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Efficacy of endoscopic sinus surgery in management of odontogenic maxillary sinusitis after control of dental pathology

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Abstract

Background Odontogenic sinusitis (ODS) has clinical features like rhinogenic sinusitis. Although it is usually unilateral, diagnostic overlap could happen. However, ODS necessitates different management which includes dental intervention to eliminate the dental infection source. In some patients, ODS may persist even after management of dental pathology. The aim of this study was to assess the clinical features, and diagnostic criteria of ODS that is persistent after management of dental pathology, and to evaluate the efficacy of endoscopic sinus surgery (ESS) as a therapeutic option of the disease.

Methods Twenty patients were included in this study. All patients were presented with ODS refractory to medical treatment after management of their dental problems. Clinical features of the patients were analyzed. Also, endoscopic nasal examination and computed tomography of paranasal sinuses (CT) were performed for all patients. ESS were used, with widening of the maxillary ostium for drainage. Follow-up was carried out for at least 6 months.

Results All patients had unilateral disease, with 3 main complaints: malodourous nasal discharge (90%), facial pain (75%), and nasal obstruction (45%). Endoscopic nasal examination showed either middle meatal purulence (70%) or polypoid mucosa (30%). CT showed either thickened maxillary sinus mucosa (50%), or complete maxillary opacity (50%) with retained foreign body in 2 patients (10%). After ESS, all patients reported relieve of their sinonasal symptoms, and nasal endoscopy showed patent middle meatus, with one patient demonstrated adhesions between the middle turbinate and lateral nasal wall which was asymptomatic.

Conclusion Prior dental intervention is a suspicious diagnostic landmark for ODS, and unilateral foul nasal discharge is the main prevalent complaint. Nasal endoscopy usually shows purulence or polypoid mucosa in the middle meatus, and CT is a good diagnostic tool for ODS. ESS with good widening of the maxillary ostium is an effective therapeutic option for those patients.

Keywords Odontogenic sinusitis, Sinusitis of dental origin, Dental sinusitis, Malodourous nasal discharge, Facial pain, Endoscopic sinus surgery

Introduction

Odontogenic sinusitis (ODS) is a different well-known entity of sinusitis, it constitutes about one third of chronic maxillary sinusitis [1, 2]. The intimate anatomical relations of the upper maxillary teeth to the maxillary sinus floor could help the development of odontogenic infection to the maxillary sinus [3]. The first and second molars are the most closely related teeth to the floor of the maxillary sinus. The bony wall that separates the

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dental roots from the sinus cavity varies in thickness, it ranges from complete loss where the roots are covered only by mucoperiosteum (Fig. 1) to a thickness of more than 12 mm [4, 5]. However, projected dental roots in the sinus cavity can often be secondary to well pneumatization of the maxillary sinus and not essentially related to dental pathology [6]. Even when there is a thick bony floor, vascular and lymphatic channels which connect the periodontal membrane to the maxillary bone marrow are present. These channels could lead to ascending inflammatory reaction resulting in decrease of the ciliary motility of the sinus with development of ODS [5].

Patients with ODS may present with sinonasal symptoms like unilateral nasal obstruction, malodourous discharge, headache, and postnasal drip. Dental pain may be present; however, it does not essentially indicate an odontogenic origin as rhinogenic maxillary sinusitis may present with referred pain to the teeth [2]. Those patients are frequently referred to otolaryngologists presented with persistent symptoms despite maximal management by dental providers [3].

Pathophysiology and microbiology of ODS differs from rhinogenic sinusitis, the commonest organisms claimed in development of ODS is the oral anaerobic bacterial flora [7]. Dynamic polymicrobial biofilms of bacterial strains which replicate and have a constant metabolism, they incorporate into a matrix rich in exopolysaccharides, proteins, and nucleic acids [8]. So, conventional treatment for chronic rhinosinusitis could often fail in ODS [6]. Failure to accurately identify the dental cause in patients with ODS can lead to persistence of the disease and failure of treatment [1]. However, treatment of the offending tooth by dental procedures especially endodontic treatment such as root canal therapy may be insufficient in treatment of ODS, and endoscopic sinus surgery (ESS) with good ventilation of the maxillary sinus may be required as a treatment option [9]. The aim of this study was to assess the clinical features, and diagnostic criteria of ODS that is persistent after management of dental pathology, and to evaluate the efficacy of ESS as a therapeutic option of the disease.

