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Case Report

Endoscopic Sinus Surgery for Otolaryngological Complications Associated with Dental and Oral Surgical Treatment : A Report of Three Illustrative Cases

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Abstract Maxillary sinusitis is one of the most serious complications associated with dental implantation. When local dental treatment with or without antibiotics is not effective, Caldwell-Luc operation is often performed by an oral surgeon. We propose that endoscopic sinus surgery should be employed more widely as the first surgical treatment of choice for odontogenic maxillary sinusitis.

This surgery aims to restore ventilation and drainage of paranasal sinuses by correcting the anatomical structures in the nasal cavity and paranasal sinuses intranasally. Unlike Caldwell-Luc procedure, the mucosa in the maxillary sinus is not totally removed; only highly polypous tissue is removed without exposing its bone surface. Resection of infected foci in the alveolar ridge or maxillary floor, when necessary, can be achieved intraorally both during or after endonasal sinus surgery. Postoperative care of irrigating the maxillary sinus with a saline solution at home is usually sufficient to eliminate the inflammation. Aeration of the maxillary sinus is restored without its deformation. Thus, endoscopic sinus surgery is much less invasive and more physiologic, as compared with the classic Caldwell-Luc operation. However, this surgery can be performed safely and securely only by an experienced and trained otolaryngologist. The authors strongly advocate a close collaboration between the dentist or oral surgeon and the otolaryngologist in treating maxillary sinusitis that develops in association with dental illness or treatment such as apical periodontitis, tooth extraction, and implantation. Three illustrative cases are reported.

Key words : Endoscopic · Maxillary · Sinusitis · Dental · Implantation

Introduction

The most serious complication associated with dental implantation to the maxilla (upper jaw) is maxillary sinusitis. In particular, maxillary sinusitis usually develops after bone augmentation with/without implant placement. When maxillary sinusitis occurs, the first treatment of choice is the administration of antibiotics, and if conservative treatment is not effective, Caldwell-Luc operation is performed by an oral surgeon.

Maxillary sinusitis, with or without the forma-

tion of oroantral fistula, may also occur along with apical periodontitis, during endodontic dental treatment, or after tooth extraction, some of which are refractory to conservative treatment. We advocate more active participation of otolaryngologists in the treatment of such odontogenic maxillary sinusitis. Endoscopic sinus surgery, which can be safely performed only by an experienced and trained otolaryngologist, should be the first surgical treatment of choice for intractable odontogenic maxillary sinusitis. This type of endoscopic surgery aims at restoring the

physiological status of the maxillary sinus, and not the total resection of the infected sinus mucosa. In addition, this surgery is much less invasive, as compared to the classic Caldwell-Luc operation.

We suggest that endoscopic sinus surgery specifically may be useful to treat complications associated with maxillary sinus lifting or placement of dental implants, because this surgery leaves the mucosa in the maxillary sinus floor intact, allowing for future re-implantation. We report two cases of maxillary sinusitis after sinus lift surgery with/without placement of implants and a case of recurrent oroantral fistula which developed after extraction of the caries-free third molar in the maxilla. We emphasize the importance of collaboration between the dentist and/or oral surgeon and the otolaryngologist in the treatment of maxillary sinusitis associated with dental treatment.

Case 1

In May, 2010, this 70 y/o female patient underwent right-side sinus lifting surgery by the lateral window approach using β -TCP and autogenous bone graft materials. Computed tomography performed postoperatively on the same day showed no signs of penetrating the maxillary sinus membrane [Fig. 1]. Several days later, however, purulent nasal discharge developed. Antibiotic treatment was ineffective. The patient was referred to the senior author's outpatient clinic for the evaluation and treatment of maxillary sinusitis in October, 2010.

Endoscopic examination showed that the middle meatus was narrowed by the laterally deviated middle turbinate and the edematous mucous membrane of the ostio-meatal complex. Septal deviation towards the right side and an outflow of pus were also noted. Computed tomography revealed the presence of anterior ethmoidal sinusitis on the right-side [Fig. 2].

Endoscopic sinus surgery was performed under general anesthesia in December of that year. Deviation of the nasal septum was also corrected

to restore the position of the laterally deviated middle turbinate and secure the form of the drainage pathway. Computed tomography after 6 months demonstrated that the maxillary sinusitis was cured completely and the elevated maxillary floor had remained unchanged [Fig. 3]. Two implants were placed successfully 1.5 years after sinus lifting surgery.

Case 2

This 38 y/o female patient underwent extraction of a non-decayed, aberrant wisdom tooth in the left maxilla in April 2009. Several days later, the patient noted a sour discharge flowing out of the socket.

