Epidemiology of Odontogenic Sinusitis

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KEYWORDS

• Odontogenic sinusitis • Oro-antral fistula • Dental implant surgery • Sinus elevation • Periapical disease • Periodontitis

KEY POINTS

- The overall prevalence of odontogenic sinusitis (ODS) is unknown but could represent 10% to 40% of all chronic maxillary sinusitis.
- More importantly, ODS is the most common cause of unilateral maxillary sinus opacification on computed tomography imaging, representing 45% to 78% of all such cases. It is important to distinguish this from maxillary sinus mucosal thickening on imaging (generally a reactive mucositis), which usually is not infectious ODS. Many studies use mucositis interchangeably with ODS, which can significantly overestimate the prevalence of ODS.
- The most common causes of ODS are endodontic infection (apical periodontitis) and oroantral communication after extraction.
- Maxillary augmentation with bone grafting and dental implantation are potential causes of ODS, and care must be taken when planning and performing these surgeries to prevent ODS.

INTRODUCTION

For many dental health care providers, diseases of the maxillary and other paranasal sinuses seem enigmatic. Dentists are well aware of the anatomic proximity of the dental roots to the maxillary sinus floor and should be aware of the potential for infectious dental conditions to cause purulent odontogenic sinusitis (ODS).[1] However, in the clinical setting, ODS is frequently overlooked,[2] so there are likely gaps in understanding between different providers.

On the other hand, due to most patients with ODS having more prominent sinusitis symptoms, they often present initially to otolaryngologists. Despite their expertise in conservative and surgical management of sinus pathology, otolaryngologist often

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neglect or underestimate odontogenic sources of sinus disease.[3] The odontogenic disease is often missed on radiological imaging by radiologists, and otolaryngologists can overlook the disease too if not reviewing imaging carefully.[4]

In addition to the issues of clinicians overlooking the diagnosis due to a lack of disease suspicion, there are also issues with confirming the diagnosis due to a lack of widespread diagnostic criteria, and challenges with collaborating between dental providers and otolaryngologists to make the diagnoses most accurately. Due to these limitations, the overall prevalence of ODS is difficult to know for certain. It is interesting how the aforementioned limitations could have led to either an underestimate (ie, dental cause not recognized) or an overestimate (mucosal thickening used as a proxy of ODS) of ODS prevalence. This article will provide an overview of the literature on the prevalence of ODS, as well as the dental etiologies that cause ODS.

EPIDEMIOLOGY OF ODONTOGENIC SINUSITIS

While the true prevalence of ODS cannot be known due to a lack of widely accepted diagnostic criteria, it may be more common than historically thought. Numerous review articles have cited older studies from the 1950s to 1960s, stating that about 10% to 12% of all sinusitis is odontogenic in nature.[5,6] However, these older studies provided no epidemiologic analysis to support the prevalence reports. And yet, this prevalence has been cited for decades. A prospective study in 1986 by Melen and colleagues[7] reported 40% of all maxillary sinusitis to be of dental origin (198 patients, 244 examined sinuses). This study was well ahead of its time, as even rhinogenic sinusitis criteria had not been established at that point. This coupled with them including patients with unilateral and bilateral sinus disease, only about half having confirmed dental examination findings, and using older radiographic and endoscopic technologies likely confounded their findings. For example, they did not specify how often purulence was identified ipsilateral to the dental pathologies, and they considered mucosal swelling on radiograph to be consistent with sinusitis. There were too many confounding variables in the Melen and colleagues study to state that 40% of all unilateral and bilateral maxillary sinusitis is odontogenic. However, it was an important study to shine a light on the greater likelihood of dental pathology causing sinusitis.

In 2010, Albu and colleagues[8] showed retrospectively that in 411 patients who failed maxillary sinus surgery, odontogenic pathology was the likely cause in about 25% of cases. While some authors suspect a rising incidence of ODS,[9] it is conceivable that this observation can be attributed to refined diagnostic methods and criteria and improved collaboration between otorhinolaryngology and dental health care providers.[2,10,11]

One very important point to make about issues with published ODS prevalence is that many studies use the terms mucositis (maxillary sinus mucosal thickening on imaging studies) and ODS (usually opacified sinuses on imaging) interchangeably. For example, a recent large systematic review reported a 50% overall prevalence of odontogenic maxillary sinusitis based on cone-beam computed tomography (CT) in patients with dental disease.[12] However, they did not separate out mucositis from ODS, so this was likely an overestimate of ODS prevalence. Additionally, that study's findings would not represent how prevalent ODS is among all sinus disease patients, since only patients presenting with dental disease were analyzed. Future studies must try to distinguish maxillary sinus mucosal thickening from opacification on CT and, ideally, include nasal endoscopies to assess for purulent sinusitis to confirm ODS.

