

Odontogenic sinusitis – main etiological factors



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Abstract

Introduction: Odontogenic sinusitis is an inflammatory process that occurs after the Schneiderian membrane is perforated as a result of a natural or iatrogenic cause of dental origin. Odontogenic sinusitis goes by various names in the literature, but the preferred ones are "odontogenic sinusitis"; or "maxillary sinusitis of dental origin". This disease has been known to medicine for more than a century. However, recent data indicate that its prevalence is increasing year by year.

Nowadays, otolaryngologists identify odontogenic sinusitis as a prevalent, but frequently misdiagnosed illness, and the association between tooth infections and maxillary sinusitis is well documented.

Therefore, dentists need to be familiar with the etiologies most commonly associated with odontogenic sinusitis in order to provide the correct diagnosis and treatment for their patients.

Aim: The purpose of this article is to summarize the most common etiologic factors associated with the development of odontogenic sinusitis.

Discussion: Odontogenic sinusitis is an inflammatory process that occurs after the Schneiderian membrane is perforated as a result of a natural or iatrogenic cause of dental origin (1, 2, 3). Odontogenic sinusitis goes by various names in the literature, but the preferred ones are "odontogenic sinusitis" or "maxillary sinusitis of dental origin", as endodontic and periodontal diseases are considered the most common etiological factors associated with the development of odontogenic sinusitis. These are followed by iatrogenic causes related to dentists' surgical interventions (3, 4).

This disease has been known in medicine for more than 100 years and accounts for 10-12% of maxillary sinusitis cases (1, 5, 6, 7). Recent data, however, show that its prevalence rate is increasing every year (8, 9).

Nowadays, dentists and otolaryngologists work together with a common goal – the correct diagnosis and treatment of this disease. Specialists need to be well versed in both the differential diagnosis of odontogenic sinusitis and the most common odontogenic etiologic factors associated with it (10, 11, 12).

Conclusion: Odontogenic sinusitis is a widespread disease. Literature sources often refer to it as an "underestimated disease". Today, it is clear that the main etiologic factors associated with the development of odontogenic sinusitis are endodontic infections and periodontal disease affecting distally positioned maxillary teeth, and iatrogenic causes in the area. Therefore, it is of utmost importance that specialists are familiar with the possible "triggers" of the disease in order to be able to make a prompt and accurate diagnosis, and plan the correct treatment accordingly.

Keywords: Odontogenic etiologies, odontogenic sinusitis, maxillary sinusitis, odontogenic infection source

INTRODUCTION

The term "odontogenic sinusitis" is still up for discussion, despite being widely recognized in the fields of otolaryngology and dentistry. The majority of experts concur that circumstances resulting from the dentoalveolar unit compromise the Schneiderian membrane, which causes odontogenic sinusitis (6).

A large number of published studies report that the most common etiologic causes of odontogenic sinusitis are iatrogenic (data range from 55.97% to 100%), followed by endodontic infections (data range from 18% to 50%) and periodontal disease (data range from 8.3% to 10%) (13, 14, 15, 16, 17). In 2021, Craig et al. (18) concluded in their study that endodontic infections are a more common cause of odontogenic sinusitis compared to iatrogenic causes. In 2023, Yassin-Kassab et al. (19) confirmed this conclusion. While individuals cannot agree on the primary cause of odontogenic sinusitis, it is widely acknowledged that unilateral sinusitis has a strong dental basis and that seeking both dental and medical treatment is necessary to treat this illness (4).

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AIM

The purpose of this article is to summarize the most common etiologic factors associated with the development of odontogenic sinusitis.

MATERIALS AND METHODS

We searched through the PubMed and Google Scholar databases to find relevant papers on the topic. All of the articles that are being reviewed were published from 1996 through 2024. A variety of phrases and their combinations were used in the search, namely “odontogenic etiologies”, “odontogenic sinusitis”, “maxillary sinusitis”, “odontogenic infection source”.