A fistula was identified at the site. Administration of antibiotics was initiated, but with no effect. A week after the start of antibiotics administration, the patient noted postnasal drip. The patient underwent a total of four fistula-closing operations with a mean interval of 1.5 months, but the fistula recurred. The patient came to our clinic in March 2010, complaining of a left cheek pain and profuse nasal discharge with a foul odor. Endoscopic examination of the left nasal cavity revealed severe infection and edema of the mucosa around the ostio-meatal complex and a purulent discharge from the semilunar dehiscence, indicating bacterial infection in the maxillary sinus. Computed tomography (CT) revealed a pooling of pus in the maxillary sinus and an inflammation of the anterior ethmoidal sinus (ostio-meatal complex) on the left side [Fig. 4]. Cone-beam CT revealed more detailed structural alterations in the ostio-meatal complex; it showed that the natural ostium of the maxillary sinus was occluded with edematous soft tissue and the medial sinus wall around the natural ostium was displaced medially to the nasal cavity by the fluid occupying the sinus [Fig. 5]. Though not evident on CT, nasoendoscopy revealed that the middle turbinate was edematous and in contact with the medially protruded structures of the ostio-meatal complex, from which purulent pus was flowing out.

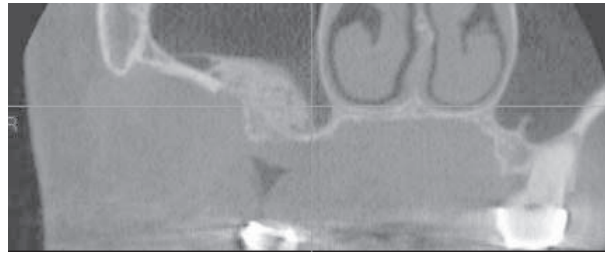


Fig. 1 Cone-beam CT taken immediately after sinus lift surgery. No evidence of penetrating the sinus floor membrane is observed, and the sinus membrane is not thickened.



Fig. 2 CT taken one month after sinus lift surgery on the right side. The maxillary sinus as well as the anterior ethmoid sinus is filled with a dense area of soft tissue, indicating the presence of sinusitis.



Fig. 3 CT 6 months after endoscopic sinus surgery. The maxillary sinus mucosa is still partially thickened, but no fluid is observed in the maxillary sinus. The grafting materials inserted during sinus lift surgery still are present without absorption. Note that septal deviation is removed.

Inspection of the oral cavity identified an oroantral fistula at the site of the extracted wisdom tooth. A simultaneous endoscopic sinus surgery and fistula-closing operation was performed in May, 2010, under general anesthesia. The oroantral fistula was covered with the buccal fat tissue and closed by a rotation flap of the gingiva. The postoperative course was uneventful. The nasal discharge stopped immediately after surgery without the administration of antibiotics. The oroantral fistula was also successfully closed. Computed tomography (CT) six months postoperatively showed that the sinusitis on the left side had disappeared almost completely, only leaving a slightly thickened mucosa on the sinus floor [Fig. 6].

Case 3

This 60 y/o male patient underwent simultaneous sinus lifting surgery and placements of three implants in the left side posterior maxilla in May, 2011, after two years of intermittent antibiotic therapy for maxillary sinusitis [Fig. 7 and 8]. Mixed β -TCP and autogenous bone taken locally were used as graft materials. The maxillary sinus membrane was not penetrated during sinus floor elevation. Several days later, however, nasal discharge with a bad smell developed from the left nose. Antibiotic therapy was started again and the sinus was irrigated with a saline solution through a window formed in the lateral sinus wall. These treatments showed no improvements. The implant at the most posterior position was extracted because of the



Fig. 4 CT after simultaneous sinus lift surgery and placement of three implants. Note that not only maxillary sinusitis but also anterior ethmoidal sinusitis is present. When maxillary sinusitis persists, an inflammation is almost always observed in the anterior ethmoidal sinus in which the ostio-meatal complex is housed.

