Original Article

American Journal of Rhinology & Allergy
2021, Vol. 35(2) 206–212

DOI: 10.1177/1945892420946969
journals.sagepub.com/home/ajr
SAGE

Treatment Strategy for Odontogenic Sinusitis

Byung Joon Yoo, MD[1], Seon Min Jung, MD[1], Ha Na Lee, MD[1], Hyung Gu Kim, MD[1], Jae Ho Chung, MD, PhD[1], and Jin Hyeok Jeong, MD, PhD[1]

Abstract

Background: The treatment options for odontogenic sinusitis (OS) include medical management including antibiotics and saline nasal irrigation, endoscopic sinus surgery (ESS), and dental treatment.

Objective: The purpose of this study was to evaluate whether OS caused by dental caries and periapical abscess can be cured by dental treatment alone and which patients should consider surgery early.

Methods: A total of 33 patients with OS caused by dental caries and periapical abscess were enrolled. Patients with OS caused by dental implants, trauma, surgery, or tooth extraction were excluded. All patients were initially treated with dental treatment and medical management without ESS. The patients were divided into two groups according to the results of dental treatment and multiple clinical parameters were compared between the two groups.

Results: Among the 33 enrolled patients, 22 patients (67%) were cured with dental and medical management, and 11 patients (33%) required ESS after the failure of dental and medical management. Based on the multivariate analysis results, patients who were smokers (OR 33.4) and had a higher Lund-Mackay score on CT (OR 2.0) required ESS after the failure of dental and medical treatment.

Conclusions: Two-thirds of the patients with OS caused by dental caries and periapical abscess were cured with dental treatment and medical management without ESS. We recommend dental treatment and medical management first in OS caused by dental caries and periapical abscess. However, we recommend early ESS in patients with smoking habits and severe CT findings of the sinus.

Keywords

sinusitis, odontogenic, odontogenic sinusitis, endoscopic sinus surgery, dental infection, dental treatment, chronic rhinosinusitis, dental caries, periapical abscess, dental sinusitis

Introduction

Odontogenic sinusitis (OS) accounts for approximately 10∼40% of all maxillary sinusitis, and its prevalence is increasing due to the increase in the elderly population.[1–3] There are many opinions on the treatment methods for OS: medical management including antibiotics and saline nasal irrigation, dental treatment including tooth root canal therapy and tooth extraction, and endoscopic sinus surgery (ESS).[4–6] However, because the management protocol of OS is not well established, doctors are often unsure about the best treatment strategy to follow - dental treatment first, ESS first, or both simultaneously.[7–9]

Odontogenic sinusitis is defined as sinusitis of dental origin. The causes of OS include infection arising from the maxillary molar teeth, maxillary dental trauma, and dental procedures such as extraction or the use of implants.[4,7,10]

There have been several studies on the treatment protocol for OS, but most of them included sinusitis due to trauma, extraction, or the use of implants.[9,11,12] Since

[1]Department of Otolaryngology-Head and Neck Surgery, Hanyang University College of Medicine, Seoul, Korea

Corresponding Author:
Jin Hyeok Jeong, Department of Otolaryngology-Head and Neck Surgery, Hanyang University College of Medicine, 222, Wangsimni-ro, Seongdong-gu, Seoul 04763, Korea.
Email: ent@hanyang.ac.kr

ESS is often performed in patients with OS due to trauma, extraction, or the use of implants, it can have a false influence in determining the treatment protocol for OS caused by endodontic disease or periapical lesions.[13–16]

Patients with OS visiting the otorhinolaryngology department tended to undergo ESS in the early stages if they did not show improvement with antibiotics.[9,17] The importance of dental treatment is often overlooked. The necessity to undergo ESS in the early stages is controversial because some cases have been reported to be cured with medical management and dental treatment alone.[11,12] Moreover, if the causative teeth were not treated, sinusitis might persist after ESS.[17]

The purpose of this study was to evaluate the treatment results of the strategy that prioritized dental treatment and medical management among the treatment strategies of OS.

Materials and Methods

This study was reviewed and approved by our Institutional Review Board (IRB FILE No: 2018-09-020).