RESULTS AND DISCUSSION

The inflammation of the paranasal sinus mucosa, known as sinusitis, is primarily brought on by allergies or respiratory infections (4). As the years go by, otolaryngologists increasingly encounter odontogenic sinusitis in their practices (9).

This disease has been known in medicine for more than 100 years and accounts for 10–12% of maxillary sinusitis cases (1, 3, 5, 6, 7). Recent data, however, show that its prevalence rate is increasing every year (8, 9). This increased incidence may be due to increasingly common surgical interventions in the area, as well as easier access to better diagnostic equipment such as CBCT (8, 20, 21).

Nowadays, otolaryngologists identify odontogenic sinusitis as a prevalent, but frequently misdiagnosed illness, and the association between tooth infections and maxillary sinusitis is well documented (17, 22). Therefore, dentists need to be familiar with the etiologies most commonly associated with odontogenic sinusitis in order to provide the correct diagnosis and treatment for their patients (6, 21).

Current trends for the management of odontogenic sinusitis recommend a multidisciplinary treatment approach involving the collaborative efforts of dentists and otolaryngologists. In patients with a serious microbial load, drug therapy alone is highly insufficient and additional surgical treatment is necessary. Today, modern minimally invasive methods are available and have proven to be significantly effective (23, 24, 25, 26).

In most cases, odontogenic sinusitis develops after the Schneiderian membrane is perforated by infec-

tions originating from maxillary distally placed teeth, from trauma in the distal maxillary region, from extraction of maxillary distally located teeth, or from noncompliant placement of dental implants in the distal maxillary areas (1, 2).

The maxillary first molar (22.51%–35.6%) is the most often implicated tooth in odontogenic sinusitis, with the second molar (3.97%–22%), third molar (17.4%–17.21%), second premolars (1.98%–14.4%), and canines (0.66%) following in order of prevalence (9, 14, 27). In 2011, Maillet et al. concluded that maxillary first and second molars are 11 times more prone than premolars to be the cause of the development of odontogenic sinusitis (17). The palatine roots of the first maxillary molars are those most commonly associated with the development of odontogenic sinusitis. They are followed by the medio-vestibular roots of the second maxillary molars (6).

In fact, the roots of distally positioned maxillary teeth in the vast majority of cases interrupt the contours of the maxillary sinus floor. Thus, they significantly increase the chance of transposition of an inflammatory process of dental origin to the maxillary sinus (4, 28). An anatomical condition where the sinus mucoperiosteum is the only thing separating the tooth apexes from the sinus might occasionally result from the constant enlargement and pneumatization that some patients experience throughout their lives. This illness may facilitate the spread of sinusitis-related odontogenic infections (29).

It is exceedingly rare that more serious complications can develop in the presence of odontogenic sinusitis (orbital abscess) (30), but cases have been published in which even life-threatening conditions can occur (central nervous system infections) (7, 31, 32).

Table 1 presents the etiological causes most commonly associated with the development of odontogenic sinusitis (9, 10, 33, 34, 35, 36, 37, 38, 39). In these conditions, the earliest response by the organism is a thickening of the maxillary sinus mucosa. Years ago, mucosal thickening over 6 mm was considered a pathological sign (40). Today, most of the literature considers thickening over 2 mm to be pathological, especially if clinical symptoms are present (41, 42, 43).

It is important to clarify that without eliminating the etiological cause leading to the development of odontogenic sinusitis, its otologic treatment would

be futile. That is why today there is a call for a multidisciplinary approach to treatment in this disease (18, 20, 44, 45).

