Received: 6 December 2020 | Revised: 14 January 2021 | Accepted: 19 January 2021

DOI: 10.1002/alr.22777

IFAR: International Forum of Allergy & Rhinology

REVIEW

Diagnosing odontogenic sinusitis: An international multidisciplinary consensus statement

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Additional Supporting Information can be found in the online version of this article.

Potential conflicts of interest: None provided.

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Background: Odontogenic sinusitis (ODS) is distinct from non-odontogenic rhinosinusitis, and often requires multidisciplinary collaboration between otolaryngologists and dental providers to make the diagnosis. The purpose of this study was to develop international multidisciplinary consensus on diagnosing ODS.

Methods: A modified Delphi method was used to assess for expert consensus on diagnosing bacterial ODS. A multidisciplinary panel of 17 authors with ODS expertise from 8 countries (8 otolaryngologists, 9 dental specialists) was assembled. Each author completed 2 of 3 surveys (2 specialty-specific, and 1 for all

authors). Thirty-seven clinical statements were created, focusing on 4 important diagnostic components: suspecting ODS; confirming sinusitis in ODS; confirming different dental pathologies causing ODS; and multidisciplinary collaborative aspects of diagnosing ODS. Target audiences were all otolaryngologists and dental providers.

Results: Of the 37 clinical statements, 36 reached consensus or strong consensus, and 1 reached no consensus. Strong consensus was reached that certain clinical and microbiologic features should arouse suspicion for ODS, and that multidisciplinary collaboration between otolaryngologists and dental providers is generally required to diagnose ODS. To diagnose ODS, otolaryngologists should confirm sinusitis mainly based on nasal endoscopic findings of middle meatal purulence, edema, or polyps, and dental providers should confirm dental pathology based on clinical examination and dental imaging.

Conclusion: Based on multidisciplinary international consensus, diagnosing ODS generally requires otolaryngologists to confirm sinusitis, and dental providers to confirm maxillary odontogenic pathology. Importantly, both dental providers and otolaryngologists should suspect ODS based on certain clinical features, and refer patients to appropriate providers for disease confirmation.

KEYWORDS

odontogenic sinusitis, chronic rhinosinusitis, consensus, maxillary sinusitis, apical periodontitis, oroantral fistula

Odontogenic sinusitis (ODS) refers to bacterial maxillary sinusitis, with or without extension to other paranasal sinuses, secondary to either adjacent infectious maxillary dental pathology, or following complications from dental procedures. ODS may account for 25% to 40% of all chronic maxillary sinusitis,[1,2] occurs unilaterally most commonly,[3–11] and represents 45% to 75% of unilateral maxillary sinus opacification on computed tomography (CT).[3–5,12] ODS is underrepresented in sinusitis literature, and diagnosing ODS has not been discussed formally in recent guidelines or position statements on acute or chronic rhinosinusitis.[13–16] Although diagnosing ODS may seem intuitive by confirming sinusitis and a concurrent dental infectious source, a recent systematic review showed that very few ODS studies have used consistent diagnostic criteria.[17]

One challenge with diagnosing ODS is that patients often require evaluations by both otolaryngologists and dental providers. If patients present initially to otolaryngologists, their clinical presentations can mimic non-odontogenic rhinosinusitis, and odontogenic sources may not be suspected. Similarly, if patients present first to dental providers with maxillary dental pathology, sinusitis can be overlooked. However, certain clinical and microbiologic features may help predict an odontogenic source of sinusitis,[7,18–21] and identifying these features could stimulate ODS suspicion and subsequent referrals to otolaryngologists or dental providers for disease confirmation. Another diagnostic hurdle is that optimal dental testing and imaging to confirm specific dental pathologies causing ODS[22–28] may not always be performed, which could lead to false negative dental evaluations. Last, optimal diagnostic modalities to confirm sinusitis in ODS have not been established, despite ODS being distinct from rhinosinusitis. This study's purpose was to generate international multidisciplinary consensus on diagnosing ODS by optimizing suspicion and confirmation of both the sinusitis and odontogenic sources.

1 | MATERIALS AND METHODS

This clinical consensus statement (CCS) was developed using an a priori protocol[29]: (1) evaluating whether diagnosing ODS is appropriate for a CCS; (2) determining scope and population of interest; (3) using expert panel recruitment; (4) vetting panelists' potential conflicts of interest; (5) performing systematic literature reviews by development group; (6) conducting modified Delphi surveys; (7) revising clinical statements in an iterative fashion based on

survey results; and (8) aggregating the data for analysis and publication.

1.1 | Panelists and scope of consensus statement

A multidisciplinary panel of 17 authors from 8 countries (8 otolaryngologists, 9 dental specialists) was assembled. Dental specialists included 3 endodontists and 6 oral or maxillofacial surgeons. The development group was comprised of a chair (J.R.C.), assistant chair (A.M.S.), and methodologists (D.M.P., G.F., and R.W.T.). Authors were selected for their ODS expertise, each having published multiple studies on ODS or topics strictly pertinent to ODS in the last 10 years. All authors are in active clinical practice. All authors disclosed potential conflicts of interest, and none were discovered. The CCS focus was to achieve international multidisciplinary consensus on diagnosing bacterial ODS, between otolaryngologists and dental specialists. Target audiences were all otolaryngologists and dental providers.

1.2 | Literature review

A systematic review of the ODS literature was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) reporting guidelines.[30] Systematic electronic searches were conducted from January 2009 to September 2020 for studies in English, Italian, German, French, or Spanish that reported data obtained from human subjects with ODS from various dental pathologies. Keyword searches were performed through Ovid MEDLINE, Embase, Web of Science, the Cochrane Library, and ClinicalTrials.gov databases for "sinusitis" in conjunction with terms associated with ODS. The ODS literature search details are shown in Table S1. Due to a lack of high-quality ODS studies, the systematic review was extended further from CCS recommendations.[29] Systematic reviews with or without meta-analyses were included as recommended, but guidelines or position statements, and nonrandomized prospective and retrospective case series, case-control, and cohort studies were also included. Case reports were excluded.

A separate dental literature review was also conducted. The following terms were searched for through Ovid MEDLINE and Embase: endodontic or clinical pulp testing, and dental imaging for apical periodontitis (AP) or periapical disease (Table S2). Predominantly systematic reviews with or without meta-analyses were included, and some case series were included if considered higher quality based on sample size and study design.

Before conducting surveys, the development group disseminated 15 articles from the medical and dental literature reviews to all authors. These articles represented the highest evidence levels on diagnosing ODS. Authors had 1 month to review articles. Additionally, all authors were e-mailed and encouraged to discuss a document that contained a working definition of ODS, as well as literature-based ODS terminology. This document was used to optimize clarity of clinical statements in surveys.

