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Optimal Timing of Endoscopic Sinus Surgery for Odontogenic Sinusitis

John R. Craig, MD; Christopher I. McHugh, MD; Zachary H. Griggs, DO; Edward I. Peterson, PhD

Objectives: Odontogenic sinusitis (ODS) is more common than historically reported, and management recommendations are limited in the literature. Although ODS case series have shown successful outcomes with dental treatment and endoscopic sinus surgery (ESS), no studies have considered the optimal timing of these treatments. The purpose of this study was to analyze times to ODS resolution after primary dental treatment and ESS based on symptom, 22-item sinonasal outcome test (SNOT-22), and endoscopic outcomes.

Study Design: Prospective cohort study.

Methods: Thirty-seven symptomatic ODS patients who failed medical management were offered primary dental treatment or ESS. Eleven patients selected primary dental treatment, and 26 patients selected ESS. The following variables were collected prospectively at every office visit before and after dental treatment or ESS: SNOT-22, presence or absence of cardinal sinusitis symptoms, and presence or absence of middle meatal endoscopy findings (edema, polyps, purulence). Times to resolution of these clinical variables were analyzed with t test, chi-square test, Fisher exact test, McNemar test, and Kaplan-Meier survival analysis.

Results: Patients in the dental treatment and ESS groups showed no significant differences in preoperative sinusitis disease burdens based on symptoms, SNOT-22, endoscopy, and computed tomography. The ESS group experienced faster and more significant improvement in nearly all symptom, SNOT-22, and endoscopic outcomes.

Conclusions: For symptomatic ODS, primary ESS resulted in faster resolution of SNOT-22, sinusitis symptoms, and endoscopic findings in ODS patients compared with primary dental treatment. ESS can be considered first-line therapy for symptomatic ODS, followed by dental treatment when necessary.

Key Words: Odontogenic sinusitis, maxillary sinusitis, endoscopic sinus surgery, chronic sinusitis, maxillary sinusitis of endodontic origin.

Level of Evidence: 2b

INTRODUCTION

Odontogenic sinusitis (ODS) is underrepresented in the literature. Early studies suggested that ODS made up 10% to 12% of sinusitis,1,2 but more recent articles suggest that it makes up 25% to 40% of all chronic rhinosinusitis3,4 and 72.6% of unilateral sinus opacification.5 In 2013, Longhini and Ferguson reviewed 85 sinusitis guidelines and found that only 11 (13%) mentioned ODS. Only three guidelines that they reviewed discussed methods to diagnose ODS, and none discussed ODS management.6 In the 2015 Adult Sinusitis Clinical Practice Guidelines, ODS again was not mentioned.7

Regarding ODS pathophysiology, in 1943 Bauer analyzed postmortem histopathologic changes of sinusitis due to various odontogenic pathologies. Bauer showed that inflammation and infection from tooth roots could spread through maxillary alveolar bone and sinus mucosa, thereby causing sinus inflammation and infection.8 Various odontogenic pathologies can cause ODS, including pulpitis, periapical lesions (cysts, abscesses, granulomas), periodontitis, oronasal fistula (OAF), or dental treatment-related sinus foreign bodies.9,10 Large series and meta-analyses have shown that the main dental etiologies of ODS are extraction-related OAFs, periapical, and periodontal disease.11–14

ODS is diagnosed in a fashion similar to other forms of sinusitis: history to detect sinusitis symptoms, nasal endoscopy to assess for inflammation or infection, and computed tomography (CT) imaging to assess sinusitis extent but also maxillary odontogenic pathology. Sinonasal symptoms of ODS are consistent with cardinal symptoms of acute and chronic sinusitis,7 although ODS symptoms are more commonly unilateral.6,13,15–17 Anterior and posterior nasal drainage are most frequently reported in ODS in 60% or more of patients.6,15,16,18 Some series have reported foul smell or taste in 50% to 84% of ODS cases,6,18 whereas other series have reported foul smell or taste in a minority of cases.15,16 Dental symptoms are usually minimal to absent in ODS.6,15,19 Although Pokorny and Tataryn reported a 40% incidence of maxillary tooth pain in their series of predominantly endodontic-related ODS,16 Sinus CT for ODS often shows maxillary odontogenic pathology, but radiologists frequently overlook the dental
Otalaryngologists must therefore carefully assess maxillary dentition on CT. Additionally, one series found that about one-third of ODS cases revealed no dental pathology on sinus CT. Sinus cultures in ODS are usually polymicrobial, with a higher likelihood of anaerobes compared with sinogenic sinusitis. When ODS is suspected, a dental provider should be consulted to perform endodontic and periodontal examinations, as well as dedicated dental imaging to determine if teeth are the likely sinusitis source. Regarding dental imaging, cone beam CT (CBCT) scans are more sensitive and specific than dental radiography in detecting maxillary dental pathology and should be considered even if dental radiography is normal. All of the aforementioned factors make it challenging to distinguish ODS from sinogenic sinusitis.