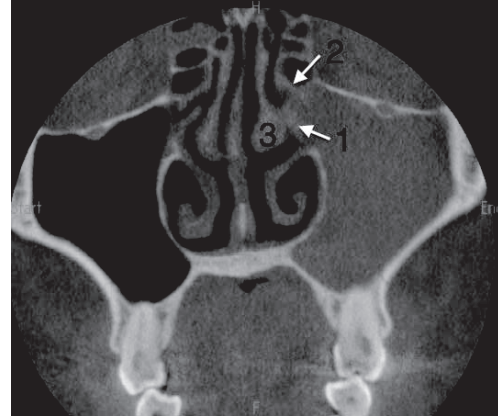


Fig. 5 Cone-beam CT shows that the natural ostium and the ethmoidal infundibulum is occluded between the edematous uncinete process and ethmoidal bulla (indicated by arrows). The inferior portion of the middle turbinate is in contact with the uncinete process, aggravating the drainage of the maxillary sinus. Note that the medial wall around the natural ostium is pushed out into the nasal cavity. 1. uncinete process 2. ethmoidal bulla 3. middle turbinate



Fig. 6 CT six months after endonasal sinus surgery. The mucosa in the left maxillary sinus floor is still thickened, but there is no pooling of fluid in the sinus. Part of the thickened mucosa is presumed to be the scar tissue induced by the long-term severe inflammation.

increasing resorption of the alveolar bone around that implant. Again, however, this did not eliminate the sinusitis. When the patient was referred to the senior author's outpatient clinic several months later, no oroantral fistula was identified. Computed tomography showed a marked thickening of the left maxillary mucosa

with a pooling of a small amount of fluid [Fig. 9]. It also showed a partial resorption of the bone surrounding one of the remaining two implants (the more posterior implant). The CT images did not allow for distinction among the pooling of pus, thickening of the mucosa, and the grafted materials. Therefore, it was not clear whether the remaining implants were penetrating into the maxillary cavity or if they were covered with the graft materials and the overlying sinus mucosa. Endoscopic sinus surgery on the left side as well as septal deviatomy was performed in June, 2012, under general anesthesia. Maxillary sinusitis on this side was cured immediately. This time, however, cheek pain developed on the opposite (right) side [Fig. 10]. Computed tomography showed the occurrence of sinusitis.

Antibiotics and irrigation of the maxillary sinus was of no effect. Culture of the nasal discharge demonstrated the infection of methicillin resistant *Staphylococcus aureus*. A second endoscopic sinus surgery was performed to treat the right-side sinusitis in September, 2012.



Fig. 7 MRI taken 2 years before dental implantation. The mucosa in the maxillary sinus and the anterior ethmoidal sinus on the left side is markedly polypous. The maxillary sinus on the right side is filled with fluid (probably pus). The mucosa in the anterior ethmoidal sinus on this side is also edematous.



Fig. 8 CT one month before dental implantation. Inflammation has been relieved almost completely, but the maxillary ostium on the left side is partly filled with a dense area of soft tissue and a polyp is present in the right maxillary sinus. The nasal septum is deviated in a sigmoid fashion and the inferior turbinate on the left side is hypertrophic.

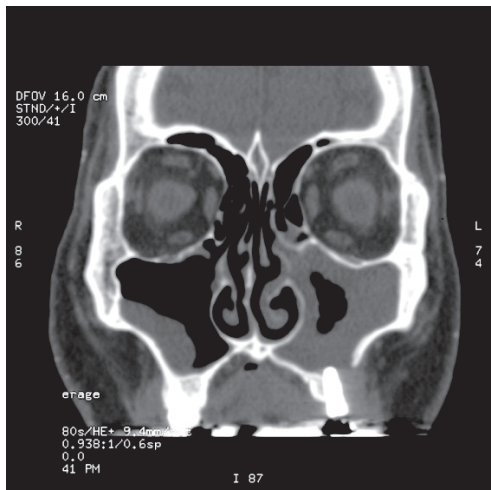


Fig. 9 CT one month after dental implantation. A marked thickening of the left maxillary mucosa with a pooling of a small amount of fluid is observed. A partial resorption of the bone surrounding one of the remaining two implants (the more posterior implant) is also seen.



Fig. 10 CT 2 months after endonasal sinus surgery on the left side and septal deviatomy. No pus is observed in the left maxillary sinus. However, sinusitis has recurred on the right side.

Discussion

Penetration of the implant into the maxillary sinus does not necessarily cause maxillary sinusitis if implantation is performed when the maxillary sinus is not infected¹⁾. However, once maxillary sinusitis occurs, it is refractory to

conservative treatment. Antibiotics can alleviate the symptoms such as cheek pain and nasal discharge, but in most cases, only temporarily. Except in exceptional cases, antibiotics cannot cure maxillary sinusitis. Long-term suppuration of the maxillary sinus may cause peri-implantitis and resorption of the alveolar bone, resulting in

displacement of the implant. Therefore, a prompt and more vigorous treatment to drain the maxillary sinus should be performed. When local debridement of infectious foci with or without antibiotics is not effective, some oral surgeons irrigate the maxillary sinus from the oral cavity through a hole formed in the anterior wall of the sinus. Others try to drain the sinus by forming a pathway in the lateral wall of the inferior meatus (meatotomy). When sinusitis does not improve with these treatments, they perform Caldwell-Luc operation²⁾³⁾. In this operation, the whole maxillary sinus mucosa is removed. The implants penetrating into the maxillary sinus may also be extracted simultaneously. After Caldwell-Luc operation, however, the bone of the maxillary cavity, once detached of the mucoperiosteum, is covered with infected granulation and scar tissue. Eventually, those tissues are almost completely replaced with bone. The maxillary bone is deformed inevitably. In addition, maxillary cysts may develop 10 or more years later⁴⁾⁵⁾.