1.3 | Clinical statement development

Clinical statements for each survey were developed by the chair and assistant chair, and edited by methodologists. Statements were developed based on literature review and the development groups' perceptions of important diagnostic scenarios. Three surveys were created: 2 specialty-specific, and 1 for all authors. For otolaryngologists, 17 statements centered on how to confirm sinusitis and recognize clinical features to suspect ODS. For dental specialists, 9 statements centered on how to confirm different dental pathologies causing ODS. For the common survey, 11 statements centered on multidisciplinary collaboration when diagnosing ODS.

1.4 | Modified Delphi survey process

Surveys were distributed to authors using Google Forms (Google, Mountain View, CA). Two surveys were sent to each author. Each author was e-mailed a randomly generated code by a third party to be used throughout the survey process to maintain anonymity. Authors first completed specialty-specific surveys, followed by common surveys.

Surveys were structured with answers on a 9-point Likert scale to measure agreement: strongly disagree (1); disagree (3); neutral (5); agree (7); and strongly agree (9). Consensus criteria were established a priori[29]: *consensus*—statements achieving a mean score of ≥7.00 with no more than 1 outlier (defined as any rating 2 or more Likert points from the mean in either direction); *near consensus*—statements achieving a mean score of ≥6.50 with no more than 2 outliers; *no consensus*—statements that did not meet criteria for consensus or near consensus; and *strong consensus*—statements with a mean score of ≥8.00 with no outliers.[31]

After the first survey round, 21 of 37 statements reached consensus, 11 reached near consensus, and 5 reached no consensus. Statements reaching near consensus, and 4 of the 5 statements reaching no consensus were reworded based on anonymous comments from authors. Importantly, the ultimate content of each statement was not

changed, only the wording to improve each statement's clarity. The second survey round included 15 statements, of which 14 reached consensus and 1 reached near consensus. A third survey round was carried out for the statement reaching near consensus, again due to statement wording and clarity. This statement then reached consensus. Overall, 1 statement reached no consensus, and this was not due to wording or other modifiable factors. Table S3 shows side-by-side comparisons of original and final clinical statements.

2 | RESULTS

All panelists completed all survey questions. Of the 36 clinical statements reaching consensus, strong consensus was reached on 18 statements. One statement reached no consensus.

2.1 | Suspecting ODS and confirming sinusitis

All 17 statements reached consensus (10 strong consensus) with regard to confirming sinusitis and suspecting ODS based on clinical features (otolaryngologist survey; Table 1). First, ODS patients generally have symptoms consistent with rhinosinusitis, but foul smell may be more specific for ODS (#4). Some ODS patients will be asymptomatic (#3). Dental pain is infrequently encountered in ODS (#5), but a history of prior dental procedures may increase the likelihood of a patient's sinusitis being odontogenic in origin (#6). Nasal endoscopy was felt to confirm sinusitis from an odontogenic source, by identifying purulence, edema, or polyps in the middle meatus, or maxillary sinus (#1, #7, and #17). Purulence is more likely in ODS compared to rhinosinusitis (#2), and sinus cultures obtained sterilely can facilitate suspicion of an odontogenic source (#16). Regarding CT findings, maxillary sinus opacification is more representative of ODS compared to isolated sinus mucosal thickening or mucus retention cysts (#8, #9, and #10). When there is extramaxillary extension in ODS, there is relative sparing of posterior ethmoid and sphenoid sinuses (#11). Near perfect consensus was reached that otolaryngologists should always assess maxillary dentition when there is maxillary sinus opacification on CT (#12). Also important, although the majority of ODS patients will have overt dental pathology on CT (#13), some will not have identifiable pathology on CT (#14).

2.2 | Confirming odontogenic sources of sinusitis

All 9 statements reached consensus (dental specialist survey; Table 2). Strong consensus was reached for 2 statements about endodontic disease causing ODS. Dental caries alone should not cause ODS (#3), and ODS due to AP should be due to necrotic or partially necrotic pulp, or failing root canal therapy (#1). To evaluate for endodontic disease, cold pulp testing is an optimal initial test of pulp vitality (#4), and cone-beam CT is superior to periapical radiography for detecting AP (#7). Importantly, in some cases, AP causing ODS is not always detectable on CT (#8). Orthopantomography and periapical radiographs are acceptable initial imaging modalities to evaluate for dental sources of sinusitis (#6). Dental bite-wing X rays are not acceptable when evaluating ODS (#5). Last, to assess for an oroantral fistula (OAF), clinicians should have patients blow their nose against occluded nostrils, and/or clinicians can probe the suspected fistula site (#9).

2.3 | Multidisciplinary collaboration to diagnose ODS

Of the 11 statements, 10 reached consensus (6 strong consensus) and 1 reached no consensus (common survey; Table 3). Strongest consensus was reached that multidisciplinary evaluations by both otolaryngologists and dental specialists are generally beneficial when evaluating for ODS (#1). Otolaryngologists and dental providers should screen for sinusitis symptoms (#3) and dental pain, pathologies, or prior treatments (#4). Generally for ODS, otolaryngologists should confirm the sinusitis, and dental specialists should confirm the odontogenic pathology. When there is a potentially treatable dental source of sinusitis, or an unknown source of unilateral sinusitis, patients should be referred to dental specialists for evaluation (#5, #6, #8, and #11). When there are CT findings of any maxillary sinus disease, dental providers can refer patients to otolaryngologists to evaluate for sinusitis (#9).

3 | DISCUSSION

ODS is distinct from rhinosinusitis as it is infectious sinusitis secondary to a dental source, with no primary sinonasal inflammation. ODS has received significantly less attention in the literature compared to

TABLE 1 Statements that reached consensus on suspecting ODS and confirming the sinusitis (otolaryngologists only)

Question number	Statements	Mean	Range	Outliers
1	In the setting of maxillary sinus opacification on CT, otolaryngologists should always assess the maxillary dentition for dental pathology.	8.88	8-9	0
2	On CT scan, the posterior ethmoid and sphenoid sinuses are less likely to be involved in ODS compared to non-odontogenic rhinosinusitis.	8.75	8-9	0
3	On CT scan, isolated maxillary sinus mucus retention cysts (or pseudocysts) do not represent ODS.	8.63	7-9	0
4	Some odontogenic pathologies leading to ODS will not be identifiable on CT scan (eg, endodontic disease with no overt periapical lesion on CT).	8.63	7-9	0
5	Once the dental pathology causing ODS has been treated adequately, patients should be followed for at least 1-2 months posttreatment to monitor for sinusitis resolution.	8.5	7-9	0
6	In presence of confirmed maxillary odontogenic pathology, sinusitis is confirmed by nasal endoscopic evidence of purulence, edema, or polyps in at least the ipsilateral middle meatus or maxillary sinus.	8.5	6-9	1
7	Sinus bacterial cultures can facilitate suspicion of an odontogenic source of sinusitis, but are not 100% confirmatory.	8.38	7-9	0
8	Some patients with ODS may have nasal polyps identified in their middle meatus.	8.38	7-9	0
9	On CT scan, isolated maxillary sinus mucosal thickening adjacent to odontogenic pathology alone is not diagnostic for ODS, without nasal endoscopic evidence of infection or inflammation.	8.38	7-9	0
10	Dental pain is frequently absent in patients with ODS.	8.25	7-9	0
11	Patients with ODS are more likely to have purulence identified in the ipsilateral middle meatus or maxillary sinus, when compared to patients with non-odontogenic rhinosinusitis.	8.25	6-9	1
12	Some patients with ODS may be asymptomatic.	8.25	7-9	0
13	Having a history of prior dental procedure(s) on the side(s) of sinonasal complaints increase(s) the likelihood of ODS.	8.13	5-9	1
14	Subjective foul smell is a symptom more specific for ODS than other forms of rhinosinusitis.	7.88	5-9	1
15	The majority of odontogenic pathologies leading to ODS will be identifiable on CT scan.	7.88	3-9	1
16	On CT scan, partial to complete maxillary sinus opacification is more likely in ODS than isolated maxillary sinus mucosal thickening.	7.75	5-9	1
17	In the setting of prior MSG or infected MSG, ODS can be diagnosed if nasal endoscopy reveals purulence, edema, or polyps in the middle meatus or maxillary sinus.	7.38	1-9	1