Although no ODS treatment guidelines exist, published series report excellent success rates with dental treatment, endoscopic sinus surgery (ESS), or both. However, series vary in how often dental treatment, ESS, or both are performed for ODS, as well as the timing of treatments. The purpose of this study was to analyze the times to ODS resolution after primary dental treatment and ESS, based on symptom, 22-item sinonasal outcome test (SNOT-22), and endoscopic outcomes.

MATERIALS AND METHODS

A prospective cohort study was conducted based on prospectively collected data from one rhinologist and multiple dental providers. Institutional review board approval was obtained. Thirty-seven adult ODS patients were included. ODS was diagnosed based on CT findings of unilateral or bilateral maxillary sinus opacification with adjacent maxillary odontogenic pathology, with or without ethmoid and frontal sinus involvement. Odontogenic pathology was confirmed by endodontists or periodontists through endodontic and periodontal examinations as well as through CBCT. Dental pathologies included periapical disease and temporary OAFs from dental extractions (Fig. 1A–B). Of note, ODS from extraction-related temporary OAFs was determined by dental provider documentation, pre- and post-treatment CBCT, and sinusitis symptoms beginning after extraction.

All patients presented first to the rhinologist’s office. Whereas 92% of patients presented due to sinonasal symptoms, 8% were asymptomatic with incidental unilateral sinus opacification on CT. All patients had received at least one 2- to 3-week course of oral antibiotics, although most patients had received multiple oral antibiotic courses by the time of consultation.

When ODS was suspected, a dental provider was consulted. If ODS was confirmed and medical therapy failed, patients were offered primary dental treatment or ESS. It was explained that although diseased teeth should be treated, frequently both the teeth and sinuses would have to be treated. Patients made their decisions after discussion with the rhinologist and dental provider. The following variables were collected prospectively at every office visit with the rhinologist before and after dental or surgical treatment: presence or absence of sinusitis symptoms (anterior and posterior nasal drainage, nasal obstruction, facial pressure, hyposmia or anosmia, foul smell and taste), SNOT-22, and presence or absence of middle mental endoscopy findings (edema, polyps, purulence). Figure 2 shows representative nasal endoscopy findings.

For primary dental treatment, dental providers performed either root canals or dental extractions and variably prescribed postprocedural oral antibiotics for up to 1 week. Patients were then followed by the rhinologist 1 month after dental treatment, then every 3 months for the first year. If patients later elected to have ESS, clinical outcomes were only measured until the time of ESS.

For primary ESS, surgery was only performed on the side or sides of ODS. Diseased sinuses were opened widely by established endoscopic techniques. Sinuses were opened surgically if preoperative sinus CT demonstrated complete or near-complete sinus opacification, or if sinuses were draining pus intraoperatively. After ESS, patients received 10 days of amoxicillin/clavulanate (or clindamycin if penicillin-allergic). High-volume sinonasal saline irrigations were initiated three times daily as well. Patients were followed at 1 week, 2 to 3 weeks, and 4 to 6 weeks postoperatively to ensure patent sinonasal cavities. Once the sinuses were healed, patients were followed every 3 months the first year. Some of the ESS patients then underwent dental treatment. Clinical outcomes were measured until the time of dental treatments postoperatively.

Patients were excluded from both treatment groups if they had undergone ESS previously, regardless of indication. Patients were excluded from the ESS group if they had prior dental procedures intended to treat ODS.