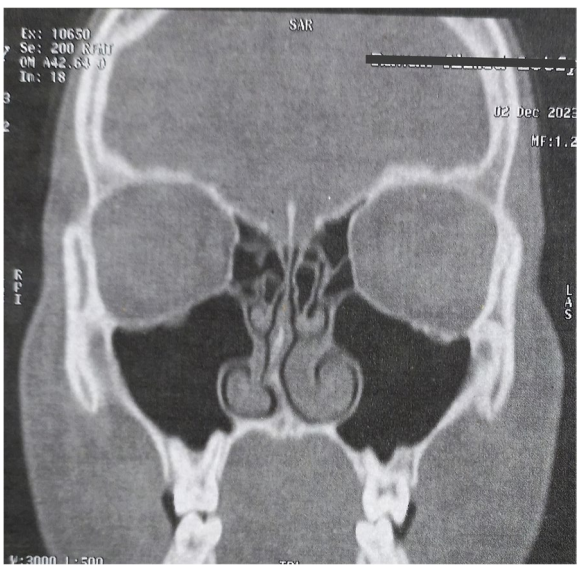

Fig. 1 Computed tomography of paranasal sinuses shows dental roots projected into the floor of the maxillary sinus with no bone in-between

Methods

We called colleagues of College of Dentistry of our institute to refer patients with odontogenic sinusitis (ODS) refractory to medical treatment after management of their dental problems. For initial diagnosis of ODS, we followed the international multidisciplinary consensus statements for diagnostic criteria of ODS which was reported by Craig et al. [10], and clinical data described by Martu et al. [8]: patients' histories of sinonasal symptoms including nasal obstruction, purulent nasal discharge, foul smell; dental pain; and/or history of maxillary dental procedures. The study was carried out in the period between October 2019 and October 2022. Informed written consent was obtained from the patients, and the principles outlined in the Declaration of Helsinki were followed. In addition, the research protocol was approved by the ethics committee of our institute (CMR-M-2019–08).

All patients were subjected to the following protocol:

Preoperative evaluation

Medical history was obtained from the patients, emphasizing on sinonasal symptoms, including nasal obstruction, nasal discharge, facial pain, headache, and foul smell. Type of previous dental problem, and interventions were extracted from medical records of the patients. Also, nasal examination was performed, using anterior rhinoscopy and nasal endoscopy with inspection of the middle meatus. In addition, oral examination was done to exclude any obvious pathology. Computed tomography (CT) of paranasal sinuses (coronal and axial cuts) was performed for all patients. Radiographic diagnosis of maxillary sinusitis was established depending on partial or complete opacification of the maxillary sinus; however, a thickening of the maxillary sinus mucosa greater than 3 mm represents a pathological finding [8].

Clinical data of the patients were analyzed including age and sex of the patients, CT findings, involved sinuses, offending tooth, and dental procedures that were done for patients.

Endoscopic sinus surgery

Under general anesthesia with oral endotracheal intubation, patients were positioned supine with head up in 45°. The procedure started with decongestion of the area of middle meatus near the uncinate process through injection of lidocaine with epinephrine (1% lidocaine with 1:100,000 epinephrine). We performed the procedure, using rigid 0°, and 30° 4 mm endoscope (Karl Storz, Tuttlingen, Germany). Complete uncinectomy was performed to expose the maxillary ostium, the middle turbinate was gently medialized if needed. Uncinectomy was done through incision by a sickle knife at the most anterior limit of the uncinate process, which is usually softer on palpation in comparison to the hard lacrimal bone, in which the nasolacrimal duct is located. Then, a Blakesley forceps was used to grasp the uncinate edge and remove it.