Table includes statements that reached consensus among otolaryngologist authors only, with regard to recognizing clinical features to suspect ODS, or confirming sinusitis from an odontogenic source. Statements were listed in order of mean score achieved, from highest to lowest, and from lowest to highest number of outliers. CT = computed tomography; MSG = maxillary sinus grafting; ODS = odontogenic sinusitis.

TABLE 2 Statements that reached consensus on confirming odontogenic sources of sinusitis (dental specialists only)

Questionnumber	Statement	Mean	Range	Outliers
1	Dental caries alone, without any pulpal involvement, should not cause ODS	8.44	7-9	0
2	If ODS with sinus opacification on CT (not just isolated sinus mucosal thickening) is due to AP, the AP is due to necrotic or partially necrotic pulpal tissue, or failing root canal therapy	8.33	7-9	0
3	Cone-beam CT is superior to periapical radiography for detecting periapical lesions due to AP	8.33	5-9	1
4	Dental bite-wing X rays are not an acceptable diagnostic modality in the evaluation of odontogenic sources of maxillary sinusitis	8.33	5-9	1
5	Maxillary sinus mucosal thickening without sinus opacification on CT scan can occur in the setting of AP due to irreversible pulpitis (vital inflamed pulp)	7.78	3-9	1
6	Orthopantomography and periapical radiographs are acceptable first line imaging studies when evaluating for odontogenic sources of maxillary sinusitis	7.67	7-9	0
7	Early AP or AP with thin to absent periapical cortical bone can cause ODS even in the absence of osseous changes radiographically	7.67	3-9	1
8	Cold pulp testing, although not always conclusive, should be the pulp vitality test of choice in the initial evaluation of possible maxillary odontogenic sources of sinusitis in non-endodontically treated teeth	7.56	2-9	1
9	If the diagnosis of oroantral fistula is uncertain on physical exam, clinicians should have patients blow their nose against occluded nostrils, and/or clinicians can probe the potential fistula site	7.33	5-9	1

Table includes statements that reached consensus among dental specialist authors only, with regard to confirming an odontogenic source of sinusitis. Statements were listed in order of mean score achieved, from highest to lowest, and from lowest to highest number of outliers. AP = apical periodontitis; CT = computed tomography; ODS = odontogenic sinusitis.

TABLE 3 Statements that reached consensus on a multidisciplinary approach to diagnosing ODS (otolaryngologists and dental specialists)

Questionnumber	Statement	Mean	Range	Outliers
1	Multidisciplinary collaboration between dental specialists and otolaryngologists is generally beneficial when evaluating for and diagnosing ODS	8.76	7-9	0
2	Patients with sinusitis should be referred to dental specialists when a potential odontogenic source is treatable	8.71	7-9	0
3	In patients with maxillary dental pathology and CT scans demonstrating any maxillary sinus disease (mucosal thickening, or partial to complete sinus opacification), regardless of sinusitis symptoms, dental providers have the option to refer to otolaryngologists	8.65	7-9	0
4	In suspected ODS after dental implant placement, patients should be referred to their dental specialist to assess whether the implant or implants require treatment or removal	8.65	3-9	1
5	Otolaryngologists and dental specialists should screen for the following symptoms of sinusitis: foul smell, smell loss, posterior nasal drainage, anterior nasal drainage, nasal obstruction, and facial pressure	8.47	7-9	0
6	Otolaryngologists and dental specialists should screen for maxillary dental pain and prior dental pathologies and treatments (eg, fillings, crowns, root canal therapies, extractions, maxillary sinus grafting, dental implants)	8.47	5-9	1
7	After ruling out more concerning conditions (eg, neoplasia, meningoencephalocele, invasive fungal rhinosinusitis), all patients with unexplained unilateral sinusitis should be referred to a dental provider to evaluate for an odontogenic source, whether or not overt dental pathology is identified on CT scan	8.41	5-9	1
8	If dental providers elect to treat dental pathology in patients with CT findings showing any maxillary sinus disease (with or without sinusitis symptoms) without referring to an otolaryngologist, they should monitor for disease resolution based on CT and/or symptom resolution after dental treatment, and refer to otolaryngologists should the disease state or symptoms worsen or persist after 3 months from dental treatment	8.35	7-9	0

(Continues)

TABLE 3 (Continued)

Questionnumber	Statement	Mean	Range	Outliers
9	When diagnosing ODS, otolaryngologists should confirm sinusitis and dental specialists should confirm odontogenic pathology	8.23	3-9	1
10	If ODS is highly suspected based on clinical features, but dental evaluation is negative (ie, no confirmed dental pathology), ODS should still be considered if patients have ongoing maxillary sinus edema or purulence despite adequate endoscopic sinus surgery and antimicrobial therapy; in these situations, repeat evaluation by dental specialists should be considered	8.18	7-9	0
Statement that did not reach consensus				
11	Odontogenic pathologies causing ODS that are recognized by otolaryngologists but do not require dental treatment, do not necessarily require referral to dental specialists for diagnostic purposes (eg, OAC, maxillary sinus foreign body without OAF)	5.76	1-9	7

Table includes statements that did or did not reach consensus among otolaryngologist and dental specialist authors, with regard to multidisciplinary collaboration to diagnose ODS. Statements were listed in order of mean score achieved, from highest to lowest, and from lowest to highest number of outliers. CT = computed tomography; OAC = oroantral communication; OAF = oroantral fistula; ODS = odontogenic sinusitis.

rhinosinusitis, and no formalized diagnostic criteria have been established.[17] ODS treatment and outcomes are very different from rhinosinusitis,[10,11,32–36] and the diagnostic approach to ODS should also be different. Until higher levels of evidence allow for validated ODS diagnostic criteria, this international multidisciplinary CCS serves as a valuable segue to such criteria.