This is a prospective cohort study of 33 patients diagnosed with OS based on their symptoms, physical examination, nasal endoscopic finding, paranasal sinus CT, and dental examination. We only included patients with OS that originated from a definite bony defect of the maxillary floor due to dental caries and periapical abscess using paranasal sinus CT, between July 2010 and May 2019. Patients with OS caused by implants, trauma, surgery, or tooth extraction were excluded. All 33 patients initially underwent dental treatment with medical management including oral antibiotics and saline nasal irrigation without ESS.

All 33 patients were divided into two groups based on the results of the dental treatment such as root canal therapy or tooth extraction: group cured without ESS and the group that underwent ESS after a failure to cure with dental treatment alone. We compared the clinical characteristics, endoscopic findings, and CT findings of the two groups. Endoscopic purulent rhinorrhea (absent = 0, mild = 1, moderate = 2, and severe = 3) and uncinate bulging (absent = 0, mild = 1, and severe = 2) were subjectively scored by a single doctor. The severity of CT findings was presented as Lund-Mackay scores.[18,19] We have additionally used a personally designed maxillary haziness score to evaluate the severity of the maxillary sinus alone (clear = 0, 0 ~ 25% = 1, 25~50% = 2, 50~75% = 3, 75~100% = 4). The causative teeth were identified by caries and bone defects as observed in the paranasal sinus CT. The number of causative teeth and the size of the bone defect around the causative teeth were measured to determine if they affected treatment outcomes.

A complete cure after dental treatment was defined as the absence of sinus and dental symptoms, no purulent rhinorrhea nor postnasal drip on nasal endoscopy, and no abnormal findings on paranasal simple X-ray (Figures 1 and 2). The outcomes were evaluated at outpatient clinic visits every 1~2 weeks.

Statistical analysis was carried out using the Pearson's chi-square test, independent t-test, and Mann-Whitney U-test. In addition, univariate and multivariate logistic regression analysis was carried out in order to construct a predictive model. The statistical analysis was performed using the Statistical Package for the Social Sciences version 20.0 (SPSS Inc., Chicago, IL, USA), and a p-value <0.05 was considered statistically significant.

Results

All 33 patients were initially treated with dental treatment, along with medication and saline nasal irrigation without ESS. Of the 33 patients included in this study, 22 patients (67%) were cured by medication and dental treatment without ESS, while 11 patients (33%) had to undergo ESS after dental treatment to cure the OS (Table 1). The duration of antibiotic use was 23.95 ± 11.32 days and the time taken to cure was 37.23 ± 26.07 days in the group that was cured by medical management and dental treatment without ESS (Figures 1 and 2).

We compared many parameters between the two groups. Patients with hypertension ($p = 0.049$), smokers ($p = 0.002$), patients with a high Lund-Mackay score on CT ($p = 0.001$), and patients with severe purulent rhinorrhea on nasal endoscopy ($p = 0.018$) were statistically more likely to undergo ESS after failure to treat with dental treatment. According to the results of the multivariate analysis, smoking habit (OR 33.4) and a high Lund-Mackay score on CT (OR 2.0) were found to be significantly different between the two groups (Table 2).

There was no statistically significant difference between the number of affected teeth, the size of the periapical abscess, and the size of the maxillary sinus floor bony defect. Of the 33 study patients, 29 patients underwent tooth extraction and 4 patients underwent root canal therapy as a part of their dental treatment. The patients who underwent extraction were significantly older than those who underwent root canal treatment ($p = 0.006$). There was no statistically significant difference in the results of OS treatment between the extraction group and root canal therapy group.

Discussion

There are many opinions on the treatment order for OS, and there have been several studies on the treatment strategies for OS. A study by Wang et al. suggested that an appropriate combination of medication, dental