After removal of the uncinate process, the natural ostium of the maxillary sinus could be clearly seen. The maxillary ostium is usually at the level of the inferior edge of the middle turbinate between its anterior one third and posterior two thirds. Polypoid mucosa was removed, and a cutting instrument was used to circumferentially enlarge the ostium especially in postero-inferior direction. Care should be taken to avoid injury of the nasolacrimal duct anteriorly. The maxillary sinus cavity was inspected by the endoscope, any retained foreign body was extracted by angled forceps, and the unhealthy mucosa was removed, also suction of maxillary sinus discharge was performed.

Endoscopic anterior ethmoidectomy was performed for patients with radiographic involvement of anterior ethmoid sinus. After achievement of hemostasis, a merocele nasal pack was introduced in the operative side.

Postoperative follow-up

All patients were discharged from hospital in the next postoperative day. Nasal pack was removed before discharge, and antibiotic was prescribed for 1 week. Patients were instructed to perform nasal saline irrigation twice daily for at least 2 weeks. Also, they were guided to return weekly for suction and cleaning of the operative nasal side for at least 1 month, then monthly follow-up was carried out for at least 6 months. After 6 months, all patients were asked about sinonasal symptoms that were present preoperatively, also we performed office-based endoscopic nasal examination to see the middle meatus.

Results

This prospective study included 20 patients with ODS. Table 1 summarizes the patients' data (written informed consent for the publication of these data were obtained

Table 1 Clinical characteristics of the patients

№	Age	Sex	Most destressing complaint	Offending tooth	Dental procedure	Endoscopic finding	CT findings
1	35	F	Foul discharge	1st molar	ROAF	Purulent discharge	TMSM
2	39	M	Nasal obst	2nd molar	DE	Purulent discharge	COMS
3	50	F	Foul discharge	1st molar	Apicoectomy	Purulent discharge	COMS + OAES
4	48	F	Foul discharge	1st molar	Apicoectomy	Purulent discharge	COMS + FBMS
5	32	F	Facial pain	2nd premolar	ROAF	Polypoid mucosa	TMSM
6	55	M	Foul discharge	1st molar	ROAF	Purulent discharge	TMSM
7	37	M	Facial pain	3rd molar	DRF	Purulent discharge	COMS
8	40	F	Foul discharge	1st molar	DRF	Purulent discharge	TMSM
9	29	F	Foul discharge	2nd premolar	DE	Purulent discharge	COMS
10	38	M	Facial pain	2nd molar	ROAF	Polypoid mucosa	TMSM
11	51	M	Nasal obst	3rd molar	DE	Purulent discharge	COMS
12	27	F	Nasal obst	1st molar	DE	Polypoid mucosa	TMSM
13	36	F	Facial pain	2nd premolar	ROAF	Polypoid mucosa	COMS
14	42	M	Foul discharge	2nd molar	ROAF	Purulent discharge	COMS
15	30	F	Foul discharge	2nd molar	ROAF	Purulent discharge	TMSM
16	52	M	Facial pain	1st molar	DRF	Polypoid mucosa	TMSM
17	37	F	Facial pain	2nd premolar	ROAF	Polypoid mucosa	TMSM
18	45	F	Foul discharge	3rd molar	DRF	Purulent discharge	COMS
19	31	F	Foul discharge	2nd molar	ROAF	Purulent discharge	TMSM
20	57	M	Facial pain	1st molar	Apicoectomy	Purulent discharge	COMS + FBMS