Three surveys were conducted in this study to highlight 4 important aspects of diagnosing ODS: suspecting ODS based on different clinical features; confirming the sinusitis; confirming odontogenic sources of sinusitis; and the utility of multidisciplinary collaboration. Figure 1 illustrates a multidisciplinary approach to diagnosing ODS. The process depends on which provider performs the initial evaluation. Otolaryngologists assess for sinusitis, and then refer to dental providers to assess for odontogenic pathology. Dental providers assess for odontogenic infectious pathology, and refer to otolaryngologists to assess for sinusitis. These referrals are pursued based on each provider's level of suspicion for ODS based on clinical features.

3.1 | Suspecting ODS

It is important for otolaryngologists and dental providers to recognize clinical features that can distinguish ODS from rhinosinusitis. Features that can facilitate ODS suspicion are disease laterality, symptoms, nasal endoscopy findings, bacterial sinus cultures, and CT findings.

First, the overwhelming majority of ODS is unilateral,[3–11] and therefore providers should suspect an odontogenic source in the setting of unilateral maxillary sinusitis. Regarding symptoms, although cardinal sinusitis symptoms[13] are common in ODS, foul smell is more specific for ODS.[18,20] However, foul smell is not pathognomonic for ODS, as some patients with non-odontogenic sinonasal disease experience foul smell. Additionally, some ODS patients will either have no foul smell, or they will have smell loss that prevents sensing the foul smell.

Regarding nasal endoscopy, purulence is more commonly identified in ODS compared to rhinosinusitis, but edema or polyps can be seen as well.[3,11,18,19,21] Regarding bacterial sinus cultures, sterilely obtained maxillary sinus cultures can help distinguish ODS from rhinosinusitis. Certain α-hemolytic streptococci, anaerobes, and other oral bacteria are more commonly isolated in ODS than in rhinosinusitis,[9,19,21,37–41] and identifying these organisms may increase the likelihood of an odontogenic source.

Regarding CT imaging, maxillary sinus partial to complete opacification is more likely to represent ODS compared to isolated mucosal thickening. Additionally,

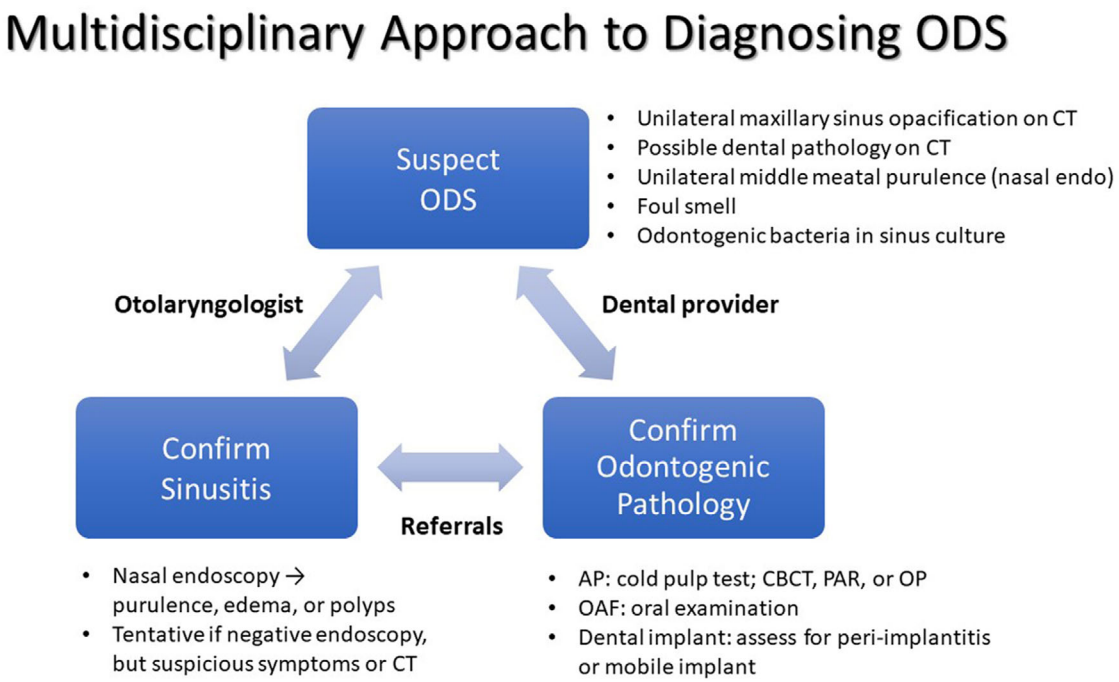

FIGURE 1 Flowchart demonstrating the multidisciplinary nature of diagnosing odontogenic sinusitis (ODS), through evaluations by both otolaryngologists and dental providers. Either provider type may initially evaluate these patients, and he/she assesses for either sinusitis or dental pathology, and then refers to the other provider based on his/her level of suspicion for ODS. Suspicion should be based on the clinical features indicated in the top right portion of this flowchart. Note that unilateral maxillary sinus opacification on computed tomography (CT) alone should arouse suspicion for ODS, even if no overt dental pathology is seen on the CT, and suspicion can be strengthened by the presence of other suspicious features. Additionally, in patients with maxillary sinus opacification on CT, identifying possible maxillary dental pathology makes ODS highly suspicious. Note that, when confirming sinusitis in ODS, symptoms are not required. Nasal endoscopy (endo) findings are the most important means by which sinusitis is confirmed, but in the setting of negative nasal endoscopy, suspicious symptoms or CT findings can tentatively confirm sinusitis. CBCT = cone-beam computed tomography; OP = orthopantomography; PAR = periapical radiography.

although extramaxillary disease extension is common, posterior ethmoid, and sphenoid sinus involvement is less likely.[3,6,7,11,18,41–43] Last, reaching strongest consensus in this study, otolaryngologists should assess for maxillary dental pathology in all patients with maxillary sinus opacification on CT, especially as radiologists frequently miss the odontogenic pathology.[3,7,8] Although the majority of ODS patients will have overt dental pathology on CT, some will have subtle or no dental disease on CT. If there is no dental pathology on CT, one must consider other clinical features to determine the likelihood of ODS.

3.2 | Confirming sinusitis in ODS

Although the previously mentioned clinical features may be more likely in ODS compared to rhinosinusitis, they do not necessarily confirm sinusitis. Based on the ODS literature and consensus from this study, nasal endoscopy was considered the most important method for confirming sinusitis, with CT scan adding further support. Note that this represents a distinction from non-odontogenic rhinosinusitis diagnostic criteria,[13–15] in that sinonasal symptoms are not required to diagnose ODS.