Table 1

The etiological causes most commonly associated with the development of odontogenic sinusitis		
1	Endodontic infection	A spreading bacterial invasion in the pulp chamber and periapical region of the tooth is found.
2	Periodontitis and Peri-implantitis	In advanced periodontal disease around natural teeth and/or implants, periodontopathogenic microorganisms can invade (directly or indirectly) and inflame the maxillary sinus mucosa or cause odontogenic sinusitis.
3	Endo-periodontal lesions	A spreading bacterial invasion by both endodontic and periodontal routes was found.
4	Iatrogenic causes	<ul style="list-style-type: none"> • Oroantral communication after extraction of a distal maxillary tooth (Temporary oroantral communication) • Oroantral fistula after extraction of a distal maxillary tooth (Permanent oroantral fistulas) • Tooth extrusion and fractured tooth roots in the maxillary sinus • Extrusion of canal filling material in the maxillary sinus • Extrusion of dental implants during implant surgery • Surgery in the apex region of a distally positioned maxillary tooth

1. Endodontic infection

Endodontic infection is one of the main etiological factors for the development of odontogenic sinusitis. It is associated with disseminated bacterial invasion into the pulp chamber and periapical region of the tooth (9). Periapical lesions occur as a result of dental caries, failed endodontic treatment, a crack or fracture of the tooth root, or trauma (43). Inflammatory processes in the periapical space of distally positioned maxillary teeth, may cause changes in the maxillary sinus mucosa and consequently cause sinusitis (5, 6, 7, 46). A large amount of research is in agreement that inflammatory processes of the first and second maxillary molars are the most common cause of the development of odontogenic sinusitis (9, 14, 47, 48)

In 2011, Maillet et al. (17) published their retrospective study that included 82 CBCT examinations on which pathologic changes were found in the maxillary sinuses. The team found that more than 50% of these cases were associated with periapical lesions.

In 2012, Chemil et al. (49) concluded that odontogenic sinusitis cases accounted for 16% of maxillary sinus pathological processes, and that 50% of these were the result of periapical lesions of distally positioned maxillary teeth.

Hoskinson et al. (8) found that in 73% of cases of odontogenic sinusitis, periapical lesions were the etiologic factor for its development. In addition, 23% had oroantral fistulas and 4% had tooth apices extruded into the sinus.

In 2014, Lechien et al. (50) published their systematic review including 23 articles that investigated the cause of odontogenic sinusitis in a total of 674 patients. The results concluded that a periapical lesion was the etiological cause in about 25% of cases.

A study was published in 2015 that analyzes the cause of the development of symptomatic unilateral maxillary sinusitis requiring surgical treatment. It appears that 75% of cases are the result of odontogenic infection (13).

Odontogenic infections and periapical lesions are a leading etiologic factor for the development of odontogenic sinusitis. In 2004, Obayashi et al. (51) found that over 70% of cases diagnosed with infection of distally positioned maxillary teeth- showed pathological changes in the maxillary sinus. of infection.



2. Periodontitis и Peri-implantitis

In advanced periodontal disease, periodontopathogenic microorganisms may invade adjacent and inflame the maxillary sinus mucosa or cause odontogenic sinusitis (9). This invasion can occur directly (diffusion) or indirectly (through the lymphovascular system) and lead to thickening of the maxillary mucosa (52).

In a retrospective analysis of 84 patients with periodontal disease, Abrahams et al. found that the odontogenic sinusitis of patients with the condition was twice as high as that of the control group (53).

In 2012, Phothikhun et al. (52) in their study, using CBCT images, found that patients with severe periodontal disease and severe bone deficiency had thickened maxillary sinus mucosa, whereas patients with periapical lesions and endodontic treatments did not show such a correlation.

A study was published in 2015 that analyzes the cause of the development of symptomatic unilateral maxillary sinusitis requiring surgical treatment. It appears that 10% of cases are the result of advanced periodontal disease (13).

A study published in 2017 concluded that patients with varying degrees of periodontal disease demonstrated a 3.45-fold increased risk of developing maxillary sinusitis. This may be explained by the fact that areas with present periodontal disease are supersaturated with pathogenic microflora and associated cytokines, which through transport through the porous maxilla can cause maxillary sinusitis (28). As in periodontitis, transposition of inflammation can occur and odontogenic sinusitis can develop in advanced peri-implant infection of maxillary distal implants (54, 55).