F Female, *M* Male, *Obst* obstruction, *ROAF* Repair of oroantral fistula, *DRF* Dental root filling, *DE* Dental extraction, *CT* Computed tomography, *TMSM* Thickened maxillary sinus mucosa, *COMS* Complete opacity of maxillary sinus, *OAES* Opacity of anterior ethmoid sinus, *FBMS* Foreign body in maxillary sinus

from the participants). They were 12 female and 8 male patients, with their ages ranged between 27 and 57 years (40.55 ± 9.08). The disease was diagnosed unilaterally in all patients, on the side of previous dental pathology. The patients suffered 3 main complaints; unilateral foul nasal discharge (18 patients, 90%), unilateral facial pain over the cheek (15 patients, 75%), and unilateral nasal obstruction (9 patients, 45%). The most distressing symptom was foul nasal discharge in 50% of patients, facial pain in 35% of patients, and nasal obstruction in 15% of patients. The offending tooth was the first molar in 40% of patients, the second molar in 25% of patients, the second premolar in 20% of patients, and the third molar in 15% of patients. Regarding previous dental problems: 9 patients (45%) had chronic oroantral fistula from previous dental pathology, they underwent repair of their fistulae using buccal flap in 6 and mucoperiosteal flap in 3 patients; 4 patients (20%) underwent extraction of their offending teeth; 4 patients (20%) underwent dental root filling; and 3 patients (15%) underwent apicoectomy.

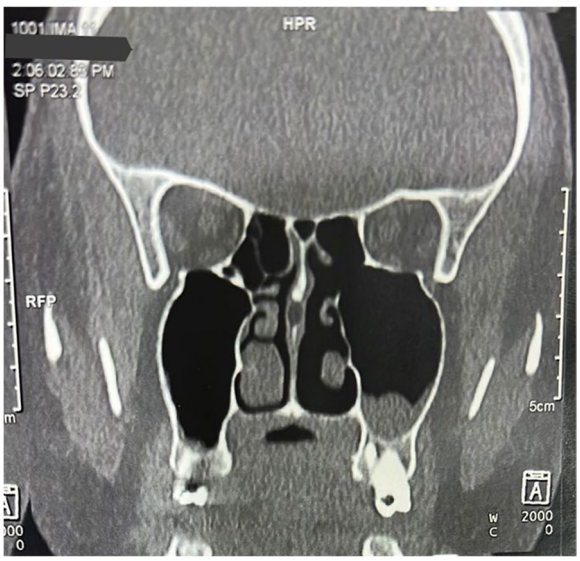

Fig. 2 Computed tomography of paranasal sinuses shows thickened left maxillary sinus mucosa at the floor related to the 2nd premolar tooth

Anterior rhinoscopy and nasal endoscopy showed copious purulent greenish-yellow nasal discharge coming out from the middle meatus in 14 patients (70%), this discharge has a peculiar character which is rapid recollection after suction. Polypoid congested mucosa prolapsed from the middle meatus were seen in 6 patients (30%). CT of paranasal sinuses showed thickening of the maxillary sinus mucosa (Fig. 2) in 10 patients (50%). However, the other 10 patients (50%) had complete opacity of the maxillary sinus (Fig. 3), with 2 of them had foreign bodies (amalgam) in their maxillary sinus (Fig. 4), one had associated opacity of the anterior ethmoid sinus (Table 1).

Endoscopic sinus surgery (ESS) was performed for all patients. The procedure was done uneventfully with widening of the maxillary sinus ostium. Purulent discharge was detected in sinus cavity in all patients, 2 patients showed retained foreign bodies which were removed easily. Anterior ethmoidectomy was performed for one patient who had involved anterior ethmoid sinus.