Although sinonasal symptoms are commonly present in ODS, some patients are asymptomatic, and therefore symptoms cannot be required for diagnosing ODS. However, prominent sinonasal symptoms, especially foul smell, can suggest sinusitis. Regarding CT scans, although they can suggest sinusitis by demonstrating sinus opacification or mucosal thickening, these findings are nonspecific, and nasal endoscopy is more effective in confirming infectious sinusitis. One important scenario highlighting the importance of nasal endoscopy over CT is when patients have maxillary sinus mucosal thickening and adjacent dental pathology. Multiple statements in this study achieved consensus that isolated maxillary sinus mucosal thickening and mucus retention cysts on CT generally do not represent ODS, unless there is concurrent nasal endoscopic evidence of infection or inflammation.

Unfortunately, nasal endoscopy findings alone are not 100% specific, as some ODS patients can have normal nasal endoscopies,[44] or other sinus pathologies can have infectious findings on endoscopy. Regardless, nasal endoscopy

was felt to be most reliable for confirming the sinusitis in ODS. However, if nasal endoscopy is normal or cannot be completed, patients could have sinusitis tentatively confirmed based on suspicious symptoms or CT findings (Fig. 1).

3.3 | Confirming odontogenic sources of sinusitis

Confirming odontogenic pathology is pivotal to diagnosing ODS. Endodontic disease, such as AP, due to pulpal necrosis or failing root canal therapy, is one of the most common causes of ODS. Diagnosing endodontic disease requires clinical pulp testing and periapical imaging. Cold, hot, and electric pulp tests help predict pulp vitality based on patients' responses after those respective stimuli are applied to dentition. Pulp test responses are typically absent in ODS because infected teeth are usually nonvital.[45,46] Cold pulp testing is widely available and has been shown to detect pulpal necrosis with a diagnostic accuracy of 82% to 95%,[23,26,47–51] and consensus was reached that it is the optimal initial pulp test if endodontic sources of ODS are suspected.

Regarding dental imaging, multiple studies have demonstrated cone-beam CT being superior to periapical radiography for detecting periapical lesions from AP.[24,25,27,52–54] However, cone-beam CT is more costly, and is not as widely available, and therefore periapical radiography and orthopantomography were also felt to be acceptable initial dental imaging modalities when assessing for periapical disease. Another important point is that AP causing ODS does not always result in an identifiable periapical lesion around the infected tooth. This can occur either from apical disease having not progressed,[25,53] or patients having absent periapical bone around the infected tooth.[7,55] Importantly, dental bite-wing X rays are not acceptable when evaluating for endodontic disease.

Oroantral communications and fistulas are other common causes of ODS, and are diagnosed by oral examination, not CT scan. These can be very small, perhaps pinpoint, and visual inspection alone may be inadequate. Consensus was reached that if an oroantral fistula is not certain on inspection, clinicians should have patients blow their noses against occluded nostrils, and clinicians can probe the potential fistula sites.

Regarding dental implant-related ODS, consensus was reached that all patients with ODS and a prior dental implant should be referred to a dental specialist to determine whether the implant requires removal. ODS can result from multiple causes after dental implants, and, if there is no peri-implantitis and the implant is stable, removal is not always necessary.[32] However, even if the dental implant is stable, if patients have ongoing sinusitis after appropriate antimicrobial therapy and endoscopic sinus surgery, the implant may still be the infectious source.

Another intriguing consideration for odontogenic source confirmation could be bacterial sinus cultures, as they can suggest an odontogenic source. However, because some non-odontogenic rhinosinusitis patients grow odontogenic organisms from their sinuses,[19,21,39] sinus cultures are not confirmatory for ODS. Further research is necessary to determine whether bacterial sinus cultures could facilitate an odontogenic source confirmation in ODS, especially in cases where dental evaluations are inconclusive.

3.4 | Multidisciplinary diagnostic approach to ODS

Strong consensus was reached that a multidisciplinary collaborative approach to diagnosing ODS is generally beneficial, through both otolaryngologist and dental specialist evaluations.

Although treatment outcomes are highly successful when both the dental source and sinusitis are treated,[10,11,32–36] if otolaryngologists miss the dental source or dental providers miss the sinusitis, patients may suffer unnecessarily from ongoing dental or sinonasal symptoms. This highlights the importance of otolaryngologists and dental providers being able to suspect ODS based on clinical features, as described earlier in the Suspecting ODS subsection, additionally to otolaryngologists confirming the sinusitis and dental providers confirming the maxillary dental pathology (Fig. 2).

One simple way to improve both dental providers' and otolaryngologists' abilities to suspect ODS is to inquire consistently about the following clinical features when obtaining patient histories: sinonasal symptoms including foul smell; dental pain; and history of maxillary dental procedures. Other important aspects of multidisciplinary collaboration during ODS evaluations are highlighted by the following clinical scenarios.

3.5 | Important clinical scenarios

1. *Unilateral maxillary sinus opacification on CT, but no overt dental pathology on CT* (Fig. 3). Pokorny and Tataryn showed that 11 of their 31 ODS patients (36%) with no obvious dental pathology on CT had pulpal necrosis on endodontic testing.[7] Consensus was reached in this study that once more concerning pathology is ruled out, patients with

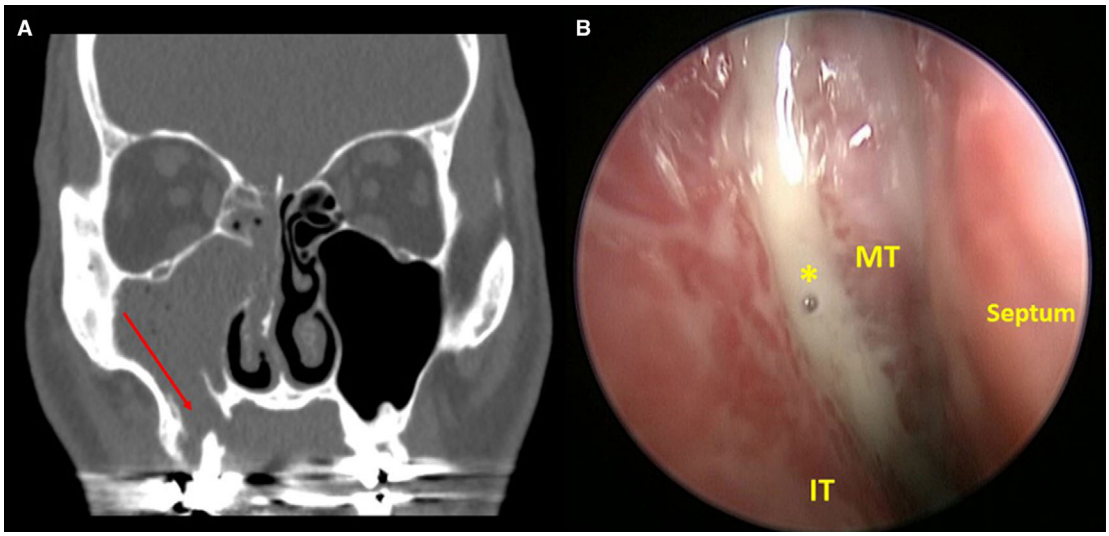

FIGURE 2 Classic example of a patient with odontogenic sinusitis illustrating the multidisciplinary diagnostic approach. The patient had (A) a computed tomography scan demonstrating unilateral right maxillary and ethmoid sinus opacification with an adjacent maxillary molar with a large periapical lesion and alveolar bone expansion and erosion (red arrow), and (B) purulence and edema in the middle meatus (yellow asterisk). The patient was suspected to have ODS, and was referred to an oral surgeon who determined the patient had a carious molar with pulpal necrosis, and both apical and marginal periodontitis. IT = inferior turbinate; MT = middle turbinate.

