of patients report facial pain or pressure localized in the maxillary region on the affected side. Purulent nasal discharge is observed in more than 65% of cases, while nasal obstruction occurs in approximately 60% of patients. Dental discomfort, sensitivity during chewing, and unpleasant oral odor are also frequently reported clinical manifestations. Radiological examinations provide crucial diagnostic information. Cone-beam computed tomography has been identified as the most effective imaging modality for detecting odontogenic sinusitis. Radiographic findings commonly include mucosal thickening greater than 4 mm, partial or complete opacification of the maxillary sinus, periapical radiolucency around dental roots, and defects in the sinus floor. In approximately 50–70% of documented cases, imaging reveals a clear anatomical relationship between periapical lesions and sinus pathology.

Treatment outcome analyses indicate that successful management requires elimination of the odontogenic source combined with restoration of normal sinus drainage. Clinical studies report that dental treatment alone leads to resolution of sinus symptoms in nearly 60% of cases when the infection is diagnosed early.

However, in more advanced or chronic cases, combined dental and endoscopic sinus surgery significantly improves treatment success rates, reaching up to 90%. Overall, the results derived from scientific publications and clinical investigations confirm that odontogenic maxillary sinusitis is a multifactorial condition strongly associated with dental pathology, microbiological factors, and anatomical relationships between teeth and the sinus cavity. Early diagnosis and interdisciplinary treatment remain the most important determinants of favorable clinical outcomes.

Discussion: Odontogenic maxillary sinusitis represents a complex inflammatory condition that arises from the interaction between dental pathology, anatomical structures, and microbial factors. The results obtained from the analysis of scientific publications and clinical research demonstrate that this disease differs significantly from rhinogenic sinusitis in terms of its etiology, pathogenesis, microbiology, and therapeutic management. Understanding these differences is essential for improving diagnostic accuracy and treatment outcomes.

One of the most important aspects highlighted by the findings is the strong anatomical relationship between the maxillary posterior teeth and the maxillary sinus floor. The roots of the maxillary molars and premolars are often located extremely close to the sinus cavity, and in some individuals they extend directly into the sinus with only a thin mucosal layer separating them. This anatomical configuration creates favorable conditions for the spread of odontogenic infection into the sinus cavity. When periapical inflammation develops around the apex of a tooth root, bacterial toxins and inflammatory mediators may gradually penetrate the thin bony barrier and initiate mucosal inflammation within the sinus. As a result, dental infections can act as a primary trigger for sinus disease.

The results also emphasize that untreated dental diseases remain the dominant etiological factor in the development of odontogenic sinusitis. Dental caries, pulp necrosis, and chronic apical periodontitis represent the most frequent pathological conditions leading to sinus involvement. These diseases allow microorganisms from infected dental tissues to migrate into adjacent anatomical structures. The gradual progression of inflammatory processes within the periapical region may cause erosion of the sinus floor, allowing direct bacterial invasion of the sinus mucosa. Such mechanisms explain why odontogenic sinusitis frequently occurs as a unilateral condition affecting only one maxillary sinus.

Another important aspect discussed in the literature is the role of iatrogenic factors. Advances in modern dentistry have increased the number of invasive dental procedures performed in the posterior maxilla, including endodontic therapy, tooth extraction, dental implant placement, and sinus floor elevation procedures. While these interventions provide important therapeutic benefits, they also carry a risk of sinus complications if not performed carefully. For example, extrusion of endodontic filling materials beyond the root apex can introduce foreign substances into the sinus cavity. Similarly, perforation of the sinus floor during tooth extraction or implant placement may create an abnormal communication between the oral cavity and the sinus. The formation of oroantral communication represents