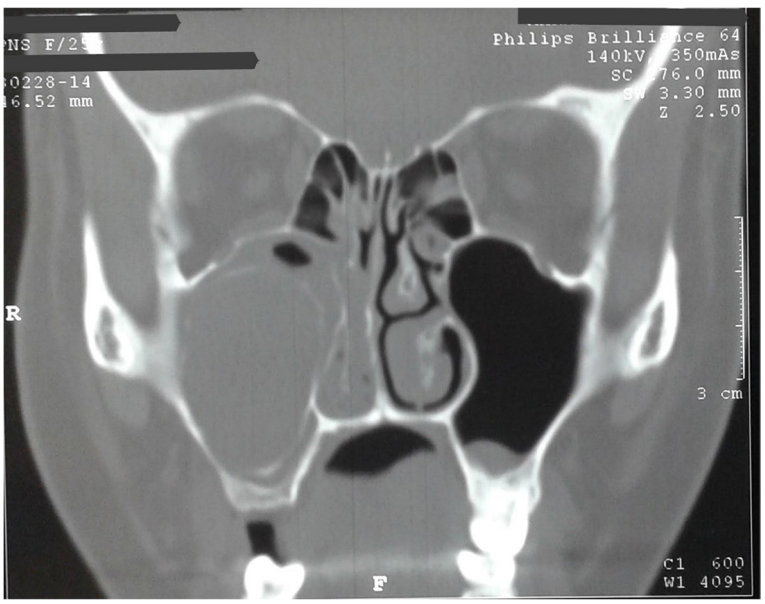

Fig. 3 Computed tomography of paranasal sinuses shows complete opacity of right maxillary sinus after extraction the right 1st molar tooth

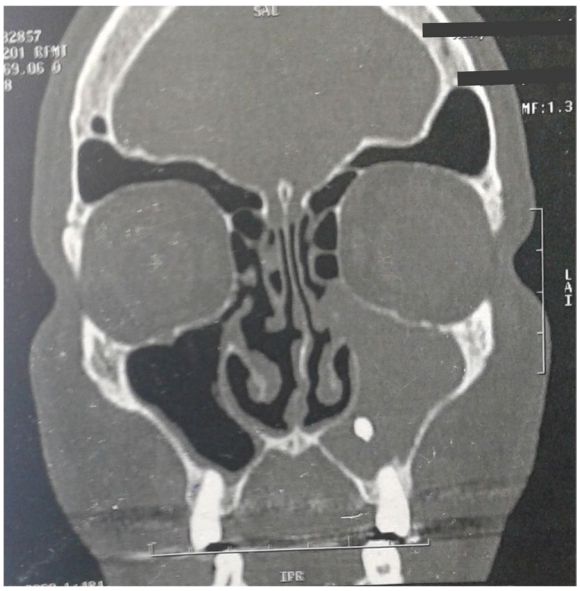

Fig. 4 Computed tomography of paranasal sinuses shows complete opacity of left maxillary sinus with retained foreign body (amalgam) after dental intervention

By the end of 6 months follow-up, all patients reported relieve of their sinonasal symptoms. Endoscopic nasal examination showed patent middle meatus, with one patient demonstrated adhesions between the middle turbinate and lateral nasal wall which was asymptomatic and left untouched.

Discussion

ODS has clinical features like rhinogenic sinusitis; facial pain, foul nasal discharge, nasal obstruction, and postnasal drip are the main symptoms of the disease. These symptoms may be present in rhinogenic sinusitis, and diagnostic overlap could happen; however, ODS necessitates different management. Treatment of ODS includes removal of dental infection and drainage of the maxillary sinus. Depending on pathology, dental treatment varies from endodontic treatment of the offending tooth to its extraction, or oroantral fistula closure. If the dental source of infection is not managed and overlooked, the treatment could be unsuccessful. After management of dental pathology, Caldwell-Luc operation or ESS is usually needed for resolution of sinus pathology [2, 4, 11].