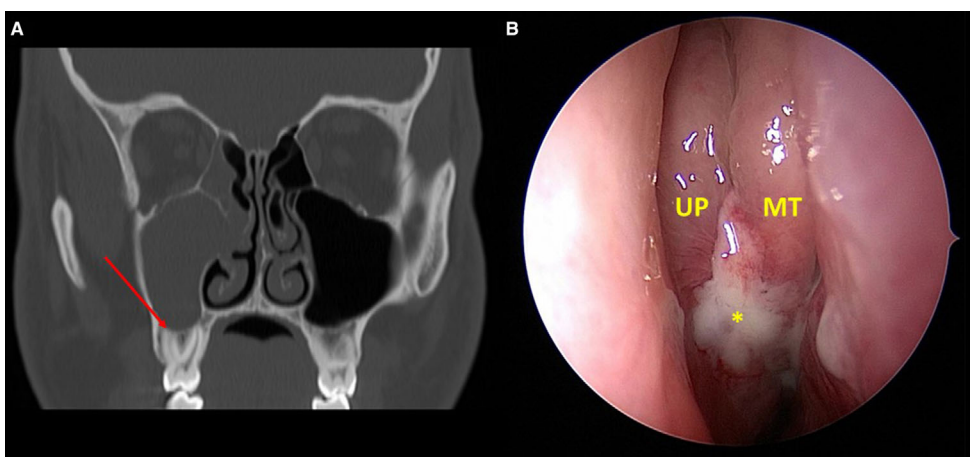

FIGURE 3 Example of a patient with (A) computed tomography scan demonstrating right maxillary sinus opacification and no overt adjacent dental pathology, but absent periapical bone (red arrow), and (B) nasal endoscopy demonstrating purulence (yellow asterisk) and significant edema in the right middle meatus. A middle meatal culture demonstrated *Streptococcus constellatus*. This patient was referred to an endodontist who confirmed apical periodontitis due to pulpal necrosis. Therefore, this was diagnosed as odontogenic sinusitis. MT = middle turbinate; UP = uncinate process.

unexplained unilateral maxillary sinusitis should be referred for dental evaluation.

2. *Dental pathology and any degree of maxillary sinus disease on CT, not necessarily with sinusitis symptoms* (Fig. 4). Because dental providers generally cannot perform in-office nasal endoscopy, it was felt that these patients should be referred to otolaryngologists for nasal endoscopy to confirm or rule-out sinusitis. Although this will result in more patients being referred to otolaryngologists who do not have sinusitis, it should optimize the diagnostic accuracy of patients with possible ODS.
3. *High ODS suspicion based on clinical features but negative dental evaluation*. In these cases, if infectious sinusitis persists despite adequate endoscopic sinus surgery and antimicrobial therapy, providers should consider repeat dental evaluations, because either the initial dental evaluation could have been falsely negative or the dental disease could have progressed and become detectable.

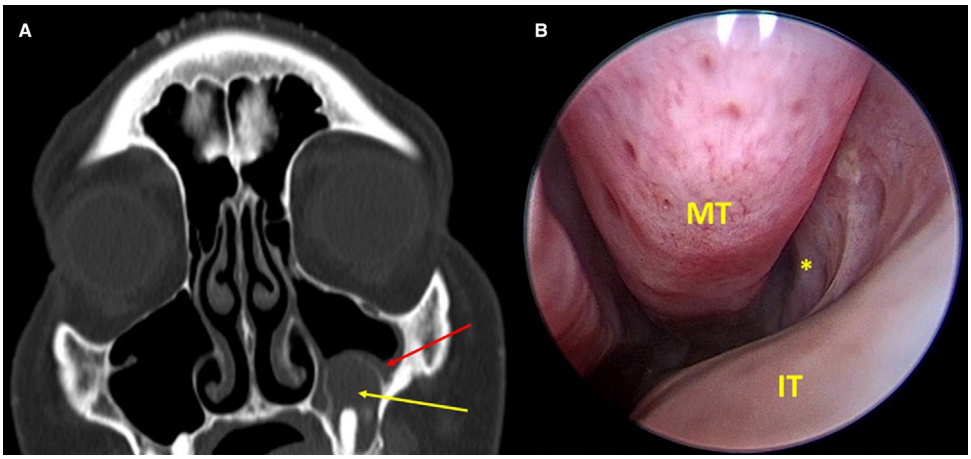

FIGURE 4 Example of a patient with (A) computed tomography scan demonstrating left maxillary sinus isolated mucosal thickening (red arrow) and adjacent large periapical lesion with alveolar bone expansion and erosion (yellow arrow), and (B) nasal endoscopy demonstrating no purulence, edema, or polyps in the left middle meatus (yellow asterisk). Therefore, this patient had reactive sinus mucosal inflammation due to the adjacent dental pathology, but did not have infectious odontogenic sinusitis. IT = inferior turbinate; MT = middle turbinate.

4. *CT showing any maxillary sinus disease after maxillary sinus grafting*. Similar to other scenarios reaching consensus, it was believed that nasal endoscopy is most important in confirming or refuting whether CT findings of opacification or mucosal thickening represents infectious sinusitis. If nasal endoscopy was normal, this would suggest an infected graft, but no ODS.
5. *ODS diagnosed but believed to have no treatable dental pathology* (statement that did not reach consensus). A significant proportion of authors thought these cases should still be referred to dental specialists because there could be residual dental pathology that otolaryngologists could overlook. Therefore, otolaryngologists should consider referring all such ODS patients to dental specialists, regardless of their perception of the dental pathology being treatable or not.