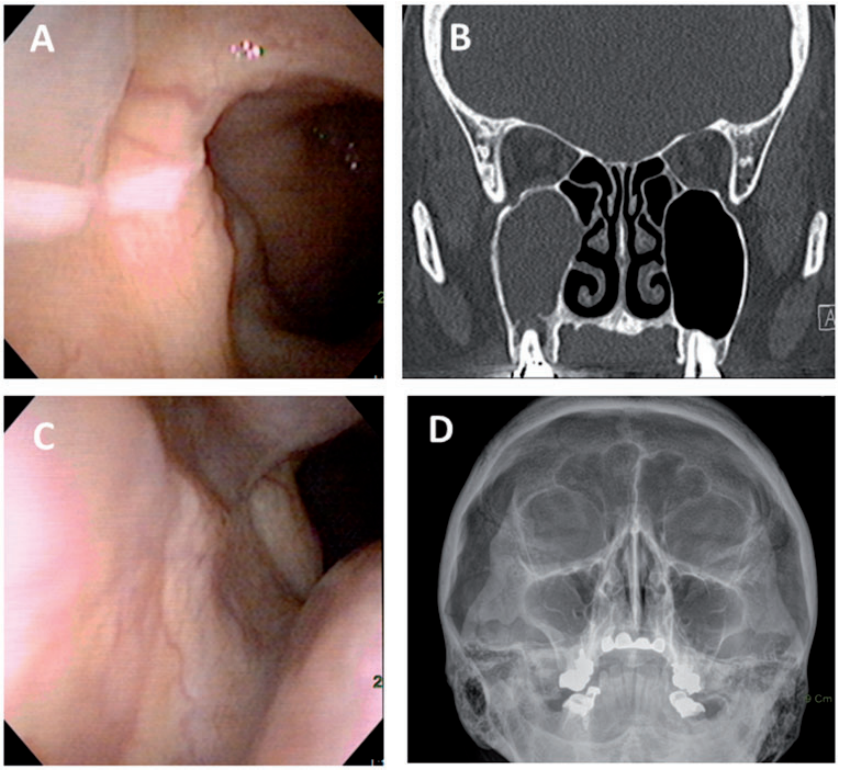

Figure 1. Representative CT, X-ray, and endoscopy findings of the odontogenic sinusitis cured by dental root therapy. (A) Purulent drainage from the right maxillary sinus into the nasopharynx before treatment. (B) Periapical abscess and defect of the right maxillary floor before treatment. (C) No discharge after treatment. (D) Clear maxillary sinus after treatment.

treatment, and ESS should be applied to each patient for the treatment of OS.[11] In their study, no treatment strategy was established; therefore, the 55 enrolled patients were treated without any specific principles. Overall, 21 (38%) patients had disease resolution. Of these 21 patients, 7 (33%) resolved with ESS alone, 7 (33%) resolved with concurrent ESS and dental surgery, 2 (10%) resolved with dental surgery alone, 2 (10%) resolved with ESS after failure to treat with dental treatment, 2 (10%) resolved with medical management alone, and 1 (5%) resolved with medical management after failure to treat with dental treatment. Therefore, they concluded that the management of OS needs to be tailored to each individual patient and involves varying combinations of medical management, dental treatment, and ESS. Additionally, in their study, there were many heterogeneous OS patients who already had an oro-antral fistula (OAF) after tooth extraction or retained a maxillary dental hardware like implant.

Although there are several studies that have explored the role of ESS in OS, most of them included sinusitis caused by extraction, or the use of implants.[9,11,12] ESS is often performed when OS is due to extraction, or the use of implants.[7,13,14] Dental treatment is not necessary and ESS should be primarily performed in cases of extraction. In cases due to the use of dental implants, sinusitis is usually caused by a perforated Schneiderian membrane at the maxillary floor because of the augmentation or extruded and displaced implant material into the maxillary sinus.[13–16] Implant related OS is usually treated with early ESS to remove displaced augmentation materials such as bone particles, blood clots and hemostatic materials.[14,15] Thus, if these materials and pus are removed and the maxillary sinusitis improves after ESS, most of the implant fixture can be preserved.[13,14] Treatment protocol for OS caused by extraction, or use of implants can have a false influence in determining the treatment protocol for OS caused by dental caries and periapical abscess. Therefore, we studied only OS caused by dental caries and periapical abscess.

Before this study, we preferentially performed ESS first before the dental treatment to improve sinusitis early on if the antibiotics did not improve OS. Recently, studies by Craig et al. suggested that upfront ESS is just as effective as dental treatment, and in fact, many patients achieve symptom resolution faster with primary ESS.[9] They concluded that primary ESS resulted in faster resolution of SNOT-22, sinusitis symptoms, and endoscopic findings in OS patients when compared with primary dental treatment. From the point of view of sinusitis, it is natural that sinusitis improves