In contrast, endoscopic sinus surgery leaves the maxillary sinus mucosa in place. Only the highly polypous portion of the mucosa is removed without exposing the bone surface. Therefore the sinus cavity is not deformed, and thus keeping its aeration. Additionally, the drainage pathway, which is formed by enlarging the natural ostium, is physiologic, because maxillary secretions converge into the middle meatus exclusively through the natural ostium⁶⁾. Above all, Endoscopic sinus surgery is much less invasive; not only does the patient's cheek not swell but paresthesia in the cheek and the gingiva also does not occur. The only possible problem is that this surgery requires the skill of an experienced and trained otolaryngologist.

In case 1, the maxillary sinus membrane was not penetrated during sinus lifting surgery. Presumably, maxillary sinusitis developed as a result of the occlusion of the natural ostium due to edema of the sinus membrane, which was induced by the surgical manipulation of the sinus floor.

Deviation of the nasal septum, which caused lateral displacement of the middle meatus, may have aggravated the occlusion. As already stated, we also consider septal deviation as one of the risk factors for maxillary sinusitis associated with dental implantation. When the maxillary floor is not penetrated, postoperative irrigation of the maxillary sinus with a saline solution at home is usually sufficient to eliminate the residual inflammation, as was the case with this patient. If the maxillary floor membrane were to be penetrated, resection of graft materials would be required.

Endoscopic sinus surgery is also useful for treating recurrent oroantral fistulas (case 2). Whenever the natural ostium is occluded, no closure surgery of the fistula will ever succeed; pus in the maxillary sinus is "squeezed" out through the most mechanically weak site—that is, the closed fistula, resulting in dehiscence of the wound. When an oroantral fistula develops after tooth extraction or recurs after a closure surgery, detailed radiographic as well as endoscopic examinations around the natural ostium (ostio-seomeatal complex) should be performed. If the total length of the drainage pathway (maxillary ostium and ethmoidal infundibulum) is not filled with air on the CT image, and/or if the mucosa around the ostio-meatal complex is edematous or purulent discharge is identified at this location endoscopically, then drainage of the maxillary sinus is considered to be impaired. Endoscopic sinus surgery should be performed by an experienced and trained otolaryngologist (sinus surgeon) prior to a revision fistula closure operation, as shown in case 2.

Case 3 warns against long-term administration of antibiotics. In this case, maxillary sinusitis on the side of dental implantation was almost totally eliminated, without extraction of the implants, by endoscopic sinus surgery and postoperative irrigation with a saline solution. Nonetheless, sinusitis on the opposite side was aggravated.

Bacteriological testing revealed methicillin-re-

sistant *Staphylococcus aureus*. Occlusion of the natural ostia by the packed gauze presumably induced the sinusitis. In our experience, this kind of contralateral sinusitis usually occurs in those patients who have undergone long-term antibiotic treatment prior to surgery, and is often due to infection caused by multiple drug resistant bacteria. In this patient (case 3), sinus irrigation was ineffective, and therefore endoscopic sinus surgery was required. No evidence indicating penetration of the maxillary sinus mucosa was obtained during or even after the sinus lift procedure. Edema of the mucosa caused by the surgical manipulation of the maxillary sinus floor membrane was presumably responsible for the occlusion of the natural ostium and the subsequent maxillary sinusitis in this case, as in case 1. Re-examination of preoperative CT images (Fig. 8) demonstrated a partial occlusion of the maxillary natural ostium, due presumably to the edema of the mucosa or the secretions. It should be noted that correction of septal deviation was performed during endoscopic sinus surgery in all the patients. In our experience, maxillary sinusitis refractory to conservative treatment is often accompanied by septal deviation. Secondary lateral deviation of the middle turbinate presumably aggravates obstruction of the ethmoid infundibulum, which is the only drainage pathway of the maxillary sinus. Radiological evaluation usually is not sufficient to assess structural problems in the nasal cavity⁶⁾; thus, nasal endoscopy is indispensable. Although septal deviation was not apparent in any patients on preoperative CT images, intraoperative endoscopic observation showed that the middle turbinate was pushed laterally by the deviated septum. Septoplasty was performed to secure the drainage pathway of the maxillary sinus that was formed endoscopically.