Limitations

Limitations of this study also deserve mention. First, although 8 countries were represented in this CCS, it was not inclusive of all continents, and therefore does not necessarily represent a worldwide view on diagnosing ODS. Second, endodontists and maxillofacial and oral surgeons represented the dental specialist authors, while general dentists and periodontists were not included. Dentists were not included for 2 reasons. First, no general dentists were identified who met the author inclusion criteria, and second, ODS is typically caused by conditions managed by dental specialists, such as periapical abscesses and OAFs. Although dental specialists were considered to be more appropriate for inclusion in this CCS, some bias was introduced in favor of dental specialists evaluating ODS patients. Whether general dentists or dental specialists should evaluate for maxillary dental pathology in ODS patients requires further study. Regarding periodontists, periodontitis represents a small minority of published etiologies of ODS,[56] so it was believed that consensus on diagnosing periodontitis would be less meaningful. Thus, it is important that clinicians be aware periodontitis can cause ODS, and is diagnosed through gingival exam, probing, assessment of periodontal ligament stability, and imaging.[57] Last, fungal sinusitis was omitted from this consensus article because fungal sinusitis due to an odontogenic source has received less attention in the literature, and the dental causes, clinical features, and treatment approaches are often distinct from bacterial ODS. Future studies would be beneficial to distinguish bacterial and fungal sinusitis due to odontogenic pathology or procedures.

In conclusion, based on multidisciplinary international consensus, diagnosing ODS generally requires otolaryngologists to confirm sinusitis, and dental providers to confirm maxillary odontogenic pathology. Importantly, both dental providers and otolaryngologists should suspect ODS based on certain clinical features and should refer patients to appropriate providers for disease confirmation.

ACKNOWLEDGMENTS

The authors thank Natalie Craig, graphic designer, for assistance in formatting the digital images used as figures in this work.

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REFERENCES

1. Albu S, Baciut M. Failures in endoscopic surgery of the maxillary sinus. *Otolaryngol Head Neck Surg*. 2010;142:196-201.
2. Melen I, Lindahl L, Andreasson L, Rundcrantz H. Chronic maxillary sinusitis. Definition, diagnosis and relation to dental infections and nasal polyposis. *Acta Otolaryngol*. 1986;101:320-327.
3. Turfe Z, Ahmad A, Peterson EI, Craig JR. Odontogenic sinusitis is a common cause of unilateral sinus disease with maxillary sinus opacification. *Int Forum Allergy Rhinol*. 2019;9:1515-1520.
4. Troeltzsch M, Pache C, Troeltzsch M, et al. Etiology and clinical characteristics of symptomatic unilateral maxillary sinusitis: a review of 174 cases. *J Craniomaxillofac Surg*. 2015;43:1522-1529.
5. Matsumoto Y, Ikeda T, Yokoi H, Kohno N. Association between odontogenic infections and unilateral sinus opacification. *Auris Nasus Larynx*. 2015;42:288-293.
6. Saibene AM, Pipolo GC, Lozza P, et al. Redefining boundaries in odontogenic sinusitis: a retrospective evaluation of extramaxillary involvement in 315 patients. *Int Forum Allergy Rhinol*. 2014;4:1020-1023.
7. Pokorny A, Tataryn R. Clinical and radiologic findings in a case series of maxillary sinusitis of dental origin. *Int Forum Allergy Rhinol*. 2013;3:973-979.
8. Wang KL, Nichols BG, Poetker DM, Loehrl TA. Odontogenic sinusitis: a case series studying diagnosis and management. *Int Forum Allergy Rhinol*. 2015;5:597-601.
9. Zirk M, Dreiseidler T, Pohl M, et al. Odontogenic sinusitis maxillaris: a retrospective study of 121 cases with surgical intervention. *J Craniomaxillofac Surg*. 2017;45:520-525.
10. Saibene AM, Collura F, Pipolo C, et al. Odontogenic rhinosinusitis and sinonasal complications of dental disease or treatment: prospective validation of a classification and treatment protocol. *Eur Arch Otorhinolaryngol*. 2019;276:401-406.
11. Craig JR, McHugh CI, Griggs ZH, Peterson EI. Optimal timing of endoscopic sinus surgery for odontogenic sinusitis. *Laryngoscope*. 2019;129:1976-1983.
12. Ly D, Hellgren J. Is dental evaluation considered in unilateral maxillary sinusitis? A retrospective case series. *Acta Odontol Scand*. 2018;76:600-604.
13. Rosenfeld RM, Piccirillo JF, Chandrasekhar SS, et al. Clinical practice guideline (update): adult sinusitis. *Otolaryngol Head Neck Surg*. 2015;152(Suppl):S1-S39.
14. Orlandi RR, Kingdom TT, Hwang PH, et al. International consensus statement on allergy and rhinology: rhinosinusitis. *Int Forum Allergy Rhinol*. 2016;6(Suppl 1):S22-209.
15. Fokkens WJ, Lund VJ, Hopkins C, et al. European position paper on rhinosinusitis and nasal polyps 2020. *Rhinology*. 2020;58(Suppl S29):1-464.
16. Orlandi RR, Kingdom TT, Smith TL, et al. International consensus statement on rhinology and allergy: rhinosinusitis. *Int Forum Allergy Rhinol*. 2020; online ahead of print.
17. Allevi F, Fadda GL, Rosso C, et al. Diagnostic criteria for odontogenic sinusitis: a systematic review. *Am J Rhinol Allergy*. 2020; online ahead of print.
18. Goyal VK, Ahmad A, Turfe Z, et al. Predicting odontogenic sinusitis in unilateral sinus disease: a prospective, multivariate analysis. *Am J Rhinol Allergy*. 2020; online ahead of print.
19. Yassin-Kassab A, Bhargava P, Tibbetts RJ, et al. Comparison of bacterial maxillary sinus cultures between odontogenic sinusitis and chronic rhinosinusitis. *Int Forum Allergy Rhinol*. 2021;11:40–47.
20. Simuntis R, Vaitkus J, Kubilius R, et al. Comparison of sino-nasal outcome test 22 symptom scores in rhinogenic and odontogenic sinusitis. *Am J Rhinol Allergy*. 2019;33:44-50.
21. Saibene AM, Vassena C, Pipolo C, et al. Odontogenic and rhinogenic chronic sinusitis: a modern microbiological comparison. *Int Forum Allergy Rhinol*. 2016;6:41-45.
22. Simuntis R, Kubilius R, Padervinskis E, et al. Clinical efficacy of main radiological diagnostic methods for odontogenic maxillary sinusitis. *Eur Arch Otorhinolaryngol*. 2017;274:3651-3658.
23. Mainkar A, Kim SG. Diagnostic accuracy of 5 dental pulp tests: a systematic review and meta-analysis. *J Endod*. 2018;44:694-702.
24. Estrela C, Bueno MR, Leles CR, et al. Accuracy of cone beam computed tomography and panoramic and periapical radiography for detection of apical periodontitis. *J Endod*. 2008;34:273-279.
25. Low KM, Dula K, Burgin W, von Arx T. Comparison of periapical radiography and limited cone-beam tomography in posterior maxillary teeth referred for apical surgery. *J Endod*. 2008;34:557-562.
26. Pigg M, Nixdorf DR, Nguyen RH, et al. Validity of preoperative clinical findings to identify dental pulp status: a National Dental Practice-Based Research Network Study. *J Endod*. 2016;42:935-942.
27. Shahbazian M, Vandewoude C, Wyatt J, Jacobs R. Comparative assessment of periapical radiography and CBCT imaging for radiodiagnostics in the posterior maxilla. *Odontology*. 2015;103:97-104.
28. Shanbhag S, Karnik P, Shirke P, Shanbhag V. Association between periapical lesions and maxillary sinus mucosal thickening: a retrospective cone-beam computed tomographic study. *J Endod*. 2013;39:853-857.
29. Rosenfeld RM, Nnacheta LC, Corrigan MD. Clinical Consensus statement development manual. *Otolaryngol Head Neck Surg*. 2015;153(Suppl 2):S1-S14.
30. Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. *BMJ (Clin Res Ed)*. 2009;339:b2700.
31. Piccirillo JF, Payne SC, Rosenfeld RM, et al. Clinical consensus statement: balloon dilation of the sinuses. *Otolaryngol Head Neck Surg*. 2018;158:203-214.
32. Craig JR, Tataryn RW, Aghaloo TL, et. al. Management of odontogenic sinusitis: multidisciplinary consensus statement. *Int Forum Allergy Rhinol*. 2020;10:901–912.
33. Chiapasco M, Felisati G, Maccari A, et al. The management of complications following displacement of oral implants in the paranasal sinuses: a multicenter clinical report and proposed treatment protocols. *Int J Oral Maxillofac Surg*. 2009;38:1273-1278.