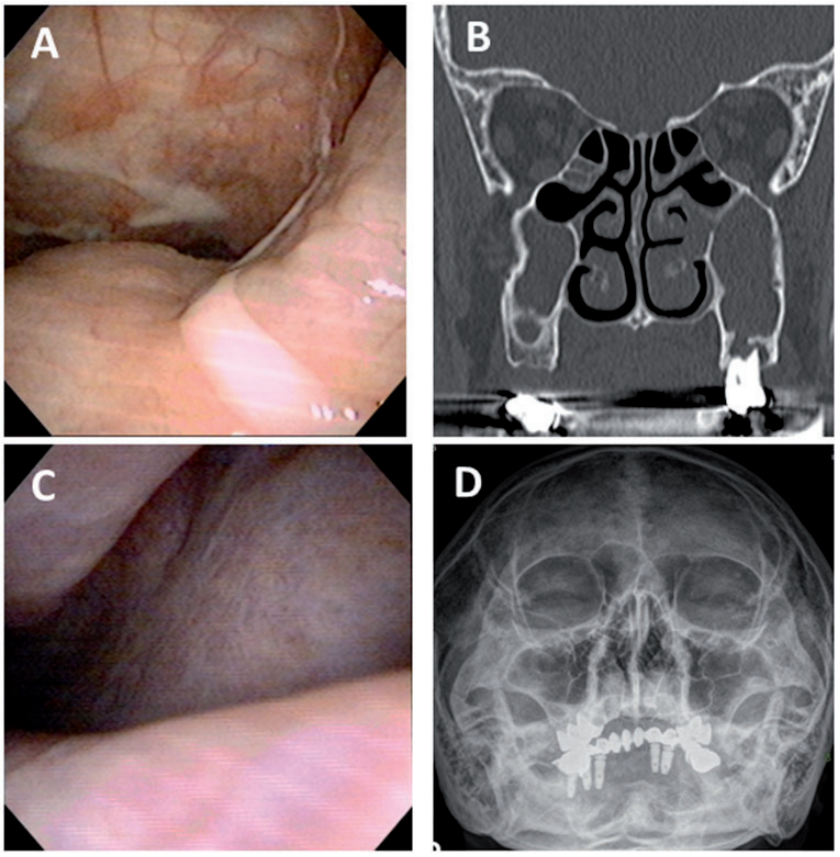

Figure 2. Representative CT, X-ray, and endoscopy findings of the odontogenic sinusitis cured by dental extraction. (A) Purulent drainage from the left maxillary sinus into the nasopharynx before treatment. (B) Periapical abscess and defect of the left maxillary floor before treatment. (C) No discharge after treatment. (D) Clear maxillary sinus after treatment.

faster with ESS than with dental treatment. However, from a pathophysiological point of view, it would be more reasonable to remove the causative pathological tooth first. In addition, if sinusitis is fully cured by dental treatment alone, unnecessary surgery can be avoided, thereby reducing the discomfort and perioperative risk that can be caused by ESS and reducing the overall medical expenses incurred. Furthermore, in their study Craig et al. included 12 temporary OAF patients in whom OS was caused after tooth extraction out of 37 subjects. These patients should be excluded because their only option was to undergo ESS as there was no tooth to treat.

In our study, all 33 patients were first subjected to dental treatment, and 22 (67%) out of 33 patients were completely cured by dental treatment alone. In another study, Mattos et al. reported that 52% of 43 patients who were treated with dental treatment and medical management without ESS were cured,[12] which is similar to the results of our study. However, since the study by Mattos et al. also included 7 patients who already had an OAF after tooth extraction or retained maxillary dental hardware, they eventually had to undergo ESS. If they were excluded, the percentage of patients cured by dental treatment alone was expected to increase as in our study results.

Another concern is to know in advance the patients who will not be cured with only dental treatment and will eventually have to undergo ESS. This would be useful since it would allow the chance to undergo early ESS to prevent prolonged treatment. In our study, 11 (33%) out of 33 patients were not cured with initial dental treatment, and therefore ESS had to be performed. Mattos et al. published a study regarding the predictive factors in patients undergoing ESS for OS.[12] They reported that patients who underwent ESS had significantly higher total Lund-Mackay scores than those who did not. Based on their multivariate analysis results, prior dental procedures and ostiomeatal complex (OMC) involvement significantly increased the likelihood of requiring ESS.