3. Endo-periodontal lesions

In endo-parodontal lesions, bacterial invasion by both endodontic and periodontal routes is coexistent. The infection is of mixed type and its spread to the maxillary sinus mucosa occurs by a similar route as in endodontic infection and periodontal disease (9, 10).

A retrospective study including 103 patients diagnosed with odontogenic sinusitis was published in 2023. Each participant who took part had an oral examination, nasal endoscopy, and sinus computer

tomography. A comparative analysis was carried out between the odontogenic etiologies and the clinical symptoms, sinus involvement, and maxillary sinus floor bone resorption of the subjects (10). Apical periodontitis (AP, 32.0%), periodontitis (PE, 8.7%), and endo-periodontal lesions (EPLs, 49.5%) were some of the most frequent odontogenic etiologies (10, 37). The study team concludes that the role of endoparodontal lesions as an etiological factor of odontogenic sinusitis is seriously underestimated (10).

4. Iatrogenic causes

Molteni et al. (39) published in 2020 their study in which they analyzed the cases of 480 patients diagnosed with odontogenic sinusitis and found that the etiological cause in 45.8% of the cases was oroantral communication.

Another study, analyzing 130 patients with the same diagnosis, concluded that the main etiologic factor for the development of odontogenic sinusitis is tooth extraction with subsequent development of oroantral fistula (13). Akhlaghi et al. (14) presented in 2015 their systematic review including 19 articles and similarly concluded that the most common etiological factor for the development of odontogenic sinusitis is oroantral fistula.

Throughout the years, cases have been published in which dental implants, fractured tooth roots and endodontic material extrude into the maxillary sinus and this leads to pathological changes. The literature documenting sinus changes after iatrogenic dental interventions are numerous. For this reason, more careful and considerate handling by dentists is strongly recommended (56, 57).

In a case series, it was discovered that in 22.3% of cases, odontogenic sinusitis was caused by extruded endodontic obturation elements into the maxillary sinus (15).

However, studies in 2012 and 2014 (4, 7) concluded that iatrogenic tooth extrusion in maxillary sinuses is not very common.

The risk of developing odontogenic sinusitis is also extremely low in interventions such as sinus lift and bone grafting procedures, especially in cases without complications such as perforation of the Schneiderian membrane (6). In opposition to this statement, in 2011 Puglisi et al. (16) concluded

that 20% of cases of chronic sinusitis are associated with odontogenic infection. Moreover, they named sinus floor elevation procedures as the main etiological factor. Their results were supported by a retrospective study that analyzed cases of patients with odontogenic sinusitis and found that 37% of cases were related to dental implant procedures, and 29.6% were the result of complications after tooth extraction (58).

In 2013, a retrospective study was published involving patients who had undergone surgery to place a dental implant whose apex protruded into the sinus. In none of the patients over 20 years, the researchers were able to detect either clinical or radiographic signs of sinusitis. The authors estimated that the apexes of the implants penetrated approximately 3 mm into the maxillary sinus and concluded that in these cases the risk of perforation of the Schneiderian membrane was minimal (59).

In 2019, Ragucci et al. published a systematic review including 493 implant placements that penetrate the maxillary sinus. The team found that this implant penetration resulted only in thickening of the sinus mucosa, but only 1 patient developed maxillary sinusitis (60).

CONCLUSION

Odontogenic sinusitis is a widespread disease. Literature sources often refer to it as an “underestimated disease”. Today, it is clear that the main etiologic factors associated with the development of odontogenic sinusitis are endodontic infections and periodontal disease affecting distally positioned maxillary teeth, and iatrogenic causes in the area. Therefore, it is of utmost importance that specialists are familiar with the possible “triggers” of the disease in order to be able to make a prompt and accurate diagnosis, and plan the correct treatment accordingly.

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