While the overall prevalence of ODS among all forms of sinus disease will require further analysis once diagnostic criteria are firmly established, one extremely

important point to appreciate is that ODS presents unilaterally in the overwhelming majority of cases. Notably, multiple studies now have shown ODS to be the most common cause of unilateral maxillary sinus opacification on CT scans, representing 45% to 78% of such cases.[13–17] These studies improved on prior ODS prevalence investigations by more regularly using CT and nasal endoscopy to establish infectious sinusitis and dental evaluations to confirm infectious dental pathology. Recognizing that ODS is the most common cause of maxillary sinus opacification on CT is arguably more important for clinicians to know compared to the overall prevalence of ODS, because it acts as a powerful hint for ODS suspicion. When clinicians see unilateral maxillary sinus opacification on a CT, especially if purulence is identified on nasal endoscopy, they should evaluate the CT for overt dental pathology and keep a high suspicion for nonovert potential dental causes too.[18]

SPECIFIC CAUSES OF ODONTOGENIC SINUSITIS

Apical Periodontitis (Endodontic Infection) and Periodontitis (Periodontal Infection)

Both endodontic and periodontal pathology can trigger ODS, though true periodontitis as the sole cause of ODS is significantly less common than endodontic infections. Failed endodontic treatment or necrosis of the dental pulp can induce periapical osteolytic lesions on imaging periapical osteolystic lesion (PAL) and is most commonly seen with the first and second maxillary molars.[19] The true prevalence of endodontic and periodontal infections causing ODS is confounded by a relative lack of consistent endodontic and periodontal testing in studies. For example, Lechien and colleagues[20] conducted a systematic review of the literature and reported that periodontitis caused 8.3% of ODS cases. However, endodontic testing was not reported in the included studies, so some of these could have been apical periodontitis. An ODS literature review by Craig and colleagues[21] showed wide variability in prevalences of endodontic (16%–95%) and periodontal (3%–50%) causes of ODS between studies. Some of the variability could be explained simply by skewed patient populations based on the fields in which the researchers practiced. While improved study designs are needed to determine the true prevalence of endodontic disease causing ODS, it should be considered one of the most common causes overall.

While advanced periodontal disease can be associated with maxillary sinus reactive mucosal thickening and varying degrees of opacification on CT,[22] whether this causes infectious ODS requires more research. Periodontitis may also be associated with a risk of maxillary sinus fungal ball development,[23] this too would not represent bacterial ODS. It is also important to note that many cases of possible periodontitis have periapical disease, and could represent endodontic-periodontal lesions, which are usually endodontic in origin.[24] In these situations, pulp vitality testing is essential to distinguish an endodontic (necrotic pulp) from periodontal (normal pulp) origin.

Dental Extraction and Oroantral Communication or Fistula

An abundance of dental pathologies can induce and/or maintain ODS including periapical infectious and inflammatory processes, periodontal disease, and jaw bone pathology.[17] Furthermore, ODS can evolve as a consequence of iatrogenic interference, such as oroantral fistula (OAF) formation following dentoalveolar surgery or maxillary sinus mucosal membrane perforation during bone augmentation or dental implant procedures.[25,26] Some authors have reported iatrogenic interventions as being one of the most common causes of ODS.[17,27] In many cases, a temporary oroantral communication or undetected/untreated OAF after molar extraction triggers

ODS.[27,28] Interestingly, some postextraction ODS cases could have had premorbid undetected ODS, and future studies should determine how often the extraction and oroantral communication causes the ODS.