Based on our multivariate analysis results, only including patients with OS caused by dental caries and periapical abscess, those who were smokers, and those who showed higher Lund-Mackay scores were the ones who eventually underwent ESS. Tobacco smoke

Table 1. Demographic and Clinical Characteristics of the Study Population.

Variables	All Patients (%) (n = 33)	Treatment Type: Only Dental Treatment (n = 22)	Treatment Type: Dental Treatment and Endoscopic Sinus Surgery (n=11)	*p*
Sex:				.218
Male	25 (75.76)	15 (68.18)	10 (90.91)	
Female	8 (24.24)	7 (31.82)	1 (9.1)	
Age (years)	52.15 ± 13.94	52.14 ± 13.46	56.00 ± 15.22	.462
Underlying disease:				
Hypertension	10 (30.30)	4 (18.18)	6 (54.55)	.049*
Diabetes mellitus	3 (9.09)	1 (4.55)	2 (18.18)	.252
Smoking	7 (21.21)	1 (4.55)	6 (54.55)	.002*
Symptoms:				
Purulent rhinorrhea	26 (78.79)	17 (77.27)	9 (81.82)	1.000
Postnasal drip	27 (81.82)	19 (86.36)	8 (72.73)	.375
Nasal obstruction	14 (42.42)	7 (31.82)	7 (63.64)	.136
Foul odor	15 (45.45)	11 (50)	4 (36.36)	.712
Dental pain	8 (24.24)	5 (22.73)	3 (27.27)	1.000
Facial pain	9 (27.27)	5 (22.73)	4 (36.36)	.438
Endoscopic score:				
Purulent rhinorrhea	1.42 ± 0.66	1.23 ± 0.61	1.82 ± 0.60	.018*
Uncinate bulging	1.39 ± 0.50	1.32 ± 0.48	1.55 ± 0.52	.215
CT score:				
Lund-Mackay score	4.67 ± 2.27	3.36 ± 1.22	7.27 ± 1.49	.000*
Maxillary haziness	3.97 ± 1.07	3.77 ± 1.07	4.36 ± 1.03	.068
Duration of antibiotic use (days)	30.15 ± 16.34	23.95 ± 11.32	42.55 ± 18.22	.007*
Duration for complete cure (days)	65.97 ± 56.55	37.23 ± 26.07	123.45 ± 57.90	.000*

*p value < .05.

Table 2. Multivariate Logistic Regression Analysis Results.

Variables	Surgery: OR	Surgery: 95% CI	*p*
Hypertension	7.363	0.659–82.283	.105
Smoking	33.398	1.656–673.633	.022*
Lund-Mackay score	1.981	1.038–3.780	.038*
Purulent rhinorrhea on endoscopy	1.389	0.153–12.586	.770

*p value < .05.

stimulates the nasal mucosa, increases intranasal air resistance, and causes physiological responses such as nasal congestion and rhinorrhea.[18] It also affects the cilia of the nasal cavity and sinus mucosal epithelium, leading to pathophysiological changes of the mucous membrane causing sinusitis by diminishing the mucociliary clearance.[18] Lieu and Feinstein conducted a study on the prevalence of smoking and sinusitis and found that smokers showed a significantly higher prevalence of sinusitis when compared with non-smokers.[19] These results further suggest that smokers were more likely to require ESS after the failure of dental treatment. However, since their sample size was small (6 in the ESS group vs 1 in the dental treatment group), future studies will be necessary to validate these results.

The Lund-Mackay score is the most commonly used method for evaluating sinus CT scans according to the location of the lesions in the sinuses, depending on partial or complete turbidity.[20] It is used to assess the extent and degree of disease in chronic sinusitis.[21] Similar to the study by Mattos et al., even in our study the Lund-Mackay score of the patients who underwent ESS was significantly higher than that of the patients cured by dental treatment alone.[12] Since a higher score indicated that more sinuses were involved beyond the maxillary sinus, if the degree and extent of sinusitis were severe and wide, then ESS was necessary to achieve a complete cure.