Statistical analysis was carried out using SAS version 9.4 (SAS Institute Inc., Cary, NC). Prevalence of the various clinical variables was compared between the two treatment groups using a chi-square
test (for two proportions). If the sample size was small, a Fisher exact test was used. Paired prevalences of the given clinical variables were compared within each group pre- and posttreatment using McNemar test for matched proportions. In both the above analyses, "pre-" represented the initial value and "post-" the last observed value. SNOT-22 was a continuous variable; thus, pre- and posttreatment differences were analyzed with a paired t test.

Kaplan-Meier curves were generated to compare times to resolution of ODS clinical outcomes between dental treatment and ESS groups. Resolution of sinusitis symptoms and endoscopy findings, as well as SNOT-22 reduction of ≥9, were considered events for the survival analysis. SNOT-22 reduction of ≥9 has been shown to be clinically significant. Median time to each outcome resolution was estimated. Hazard ratios (HR) were generated through the Cox proportional hazards model. The HR represented how likely ESS was to resolve a given clinical variable in a given time period relative to dental treatment.

RESULTS

Of the 37 study patients, 11 selected primary dental treatment and 26 selected ESS. Table I shows preoperative demographic and clinical data of all patients (age, gender, dental pathology, sinusitis extent on CT, SNOT-22, symptom incidence and duration, and endoscopy findings). Table II compares preoperative patient demographic and clinical data in dental treatment versus ESS groups, except for symptoms and endoscopy findings, which are included in Table III. There was no significant difference between the two treatment groups based on preoperative symptoms, SNOT-22, endoscopy findings, and sinusitis extent on CT. Regarding dental pathology, the ESS group had patients with both periapical disease (53.9%) and extraction-related temporary OAFs (46.1%), whereas all dental treatment patients had periapical disease. Overall, patients received 2.6 ± 1.6 oral antibiotics before undergoing dental treatment or ESS.

Table III shows the comparison of sinusitis symptoms and endoscopy findings between dental treatment and ESS groups before and after treatments. Table IV shows the analysis of whether the changes in sinusitis symptoms and endoscopy findings were significant within each treatment group.

### TABLE I.
Preoperative Demographic and Clinical Data for All Patients.

<table>
<thead>
<tr>
<th>Patient Variables</th>
<th>All Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>53.4</td>
</tr>
<tr>
<td>Gender (%)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>62.2</td>
</tr>
<tr>
<td>Female</td>
<td>35.1</td>
</tr>
<tr>
<td>Dental pathology (%)</td>
<td></td>
</tr>
<tr>
<td>Periapical</td>
<td>67.6</td>
</tr>
<tr>
<td>Temporary OAF</td>
<td>32.4</td>
</tr>
<tr>
<td>Unilateral disease (%)</td>
<td>89.2</td>
</tr>
<tr>
<td>Sinusitis extent on CT (%)</td>
<td></td>
</tr>
<tr>
<td>Maxillary</td>
<td>13.9</td>
</tr>
<tr>
<td>Maxillary + AE</td>
<td>25</td>
</tr>
<tr>
<td>Maxillary, AE, frontal</td>
<td>61.1</td>
</tr>
<tr>
<td>Extra-maxillary</td>
<td>86.1</td>
</tr>
<tr>
<td>SNOT-22 (mean)</td>
<td>37.9</td>
</tr>
<tr>
<td>Symptom duration (median, months)</td>
<td>6</td>
</tr>
<tr>
<td>Symptoms (%)</td>
<td></td>
</tr>
<tr>
<td>Anterior drainage</td>
<td>75.7</td>
</tr>
<tr>
<td>Posterior drainage</td>
<td>70.3</td>
</tr>
<tr>
<td>Nasal obstruction</td>
<td>64.9</td>
</tr>
<tr>
<td>Facial pressure</td>
<td>62.2</td>
</tr>
<tr>
<td>Hyposmia/anosmia</td>
<td>29.7</td>
</tr>
<tr>
<td>Foul smell/taste</td>
<td>35.1</td>
</tr>
<tr>
<td>Endoscopic findings (%)</td>
<td></td>
</tr>
<tr>
<td>Edema</td>
<td>43.2</td>
</tr>
<tr>
<td>Polyps</td>
<td>16.2</td>
</tr>
<tr>
<td>Purulence</td>
<td>75.7</td>
</tr>
</tbody>
</table>