34. Chiapasco M, Felisati G, Zaniboni M, et al. The treatment of sinusitis following maxillary sinus grafting with the association of functional endoscopic sinus surgery (FESS) and an intra-oral approach. *Clin Oral Implants Res*. 2013;24:623-629.
35. Simuntis R, Kubilius R, Tušas P, et al. Chronic odontogenic rhinosinusitis: optimization of surgical treatment indications. *Am J Rhinol Allergy*. 2020;34:767–774.
36. Yoo BJ, Jung SM, Lee HN, et al. Treatment strategy for odontogenic sinusitis. *Am J Rhinol Allergy*. 2020. Online ahead of print.
37. Haider AA, Marino MJ, Yao WC, et al. The potential of high-throughput DNA sequencing of the paranasal sinus microbiome in diagnosing odontogenic sinusitis. *Otolaryngol Head Neck Surg*. 2019;161:1043-1047.
38. Brook I. Microbiology of acute and chronic maxillary sinusitis associated with an odontogenic origin. *Laryngoscope*. 2005;115:823-825.
39. Puglisi S, Privitera S, Maiolino L, et al. Bacteriological findings and antimicrobial resistance in odontogenic and non-odontogenic chronic maxillary sinusitis. *J Med Microbiol*. 2011;60:1353-1359.
40. Brook I. Microbiology of acute sinusitis of odontogenic origin presenting with periorbital cellulitis in children. *Ann Otol Rhinol Laryngol*. 2007;116:386-388.
41. Longhini AB, Ferguson BJ. Clinical aspects of odontogenic maxillary sinusitis: a case series. *Int Forum Allergy Rhinol*. 2011;1:409-415.
42. Crovetto-Martinez R, Martin-Arregui FJ, Zabala-Lopez-de-Maturana A, et al. Frequency of the odontogenic maxillary sinusitis extended to the anterior ethmoid sinus and response to surgical treatment. *Med Oral Patol Oral Cirugia Bucal*. 2014;19:e409-413.
43. Akiyama K, Nakai Y, Samukawa Y, et al. Assessment of simultaneous surgery for odontogenic sinusitis: endoscopic sinus surgery with endoscopic apicoectomy. *J Craniofac Surg*. 2019;30:239-243.
44. Costa F, Emanuelli E, Franz L, et al. Single-step surgical treatment of odontogenic maxillary sinusitis: A retrospective study of 98 cases. *J Craniomaxillofac Surg*. 2019;47:1249-1254.
45. Tataryn RW, Lewis MJ, Horalek AL, Thompson CG, Cha BY, Pokorny AT. *Maxillary sinusitis of endodontic origin: AAE position statement*. Chicago, IL: American Association of Endodontists; 2018. https://www.aae.org/specialty/wp-content/uploads/sites/2/2018/04/AAE_PositionStatement_MaxillarySinusitis.pdf. Accessed May 25, 2020.
46. Levin LG, Law AS, Holland GR, et al. Identify and define all diagnostic terms for pulpal health and disease states. *J Endod*. 2009;35:1645-1657.
47. Petersson K, Soderstrom C, Kiani-Anaraki M, Levy G. Evaluation of the ability of thermal and electrical tests to register pulp vitality. *Endod Dent Traumatol*. 1999;15:127-131.
48. Jespersen JJ, Hellstein J, Williamson A, et al. Evaluation of dental pulp sensibility tests in a clinical setting. *J Endod*. 2014;40:351-354.
49. Gopikrishna V, Tinagupta K, Kandaswamy D. Evaluation of efficacy of a new custom-made pulse oximeter dental probe in comparison with the electrical and thermal tests for assessing pulp vitality. *J Endod*. 2007;33:411-414.
50. Villa-Chavez CE, Patino-Marin N, Loyola-Rodriguez JP, et al. Predictive values of thermal and electrical dental pulp tests: a clinical study. *J Endod*. 2013;39:965-969.
51. Weisleder R, Yamauchi S, Caplan DJ, et al. The validity of pulp testing: a clinical study. *J Am Dent Assoc*. 2009;140:1013-1017.
52. Patel S, Wilson R, Dawood A, Mannocci F. The detection of periapical pathosis using periapical radiography and cone beam computed tomography—part 1: pre-operative status. *Int Endod J*. 2012;45:702-710.
53. Abella F, Patel S, Duran-Sindreu F, et al. An evaluation of the periapical status of teeth with necrotic pulps using periapical radiography and cone-beam computed tomography. *Int Endod J*. 2014;47:387-396.
54. Weissman J, Johnson JD, Anderson M, et al. Association between the presence of apical periodontitis and clinical symptoms in endodontic patients using cone-beam computed tomography and periapical radiographs. *J Endod*. 2015;41:1824-1829.
55. McCarty JL, David RM, Lensing SY, et al. Root cause analysis: an examination of odontogenic origins of acute maxillary sinusitis in both immunocompetent & immunocompromised patients. *J Comput Assist Tomogr*. 2017;41:484-488.
56. Lechien JR, Filleul O, Costa de Araujo P, et al. Chronic maxillary rhinosinusitis of dental origin: a systematic review of 674 patient cases. *Int J Otolaryngol*. 2014;2014:465173.
57. American Academy of Periodontology. Comprehensive periodontal therapy: a statement by the American Academy of Periodontology. *J Periodontol*. 2011;82:943-949.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

How to cite this article: Craig JR, Poetker DM, Aksoy U, et al. Diagnosing odontogenic sinusitis: An international multidisciplinary consensus statement. *Int Forum Allergy Rhinol*. 2021;11:1235-1248. https://doi.org/10.1002/alr.22777