Another consideration point is OAF after tooth extraction. If the ESS is delayed, the possibility of occurrence of permanent OAF after extraction can increase because the dental caries and bone destruction progress. If the tooth is extracted under active inflammation, OAF may increase too. So, if the dental caries and the bony destruction at the maxillary floor are severe, the ESS may be done first to control

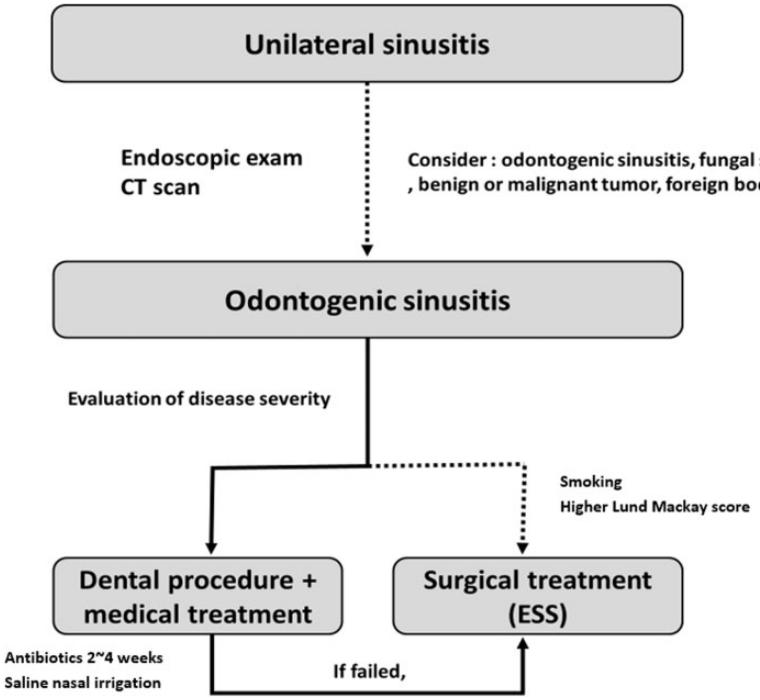

Figure 3. Schematic of the treatment flow of odontogenic sinusitis (CT: computed tomography; ESS: endoscopic sinus surgery).

inflammation before tooth extraction. Our study excluded OAF patients after tooth extraction. And in 29 cases extracted prior to ESS, there was no permanent OAF that needed to be closed afterwards. Since we used antibiotics for 3–4 weeks after extraction and waiting time did not exceed 3–4 weeks, additional bone destruction and permanent OAF was not considered.[22] Further study would be needed in the future. Oroantral fistula should be considered when making treatment decision as permanent OAF causes significant clinical and economic burden.

One major limitation of our study is that the study design was based on a relatively small sample size of 33 patients. Further studies will need larger sample sizes and more research on the various factors that are necessary to screen patients requiring early ESS.

Based on our results, we propose a treatment strategy for OS caused by dental caries and periapical abscess (Figure 3). In the case of unilateral sinusitis, physical examination, including history taking, endoscopic examination, and sinus CT should be performed for the differential diagnosis of not only OS, but also to detect benign or malignant sinus tumors, fungal sinusitis, and foreign bodies in the sinus. When a patient is diagnosed with OS caused by dental caries and periapical abscess, we recommend dental treatment along with medical treatment first, including antibiotics and saline irrigation. However, if the patient is found to be a smoker with a high Lund-Mackay score at the initial diagnosis, we recommend early ESS.

Conclusion

Two-thirds (67%) of the OS patients caused by dental caries and periapical abscess were cured with dental treatment and medical management without ESS. Therefore, we recommend dental treatment and medical management first in OS caused by dental caries and periapical abscess. It can also help to remove the causative origin of sinusitis and to avoid unnecessary sinus surgery. However, we recommend early ESS in patients with smoking habits and severe CT findings of the sinus.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical Approval

This study was reviewed and approved by the Institutional Review Board of Hanyang University Guri Hospital (IRB FILE No: 2018-09-020) and informed consent was obtained from all participants before the study.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was supported by the research fund of Hanyang University (HY-2017).