AE = anterior ethmoid; CT = computed tomography; OAF = oroantral fistula; SNOT-22 = 22-Item Sino-Nasal Outcome Test.
Among the dental treatment patients, four had root canals and seven had extractions. Patients were followed for an average of 77.5 ± 66.5 days after treatment. The mean pretreatment SNOT-22 score was 32.6, and mean SNOT-22 change posttreatment was 0 ± 14.8 (P = 1.000). Of the 11 patients, seven (63.6%) failed to improve after dental treatment, and five of the seven patients then underwent ESS. The other two patients who failed dental treatment elected not to undergo ESS. Four of 11 patients (36.4%) improved symptomatically, endoscopically, and by SNOT-22 improvement was significantly greater than that of the dental treatment group (P = 0.004). After ESS and before subsequent dental treatment, all 26 patients experienced sinusitis resolution without recurrence with regard to symptoms, endoscopic findings, and clinically significant SNOT-22 reductions. Of the 14 patients with periapical disease, seven underwent dental treatment at an average 34.3 days postoperatively (two root canals, five extractions). Of the other seven patients who chose not to undergo dental treatment after ESS, none developed recurrent sinusitis symptoms, SNOT-22, or endoscopic worsening (mean follow-up, 213.6 ± 152.4 days). No complications occurred during or after ESS, and no revision ESS was required during the follow-up period. There were no significant differences in clinical outcomes based on dental procedure type. No complications, such as OAFs or chronic pain, occurred from dental procedures during the study period.

For the ESS group, patients were followed for an average 146.6 ± 195 days postoperatively. The mean preoperative SNOT-22 score was 40.2, and mean SNOT-22 change postoperatively was 28.7 ± 24.8 (P = 0.001). The ESS group’s mean SNOT-22 improvement was significantly greater than that of the dental treatment group (P = 0.004). After ESS and before subsequent dental treatment, all 26 patients experienced sinusitis resolution without recurrence with regard to symptoms, endoscopic findings, and clinically significant SNOT-22 reductions. Of the 14 patients with periapical disease, seven underwent dental treatment at an average 34.3 days postoperatively (two root canals, five extractions). Of the other seven patients who chose not to undergo dental treatment after ESS, none developed recurrent sinusitis symptoms, SNOT-22, or endoscopic worsening (mean follow-up, 213.6 ± 152.4 days). No complications occurred during or after ESS, and no revision ESS was required during the study period.

On subset analyses stratifying dental treatment and ESS outcomes by dental pathology and sinusitis extent on CT, neither dental pathology nor sinusitis extent affected outcomes in either treatment group. Regarding sinusitis extent, outcomes were compared between maxillary and extramaxillary sinusitis.

Kaplan-Meier curves showed that nearly all symptoms, SNOT-22 scores, and endoscopy findings improved faster and more significantly after ESS (Fig. 3). The only nonsignificant difference between the two treatment groups occurred for hyposmia and anosmia. Table V shows the median times to outcomes resolutions and HRs for each treatment group.

**DISCUSSION**

ODS is more common than historically reported, and its incidence has been increasing over the last decade. Physicians should consider ODS in the differential diagnosis of every sinusitis patient, especially when unilateral. ODS more often presents with chronic symptoms (>3 months), consistent with the current study. However, acute sinusitis with or without orbital or intracranial complications can also arise from an odontogenic source.

In symptomatic ODS, sinus symptoms usually outweigh dental symptoms, with patients often having no dental complaints. ODS management should aim to address the most prominent symptoms first, while still achieving a long-term cure.

Oral antibiotics alone are ineffective for ODS, but may improve symptoms temporarily until definitive
dental or surgical intervention is performed. The current study reinforced this; patients had an average 2.6 oral antibiotic courses without long-term relief, ultimately requiring dental treatment or ESS.

Dental treatment may be appropriate for some forms of ODS with pulpal, periapical, or periodontal disease. Dental treatments include root canal, apicoectomy, or dental extraction.19 The American Academy of Endodontics published a 2018 position statement on maxillary sinusitis of endodontic origin, suggesting that dental treatment should be performed first, followed by ESS only if needed.19 To support this position, the authors cited case reports or series showing full resolution of maxillary ODS following endodontic treatment.33–35 They also referenced Tomomatsu et al.25 for their assessment of 39 maxillary ODS patients who underwent primary endodontic therapy or extraction plus 3 months of oral antibiotics. Patients were followed for sinusitis resolution, defined as either resolution of inflammation on CT or of sinusitis symptoms. Sinusitis symptoms were mentioned (pain, swelling, headache, and sense of incongruity), but there was no detailed explanation of the symptoms or description of which symptoms resolved. Other cardinal sinusitis symptoms were not reported. Based on their definition of sinusitis resolution, 20 patients completely resolved after dental treatment alone (51.2% success). Nineteen patients remained symptomatic and required ESS, which ultimately cured them. Of note, time to sinusitis resolution was not reported, and follow-up duration of the dental treatment group was limited to 3 months, immediately after completion of the prolonged antibiotic course. No long-term follow-up was reported.