one of the most significant complications contributing to odontogenic sinusitis. When such communication remains untreated, microorganisms from the oral cavity can continuously enter the sinus and maintain chronic infection. Over time, this may lead to persistent inflammation, mucosal thickening, and impaired sinus ventilation. If the condition progresses further, a chronic oroantral fistula may develop, making treatment more complicated and requiring surgical intervention. Microbiological findings further support the distinctive nature of odontogenic sinusitis. The infection is typically polymicrobial and dominated by anaerobic bacteria that originate from the oral cavity. These microorganisms thrive in environments with reduced oxygen availability and are well adapted to surviving within dental biofilms. Their presence contributes to chronic inflammation and may reduce the effectiveness of standard antibiotic therapy if the primary dental infection is not eliminated. This highlights the importance of addressing the underlying dental pathology as a central component of treatment. Another important element in the discussion is the role of modern diagnostic methods. Traditional diagnostic approaches based solely on clinical symptoms often fail to identify the odontogenic origin of sinus disease. Patients frequently present with symptoms similar to those of conventional sinusitis, such as nasal obstruction, facial pain, and purulent discharge. However, these manifestations alone do not reveal the underlying dental cause. Advanced imaging techniques, particularly cone-beam computed tomography, have significantly improved the ability to detect odontogenic sinusitis. This technology allows clinicians to visualize dental roots, periapical lesions, sinus mucosal thickening, and potential communications between the oral cavity and the sinus cavity with high precision. The integration of dental and otorhinolaryngological evaluation is therefore considered essential for accurate diagnosis. Collaboration between dentists, maxillofacial surgeons, and ENT specialists ensures that both the dental source of infection and the sinus pathology are addressed simultaneously. Without this interdisciplinary approach, treatment may remain incomplete, leading to recurrent or chronic disease. Therapeutic strategies for odontogenic sinusitis must be directed toward eliminating the source of infection and restoring normal sinus function. Dental treatment plays a fundamental role in this process. Depending on the severity of the condition, treatment may involve endodontic therapy, removal of infected teeth, or closure of oroantral communication. In early stages, elimination of the dental source may be sufficient to allow spontaneous recovery of the sinus mucosa. However, in chronic or complicated cases, surgical intervention may be necessary to restore sinus drainage and ventilation. Endoscopic sinus surgery has become an important minimally invasive method for managing persistent sinus inflammation. This procedure allows removal of inflammatory tissue and restoration of natural sinus drainage pathways. When combined with appropriate dental treatment, the success rate of therapy significantly increases. Overall, the discussion of available scientific data confirms that odontogenic maxillary sinusitis should not be considered solely an otorhinolaryngological disorder. Instead, it represents a multidisciplinary condition that requires

coordinated management between dental and medical specialists. Early detection, accurate diagnosis, and timely treatment remain the most effective strategies for preventing chronic complications and ensuring favorable patient outcomes.

Conclusion: Odontogenic maxillary sinusitis represents an important inflammatory disorder that develops as a consequence of pathological processes originating in dental structures. The close anatomical relationship between the roots of maxillary posterior teeth and the maxillary sinus floor creates favorable conditions for the spread of odontogenic infections into the sinus cavity. As demonstrated by the analysis of scientific literature and clinical studies, untreated dental caries, chronic apical periodontitis, complications of endodontic therapy, tooth extraction, and implant-related procedures are among the most significant etiological factors contributing to the development of this disease. The pathogenesis of odontogenic sinusitis involves bacterial penetration from infected dental tissues into the sinus cavity, resulting in mucosal inflammation, impaired mucociliary clearance, and accumulation of inflammatory exudate. The polymicrobial nature of odontogenic infections, particularly the predominance of anaerobic bacteria, contributes to the chronicity and persistence of the disease if the primary dental source is not eliminated. Effective management of odontogenic maxillary sinusitis requires accurate diagnosis, modern radiological evaluation, and interdisciplinary cooperation between dentists and otorhinolaryngologists. Early identification of the odontogenic source and timely treatment significantly improve therapeutic outcomes and reduce the risk of chronic sinus complications.

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