This study included 20 patients with ODS, dental pathology was treated in all patients before enrollment in the study. The disease was diagnosed unilaterally in all patients. The patients suffered 3 main complaints; foul nasal discharge in 90%, facial pain over the cheek in 75%, and nasal obstruction in 45%. However, the most distressing symptom was foul nasal discharge in 50% of patients, facial pain in 35%, and nasal obstruction in 15%. Simuntis et al. [12] compared ODS with rhinogenic sinusitis in a prospective cohort study, they found foul nasal discharge in 93% of patients with ODS in contrast to 29% of rhinogenic sinusitis patients. Also, Brook [13] detected an offensive nasal discharge in 60.7% of ODS patients. Many authors supported this finding, and they indicated that malodorous nasal discharge is the most important complaint and should not be understated [5, 10, 12, 14]. In contrary to this opinion, Galli et al. [15] in their case series detected that unilateral nasal obstruction was the commonest complaint (50%), followed by postnasal drip (26.47%), hyposmia (23.5%), headache (20.58%), unpleasant smell sensation (17.64%), facial pain (14.7%), and swollen cheek (14.7%); however, all patient in their study had developed ODS due to OAF that may cause more inflammatory changes and nasal obstructive effect.

Kim [4] reported that the first and second molars are the closest to the maxillary sinus floor, with the premolar teeth less so. Our study showed that the offending tooth was the first molar in 40%, the second molar in 25%, the second premolar in 20% of patients, and the third molar in 15% of patients. This observation has been detected before by Newsome and Poetker [5] who reported that the most commonly offending teeth causing ODS are the posterior maxillary teeth, especially the first and second molars. Also, Simuntis et al. [2] reported that the main teeth involved in ODS are the molars in this order of frequency: the first molar tooth, followed by the third molar tooth, and the second molar tooth. However, they found that the premolars are less frequently affected. This finding looks logic as Kodur et al. [16] found that the frequency of proximity (0.5 mm or less) of roots of posterior maxillary teeth to the sinus floor: second molars 45.5%, first molars 30.4%, second premolars 19.7%, and first premolars 0%.

A history of prior dental interventions may increase the likelihood of odontogenic origin of a patient's sinusitis [6, 10]. All ODS patients enrolled in our study had undergone dental interventions for treatment of their prior dental problems; 45% underwent OAF repair, 20% underwent extraction of their offending teeth, 20% underwent dental root canal filling, and 15% underwent apicoectomy. Psillas et al. [17] and Newsome and Poetker [5] reported that patients with history of dental extractions or an endodontic therapy of molar teeth may develop ODS, even years before diagnosis of sinus pathology. Based on this fact, treatment of dental pathology alone may be insufficient for control of ODS in some patients.

Nasal examination exhibited middle meatal pathology in all our patients; this finding is matched with the review study done by Craig et al. [18] who noted endoscopic changes in the middle meatus in 100% of

ODS patients in some studies. We found middle meatal purulence in 70%, and polypoid congested mucosa in 30% of our patients. Martu et al. [8] and Craig et al. [18] stated that middle meatal purulence is the commonest endoscopic finding (66–88%), followed by middle meatal edema (34–43%) of ODS. However, Costa et al. [19] detected normal nasal endoscopic finding in about one third of their ODS patients, who were more likely asymptomatic patients.

CT is the gold standard method for diagnosis of maxillary sinus pathology due to its high resolution and its ability to delineate bone and soft tissue [2, 20]. Conventional panoramic radiographs are very poorly suited to rule out ODS and cannot be relied on to identify disease [6]. In our study, CT showed thickening of the maxillary sinus mucosa in 50%, and complete opacity of the sinus cavity in 50%, with 2 of them had retained foreign bodies (amalgam). Martu et al. [8] reported that thickening of the maxillary sinus mucosa > 3 mm can be a diagnostic radiologic sign for ODS in patients with dental pathology. Bomeli et al. [3] identified 3 radiologic findings suggestive of ODS: (1) oroantral fistula, (2) periodontal disease with periapical abscess, and/or (3) a projection of molar/premolar tooth root with periodontal disease. Cone beam CT (CBCT) is a new tool which utilizes less radiation dose than conventional CT, and can show bony detail quietly, although soft tissue detail is reduced. It has a higher resolution than conventional CT which is a good advantage, especially in challenging cases of ODS [2]. However, it is an expensive method, used in the field of implant dentistry, to assess the thickness of the maxillary sinus floor prior to implantation [17]. In our opinion, CT is a good diagnostic tool which is familiar for otolaryngologists, and we can highly suspect ODS by 3 criteria: (1) unilaterality, (2) maxillary opacity or mucosal thickening > 3 mm, and (3) dental pathology or prior dental intervention.