In placement of implants in the posterior maxilla, it is necessary to respect the natural maxillary homeostasis of the maxillary sinus and to perform surgery only in the presence of an

efficient ciliary movement, normal sinus mucosa, or a pervious sinus ostium⁶⁾⁷⁾. In the absence of one or more of these natural defense mechanisms, the risk for developing complications after a sinus lift procedure becomes much higher^{6)~8)}. We suggest that anatomical aberrations outside the maxillary sinus—that is, the ostio-meatal complex—should also be included as one of the risk factors for precipitating the occurrence of maxillary sinusitis associated with placement of implants in posterior maxilla with or without maxillary floor lifting. In our experience, these anatomical aberrations include (besides septal deviation⁸⁾): hypertrophic uncinat process, overpneumatized ethmoidal bulla, and choncha bullosa⁶⁾⁷⁾. All of them potentially aggravate the occlusion of the natural ostium in the presence of minimally edematous mucosa. As shown in case 3, the medical history of recurrent rhinosinusitis should be also considered to be a risk factor. The role of allergic rhinitis has yet to be established.

In conclusion, disease around the natural ostium should be examined closely, especially when maxillary sinusitis is resistant to conservative treatment. Once the natural ostium is occluded, the maxillary sinus becomes a closed cavity, namely, a dead space. Administration of antibiotics to such a dead space is ineffective. Vigorous treatment should be started promptly. The first surgical treatment of choice should not be Caldwell-Luc operation. Endoscopic sinus surgery, which is much less invasive and more physiologic, should be considered first. We emphasize the importance of collaboration between the dentist and/or oral surgeon and the otolaryngologist in the treatment of maxillary sinusitis associated with dental treatment. However, it should always be kept in mind that endoscopic sinus surgery is not an easy procedure; it can cause serious complications including injury to vital structures such as the orbit, nasolacrimal duct, anterior cranial fossa, and the optic nerve. Therefore to accomplish dental implantation safely, it is mandatory for the dentist

or surgeon to seek the participation of an experienced and trained otolaryngologist.

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(和文抄録)

歯科・口腔外科的手術後の耳鼻咽喉科的合併症に対する 内視鏡下鼻内手術の3例

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口腔インプラント治療における最も重篤な合併症は上顎洞炎である。インプラント治療後に生じた上顎洞炎に対して、歯科・口腔外科領域ではまず抗生物質の投与が行われる。口腔内から上顎洞を開放し洞内を洗浄する歯科・口腔外科医もいないわけではないが、長期にわたって漫然と抗生物質が投与されていることが珍しくない。短期に上顎洞炎が消褪しなければ埋入したインプラントが脱落することもある。

口腔インプラント治療によって引き起こされた上顎洞炎に対する手術治療としては、下鼻道側壁に対孔を設置する手術が行われることがある。しかしこの手術は上顎洞の生理を無視した治療法である。上顎洞内の粘液は中鼻道の篩骨漏斗に開いている自然孔を通じて鼻内に排泄される。この自然孔を開大してこの部位に排泄孔を設置するのが最も自然な治療法である。口腔インプラント治療に関連して生じた上顎洞炎の根治的治療として歯科・口腔外科領域でよく行われる Caldwell-Luc 手術では上顎洞内の粘膜が全摘される。露出した上顎洞内の骨面には感染した肉芽組織が増生する。この肉芽組織は瘢痕となり、やがて骨組織で置換される。つまり上顎洞腔が消失する。上顎骨の変形も避けられない。

本論文では、耳鼻咽喉科領域で広く行われている内視鏡下鼻内副鼻腔手術によって治療を行った、口腔インプラント治療後に上顎洞炎が併発した2症例と上顎の第三大臼歯の抜歯後に生じた口腔上顎瘻の1症例を報告する。原因が何であれ、上顎洞炎が遷延する原因は上顎洞自然孔の閉塞である。上顎洞自然孔を通じた上顎洞の換気と排泄機能が改善されれば上顎洞炎は治癒する。内視鏡下鼻内副鼻腔手術は上顎洞に元々存在するこの機能を回復させる生理的な治療である。また、Caldwell-Luc 手術よりも侵襲が少ない。ただし本手術は十分な修練を積んだ耳鼻咽喉科医でなければ安全に行うことができない。歯科・口腔外科領域の疾患や治療によって上顎洞炎が生じることは珍しくないが、その治療に耳鼻咽喉科医が積極的に参加することを提案したい。