Longhini and Ferguson published a case series of 21 ODS patients. Nineteen of these patients resolved after dental extraction; thus, they suggested that dental treatment should precede ESS.6 They did not report time to disease resolution or how clinical outcome measures responded to interventions (i.e., symptoms, quality of life, or endoscopy findings). Other indirect evidence suggesting dental treatment should precede ESS when managing ODS comes from studies showing that unrecognized odontogenic pathology can lead to ESS failure.3,36 Although these studies suggest that dental treatment is necessary for complete ODS resolution, they do not provide evidence that dental treatment must precede ESS. An interesting finding from the current study was that sinusitis recurrence after primary ESS for ODS was not imminent. Actually, no ESS patients with endodontic disease had their sinusitis recur symptomatically or endoscopically up to the time of their postoperative dental treatments, and this was also true for ESS patients who never received dental treatment during the follow-up period. This suggests either that patients were not followed long enough or that perhaps some dental pathology in ODS is reversible.

Wang et al. performed a retrospective chart review of 55 ODS patients, analyzing 31 of the patients’ treatment outcomes. Treatments included antibiotics alone, dental treatment, ESS, or a combination. Twenty-one patients resolved; of those, seven (33%) resolved with ESS alone; seven (33%) resolved with concurrent ESS plus dental treatment; two (10%) resolved with dental treatment alone; two (10%) resolved with antibiotics alone; two (10%) resolved with ESS after failing dental treatment; and one (5%) resolved with antibiotics after failing dental treatment. ODS resolution was defined by absence of inflammation on nasal endoscopy or sinus CT, with an average follow-up of 5 months.20 The researchers did not discuss sinusitis symptoms. Overall, the study showed that most ODS patients resolved after treatment, although heterogenous treatment groups made it difficult to draw conclusions regarding optimal treatment timing.

The previously mentioned studies show that dental treatment, with or without ESS, ultimately cures the majority of ODS patients. However, no studies have proposed an optimal sequence of treatments because no studies have analyzed the time course of ODS resolution after dental treatment and ESS. The current study showed that, regardless of dental pathology and sinusitis extent, ESS led to a more rapid resolution of sinusitis symptoms, SNOT-22, and endoscopy findings. These findings suggest that ESS can be considered a primary treatment for ODS to improve patients’ short-term clinical outcomes until they are deemed appropriate for dental treatment.

Some strengths of the study are worth highlighting. First, prospective data collection allowed for complete...
and accurate pre- and postprocedural data for both cohorts. No ODS study to date has analyzed all the outcome measures reported in the current study, and these metrics are integral to measuring sinusitis treatment success. Second, the two treatment cohorts had equivalent, significant preoperative sinusitis burdens based on symptoms, SNOT-22, endoscopy, and CT. Therefore, the significant differences in outcomes can be attributed to treatment types rather than differences in disease severity. Lastly, the Kaplan-Meier analysis provided a novel demonstration of time to resolution of ODS clinical outcomes, allowing one to conclude that symptomatic ODS resolves faster with primary ESS.

Study limitations should also be discussed. First, the sample size was small, especially for the dental treatment group. However, the sample size was still large enough to

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**Fig. 3.** Kaplan-Meier curves highlighting the times to resolution of a representative subset of sinusitis symptoms and nasal endoscopy findings, and clinically significant SNOT-22 reductions of SNOT-22 reduction of $\geq 9$, for dental treatment versus endoscopic sinus surgery groups. Other Kaplan-Meier analyses are summarized in Table V. HR = hazard ratio; SNOT-22 = 22-Item Sino-Nasal Outcome Test. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]
TABLE V.
Median Times to Resolution of Sinusitis Symptoms and Endoscopy Findings, and SNOT-22 Reduction of ≥9, for the Dental Treatment and Endoscopic Sinus Surgery Groups.