Many studies reported that successful treatment of ODS requires management of the odontogenic infection source and may require concomitant or subsequent maxillary sinus surgery [1, 2, 6, 11, 20]. Sometimes, eliminating the source of infection by management of dental problem is a sufficient step in the treatment of this condition [4, 20]. Aukštakalnis et al. [11] reported that if the odontogenic etiology is missed, the treatment may fail as the source of infection is left untreated. This indicates that management of dental problem is not enough for treatment of some patients [5, 17, 20]. Psillas et al. [17] reported that if symptoms of ODS persist after management of dental pathology, surgical cleaning of the maxillary sinus is recommended, this treatment plan was used in our study which included patients who complained of ODS after eliminating their dental source of infection.

Caldwell-Luc approach was the most popular surgical procedure for treating ODS. It is an easy direct procedure, however; it has many disadvantages such as closure of inferior antrostomy opening and recurrence of the disease, intraoperative hemorrhage, postoperative facial edema, and cheek paresthesia due to infraorbital nerve involvement [4, 7, 17]. Nowadays, ESS became the most common surgical option for cleaning the antrum and the infected mucosa [7]. It is a less-invasive procedure and allows a surgical toilette and enlargement of the maxillary sinus ostium for restoration of physiological drainage which is the key for long-term success. Furthermore, endoscopic approach enables to explore the other sinuses that may sometimes be involved in the infective process [15]. We used ESS for treatment of our patients, with widening of the maxillary ostium for good aeration and drainage. We achieved resolution of the disease in all patients. This approach was recommended by many authors [6, 9]. Felisati et al. [21] achieved 99% successful rate of ODS treated with similar route. However, the sequence of treatment procedures (odontogenic infection source and maxillary sinus drainage); either concomitantly or one before the other, and which one precedes the other remains a controversial issue [5]. More prospective studies on this subject are needed to determine the best treatment option of care for those patients.

This study has some limitations. The sample of patients is small relative to this important topic. Dental problems of our ODS patients had been treated before enrollment in the study, so we cannot estimate the incidence of ODS patients who had been successfully managed by dental intervention alone, and who need additional surgical management.

Conclusion

Odontogenic maxillary sinusitis may persist even after treatment of dental pathology in some patients. Accurate diagnosis of the disease is crucially important; prior dental intervention is considered a suspicious diagnostic landmark, whereas unilateral foul nasal discharge, facial pain, and/or nasal obstruction are the prevalent patient's complaints. Endoscopic examination of the nose usually shows purulence and/or polypoid mucosa in the middle meatus. CT is a good diagnostic tool as it shows the disease extension, and if associated with retained foreign bodies after dental procedures. ESS with good widening of the maxillary ostium is an effective therapeutic option for patients with persistent ODS after management of their dental pathology.

Abbreviations

ODS	Odontogenic sinusitis
ESS	Endoscopic sinus surgery
CT	Computed tomography

OAF Oroantral fistula
CBCT Cone beam CT

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Not applicable.

Authors' contributions
The study was done completely by a single author (TA).

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Availability of data and materials
The datasets used during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by Taibah University, College of Medical Rehabilitation Sciences Research Ethics committee (TUCMRS- REC) on 10rd Oct, 2019 under number (CMR-M-2019–08).
Informed written consent to participate in the study was provided by all participants.

Consent for publication
The authors affirm that human research participants provided informed written consent for publication including the images in Figs. 1, 2, 3, and 4. Written informed consent for the publication of the data in Table 1 were obtained from the participants.

Competing interests
The authors declare that they have no competing interests.

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