ORCID iD

Jin Hyeok Jeong https://orcid.org/0000-0001-8424-3998

References

1. Mehra P, Jeong D. Maxillary sinusitis of odontogenic origin. *Curr Allergy Asthma Rep*. 2009;9(3):238–243.
2. Hoskison E, Daniel M, Rowson JE, Jones NS. Evidence of an increase in the incidence of odontogenic sinusitis over the last decade in the UK. *J Laryngol Otol*. 2012;126(1):43–46.
3. Ly D, Hellgren J. Is dental evaluation considered in unilateral maxillary sinusitis? A retrospective case series. *Acta Odontol Scand*. 2018;76(8):600–604.
4. Brook I. Sinusitis of odontogenic origin. *Otolaryngol Head Neck Surg*. 2006;135(3):349–355.
5. Patel NA, Ferguson BJ. Odontogenic sinusitis: an ancient but under-appreciated cause of maxillary sinusitis. *Curr Opin Otolaryngol Head Neck Surg*. 2012;20(1):24–28.
6. Lopatin AS, Sysolyatin SP, Sysolyatin PG, Melnikov MN. Chronic maxillary sinusitis of dental origin: is external surgical approach mandatory? *Laryngoscope*. 2002; 112(6):1056–1059.
7. Lee KC, Lee SJ. Clinical features and treatments of odontogenic sinusitis. *Yonsei Med J*. 2010;51(6):932–937.
8. Longhini AB, Ferguson BJ. Clinical aspects of odontogenic maxillary sinusitis: a case series. *Int Forum Allergy Rhinol*. 2011;1(5):409–415.
9. Craig JR, McHugh CI, Griggs ZH, Peterson EI. Optimal timing of endoscopic sinus surgery for odontogenic sinusitis. *Laryngoscope*. 2019;129(9):1976–1983.
10. Biafora M, Bertazzoni G, Trimarchi M. Maxillary sinusitis caused by dental implants extending into the maxillary sinus and the nasal cavities. *J Prosthodont*. 2014;23(3):227–231.
11. Wang KL, Nichols BG, Poetker DM, Loehrl TA. Odontogenic sinusitis: a case series studying diagnosis and management. *Int Forum Allergy Rhinol*. 2015;5(7):597–601.
12. Mattos JL, Ferguson BJ, Lee S. Predictive factors in patients undergoing endoscopic sinus surgery for odontogenic sinusitis. *Int Forum Allergy Rhinol*. 2016;6(7):697–700.
13. Kim SJ, Park JS, Kim HT, Lee CH, Park YH, Bae JH. Clinical features and treatment outcomes of dental implant-related paranasal sinusitis: a 2-year prospective observational study. *Clin Oral Implants Res*. 2016;27(11): e100–e104.
14. Chen YW, Huang CC, Chang PH, et al. The characteristics and new treatment paradigm of dental implant-related chronic rhinosinusitis. *Am J Rhinol Allergy*. 2013;27(3):237–244.
15. Nolan PJ, Freeman K, Kraut RA. Correlation between Schneiderian membrane perforation and sinus lift graft outcome: a retrospective evaluation of 359 augmented sinus. *J Oral Maxillofac Surg*. 2014;72(1):47–52.
16. Kayabasoglu G, Nacar A, Altundag A, Cayonu M, Muhtarogullari M, Cingi C. A retrospective analysis of the relationship between rhinosinusitis and sinus lift dental implantation. *Head Face Med*. 2014;10(1):53.
17. Choi KY, Mo JH, Chung YJ. Analysis of treatment outcome associated with pre-operative diagnostic accuracy changes and dental treatment timing in odontogenic sinusitis involving unilateral maxillary sinus. *Korean J Otolaryngol Head Neck*. 2019;62(11):624–630.
18. Reh DD, Higgins TS, Smith TL. Impact of tobacco smoke on chronic rhinosinusitis: a review of the literature. *Int Forum Allergy Rhinol*. 2012;2(5):362–369.
19. Lieu JE, Feinstein AR. Confirmations and surprises in the association of tobacco use with sinusitis. *Arch Otolaryngol Head Neck Surg*. 2000;126(8):940–946.
20. Lund VJ, Mackay IS. Staging in rhinosinusitis. *Rhinology*. 1993;31(4):183–184.
21. Hopkins C, Browne JP, Slack R, Lund V, Brown P. The Lund-Mackay staging system for chronic rhinosinusitis: how is it used and what does it predict? *Otolaryngol Head Neck Surg*. 2007;137(4):555–561.
22. Tsuzuki K, Kuroda K, Hashimoto K, et al. Odontogenic chronic rhinosinusitis patients undergoing tooth extraction: oral surgeon and otolaryngologist viewpoints and appropriate management. *J Laryngol Otol*. 2020;134(3):241–246.