<table>
<thead>
<tr>
<th>Clinical Outcome Measures</th>
<th>Median Days to Resolution (dental treatment)</th>
<th>Median Days to Resolution (ESS)</th>
<th>Hazard Ratio*</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior drainage</td>
<td>45.5</td>
<td>8.5</td>
<td>8.24</td>
<td>0.002</td>
</tr>
<tr>
<td>Posterior drainage</td>
<td>48</td>
<td>8</td>
<td>9.32</td>
<td>0.004</td>
</tr>
<tr>
<td>Nasal obstruction</td>
<td>38†</td>
<td>9</td>
<td>5.25</td>
<td>0.01</td>
</tr>
<tr>
<td>Facial pressure</td>
<td>48</td>
<td>9</td>
<td>2.97</td>
<td>0.026</td>
</tr>
<tr>
<td>Hyposmia/anosmia</td>
<td>35</td>
<td>8</td>
<td>2.33</td>
<td>0.306</td>
</tr>
<tr>
<td>Foul smell/taste</td>
<td>49</td>
<td>7</td>
<td>11.2</td>
<td>0.025</td>
</tr>
<tr>
<td>Edema (endoscopic)</td>
<td>49</td>
<td>9</td>
<td>15.27</td>
<td>0.011</td>
</tr>
<tr>
<td>Polyps (endoscopic)</td>
<td>49</td>
<td>8</td>
<td>NA</td>
<td>0.139</td>
</tr>
<tr>
<td>Purulence (endoscopic)</td>
<td>53.6†</td>
<td>7</td>
<td>10.14</td>
<td>0.003</td>
</tr>
<tr>
<td>SNOT-22 improvement</td>
<td>56.2†</td>
<td>12.5</td>
<td>9.97</td>
<td>0.002</td>
</tr>
</tbody>
</table>

*Hazard ratios show how much more likely and faster ESS patients were to have resolution of a given symptom, SNOT-22 improvement, or endoscopic finding. P values <0.05 were considered statistically significant (bold).
†Mean time reported because median time could not be estimated.
ESS = endoscopic sinus surgery; SNOT-22 = 22-Item Sino-Nasal Outcome Test.

demonstrate significantly different outcomes between ESS and dental treatments. Another potential limitation was the effect of combining periapical disease and temporary OAF patients in the ESS outcomes analysis. However, subset analyses showed no significant differences in sinusitis extent or clinical outcomes between the dental pathologies. Therefore, any confounding by combining both dental pathologies for outcomes analysis was minimized. Third, in the absence of randomization, bias was introduced when patients selected primary dental treatment versus ESS. Although patients themselves made the choice, unintentional influence could have been introduced by either the rhinologist or the dental provider. A randomized study would be optimal to determine what preoperative factors predict whether ODS patients undergo primary dental treatment or ESS. Lastly, it is theoretically possible that a longer duration of oral antibiotics could have improved the time to resolution of primary dental treatment patients once the dental source was eliminated. A separate study with a larger sample size of dentally treated patients would be necessary to determine whether oral antibiotics would significantly speed their sinusitis resolution.

An ODS management paradigm could be proposed by integrating the findings from the current study with previous studies. When ODS is suspected, a multidisciplinary plan should be developed between an otolaryngologist and dental provider to treat both sinus and dental pathology. If the sinusitis disease burden is low based on symptoms, SNOT-22, endoscopy, and CT, primary dental treatment could be performed. Posttreatment follow-up by an otolaryngologist would then be implemented to monitor for sinusitis resolution. However, if the sinusitis disease burden is high, primary ESS could be recommended, followed by close dental follow-up and treatment as needed. The latter approach would still ensure odontogenic source control and could also lead to improved sinonasal symptoms and quality of life until definitive dental treatment could be performed. Lastly, it could still be acceptable for ODS patients with high sinusitis disease burdens to choose primary dental treatment. They could then be counseled about the possibility of requiring ESS due to slower or incomplete sinusitis resolution.

CONCLUSION
For symptomatic ODS, primary ESS resulted in faster resolution of sinusitis symptoms, SNOT-22, and endoscopic findings in ODS patients compared with primary dental treatment. ESS can be considered first-line therapy for symptomatic ODS, followed by dental treatment when necessary.

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