Dental Implants and Maxillary Sinus Augmentation (Bone Grafting)

Although ODS is frequently mentioned as a potential complication of maxillary sinus bone graft augmentation or dental implant surgery, it has been rare in studies to date.[29] A recent meta-analysis showed an ODS prevalence after open sinus elevation surgery of about 1% and almost no risk after a transcrestal approach.[29] One study showed the risk of ODS increasing 1% to 11% if the maxillary sinus mucosa (Schneiderian membrane) was perforated,[30] which may be higher risk with certain anatomic configurations of the maxillary sinus floor. If implants are inserted into resorbed maxillary ridges without bone grafting, penetration of the maxillary sinus mucosa (Schneiderian membrane) by the dental implant tip can occur.[31,32] If implant penetration into the maxillary sinus is limited (<4 mm), the long-term complication rate is low and ODS development is unlikely (<5%).[31,32] The chance of ODS increases to about 30% if the implant penetration depth exceeds 4 mm.[31,33]

In addition to ODS from sinus mucosal perforation, peri-implantitis (infection in the bone around an implant) can also lead to ODS. About 20% of all dental implants will be affected by peri-implantitis.[34] The prevalence of peri-implantitis causing ODS has not been studied sufficiently to date. A few case reports and series have reported purulent sinusitis in association with peri-implantitis.[33,35] It is suspected that maxillary sinus floor bone grafts are prone to infection triggered by peri-implantitis, which may then lead to infectious sinus transmission.[36,37] Case reports have also described persistent OAF after peri-implantitis inducing loss of implant osseointegration and consecutive implant removal,[35,36] which could lead to ODS.

The risk of ODS due to implant dislocation into the sinus is very low.[38] A recent 2023 literature review discussed 321 cases of implant-to-sinus dislocation, most of which occurred during or immediately after implant placement, or within the first 6 months of surgery.[39] If not detected intraoperatively, over 50% of these cases cause OAF or ODS.[39]

Uncommon Possible Causes of Odontogenic Sinusitis

Sinusitis can also occur in the wake of orthognathic surgery or maxillary trauma due to sinus volume and anatomy changes.[40] A large systematic review reported an incidence of about 3% of sinusitis following orthognathic maxillary surgery.[41] Additionally, about 10% of patients develop sinus pathology after open reduction and internal fixation (ORIF) of maxillary fractures.[42] Transient sinus opacification up to 3 months after ORIF of maxillary fracture is common, occurring in about 60% of the operated patients.[43] Imperfect reduction results and screws perforating the maxillary sinus mucosa (Schneiderian membrane) increase the risk of symptomatic sinusitis after maxillary trauma.[43]

Maxillary sinusitis can also evolve in association with or as a sequela of maxillary medication-related osteonecrosis of the jaw (MRONJ).[44] Studies reported that between 40% and almost 100% of maxillary MRONJ cases occur concomitantly with signs of maxillary sinusitis.[44–46] According to the position paper of the American Association of Oral and Maxillofacial Surgeons, the extension of the necrotic bone into the maxillary sinus and/or OAF marks the most advances stage of the disease (stage 3).[47] However, sinus mucosal thickening or opacification on CT may also occur reactively in cases of maxillary MRONJ, without sinus wall necrosis.[48] The exact prevalence of clinical and/or radiological signs of sinusitis in patients with MRONJ is

currently unknown. It should be noted that sinusitis in the setting of orthognathic procedures, maxillary fracture reductions, and MRONJ may or may not represent ODS, and little is known about their pathophysiology and microbiological milieu. It is understandable that these conditions can induce sinus disease similar to ODS, but more data are needed to determine whether they will be managed like ODS.

Finally, the presence of odontogenic pathologies such as cysts or tumors can mimic or induce ODS if they become infected. These events are very rare and reports have been scant.[49]

CLINICS CARE POINTS

- ODS is the most common cause of unilateral maxillary sinus opacification on CT scans, and its presence should trigger an evaluation for dental pathology on the CT.
- Maxillary sinus mucosal thickening (mucositis) adjacent to dental pathology should not be labeled ODS unless purulent sinusitis is confirmed endoscopically; prevalence studies that do not distinguish mucositis from ODS may be overestimating the overall ODS prevalence.
- The most common causes of ODS are endodontic disease (apical periodontitis with or without periapical abscesses) and iatrogenic (especially OACs and OAFs after extraction and infected bone grafts and dental implants).
- Future studies are needed to determine the overall prevalence of ODS among all forms of sinonasal disease, utilizing consistent diagnostic criteria with multidisciplinary collaboration.

DISCLOSURE

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