The characteristics and new treatment paradigm of dental implant–related chronic rhinosinusitis

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ABSTRACT

Background: Because dental implantation and sinus augmentation are widely performed in recent years, one of their possible complications, maxillary sinusitis, has become a major concern for both dentists and otolaryngologists. This study evaluates the characteristics of dental implant–related chronic rhinosinusitis (DIrCRS) and the outcome of endoscopic sinus surgery (ESS) for these patients.

Methods: Eighteen patients diagnosed with DIrCRS from 2007 to 2012 and who were recommended for operation were included. ESS served as the first surgical choice. Dental implants were not routinely removed unless there was severe periimplantitis. All data, including CT and surgical findings, were collected and analyzed.

Results: All 18 patients had findings of maxillary sinus floor perforation or penetration by dental implants on CT. Fifteen of the 18 patients underwent ESS. Two patients had the dental implants removed before ESS and did not experience recurrence. Four patients had recurrence and the dental implants were removed before revised ESS. They did not experience recurrence again after the revised operation. The other nine patients had their dental implants preserved and did not experience recurrence during follow-up. None of the 15 patients required a Caldwell-Luc operation.

Conclusion: In patients with DIrCRS, ESS can be used as the first surgical choice with good prognosis and low morbidity. Although most cases of DIrCRS are caused by dental implants penetrating into the maxillary sinus, the dental implants can be preserved unless there is severe periimplantitis or recurrence of sinusitis. Nonetheless, the sinus mucosa above the dental implants must be kept intact during ESS.

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Chronic rhinosinusitis (CRS) of dental origin accounts for 10–12% of all cases of maxillary sinusitis. The most common causes of odontogenic sinusitis include dental abscesses and periodontal diseases that have perforated the Schneiderian membrane, irritation and secondary infection caused by intra-antral foreign bodies, and sinus perforation during tooth extraction. Despite the wide adoption of dental implants, the incidence of dental implant–related CRS (DIrCRS) remains very low. However, some recent studies have reported that the incidence is gradually increasing.

Dental implants for the upper dental arch were not considered in the past because of the proximity of the maxillary sinus and the unpleasant complications arising from surgery. This problem was solved by Tatum and Boyne and James with the introduction of the sinus lift technique, where augmentation of the maxillary sinus floor is usually performed through an osteotomy of the lateral sinus wall, careful elevation of the sinus membrane, and the creation of a space into which graft material (allograft, xenograft, and alloplast) is placed. This technique enables the promotion of bone thickening by inducing osteoinduction and osteoconduction, hence, increasing alveolar bone height without compromising the interalveolar space. Over the past few years, maxillary sinus augmentation for dental implantation has become a well-established procedure for patients with extensive resection of the posterior maxilla, and implants for the upper dental arch are now widely performed by dentists.

The incidence of acute rhinosinusitis and CRS after sinus augmentation is low (<5%), and most cases can be resolved by using antibiotics. Chronic maxillary sinusitis requiring surgical intervention occurs only in 1.3% of patients; however, it often leads to legal problems. Although an endoscopic approach has been widely used in chronic maxillary sinusitis of dental origin with less morbidity and lower incidence of complications, its therapeutic effect in DIrCRS has only been reported in sporadic case reports. In addition, dental implantation with or without sinus augmentation ideally requires the collaboration of the otolaryngologist and the dentist. The role of the otolaryngologist does not only cover the treatment of postimplant sinusitis, but also the diagnosis and treatment before dental implantation to prevent sinus complications. Therefore, the purpose of this study was to identify the characteristics of DIrCRS and the therapeutic effect of endoscopic sinus surgery (ESS). We also aimed to detail the role that an otolaryngologist plays in dental implantation and how they work with the dentist during the whole procedure.

MATERIALS AND METHODS

Patients

The Institutional Review Board of Chang Gung Memorial Hospital approved this study. All patients diagnosed with DIrCRS and who were indicated to receive ESS in Chang Gung Memorial Hospital from 2007 to 2012 were collected and analyzed. These inclusion criteria were as follows: (1) patients with a history of dental implantation with or without sinus augmentation, (2) patients who developed CRS after dental implantation as supported by medical records or imaging studies, (3) patients in whom CRS occurred on and only on the same side of the dental implantation, and (4) patients who were refractory to medication and thus ESS was arranged to treat DIrCRS.

A total of 18 patients were included in this study. Two patients developed bilateral CRS after bilateral dental implantation; hence, a total of 20 sinuses of DIrCRS were analyzed.

Surgical Techniques

Patients were initially treated with broad-spectrum antibiotics, anti-histamines, decongestants, and topical corticosteroid nasal spray for at least 4 weeks after the diagnosis of DIrCRS. Nasal irrigation with normal saline was also suggested at the same time. ESS was arranged in patients refractory to medical treatment and performed following the Messerklinger technique. The natural ostium of the maxillary sinus was identified and enlarged. Foreign bodies and fungal balls were totally removed. However, there was no need for intensive
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15 patients with 17 sinuses received ESS to treat their CRS. The patients refused an operation and were lost to follow-up. Therefore, without success, after which ESS was suggested. However, three the maxillary sinus. All patients had findings of maxillary sinus floor was seen in nearly all of the patients. Figure 3 lists the CT findings of maxillary sinus.

rhinorrhea/postnasal dripping was the most frequent complaint and consistent with the report by Lee et al. The most frequent cause of DIrCRS in this study was implant penetration, regardless of sinus augmentation. The majority of these cases is of the acute or subacute type and often responds well to antibiotic treatment. Chronic maxillary sinusitis has been reported to occur only in 1.3% of patients after dental implantation with sinus augmentation, and these patients may be transferred to ear, nose, and throat clinics for additional surgical intervention. According to our study and a review of the literature, the possible causes for chronic maxillary sinusitis after dental implantation include implant penetration into the sinus, oral antral fistulas, uncontrolled graft infections, dislodged bone grafts or dental implants with foreign body reaction, Schneiderian membrane perforation, postoperative obliteration of the ostium, and preoperative CRS.

The most frequent cause of DIrCRS in this study was implant penetration into the maxillary sinus, which was evident in all of our patients (Fig. 4). Among them, six had thin maxillary floors but did not receive sinus augmentation. However, even in those who received sinus augmentation before dental implantation, this finding was still found in 12 patients. In patients with uncontrolled graft infection or perimplantitis, resorption of the surrounding bone or bone graft may occur and expose the dental implant to the maxillary sinus. In addition, a minimum of 10 mm of vertical alveolar bone height is usually required for predictable implant success, and insufficient bone graft height or placing the dental implant too deep may lead to penetration of the maxillary sinus floor. Chronic maxillary sinusitis

stripping of the polypoid mucosa—only polyps and necrotic tissues had to be removed. The mucosa above the dental implants was also kept intact to prevent direct exposure of the implants into the maxillary sinus. The frontal, ethmoid, and sphenoid sinuses were opened wide as well if there was purulent inflammation or polyposis. A Caldwell-Luc operation with a canine fossa approach was prepared as backup treatment; however, none of the patients required this.

Of note, the dental implants were not routinely removed before or at the time of ESS unless they were mobile or had severe infection. The dental implants were removed before or during a revision operation with the closure of oral antral fistulas only if there was recurrence of sinusitis.

RESULTS

There were 18 patients and a total of 20 sinuses included in this study. The average age was 53.1 years, and there were 7 men and 11 women. The sites of the dental implantations are listed in Fig. 1. The most frequently involved tooth was the second molar, which is consistent with the report by Lee et al. Twelve patients had sinus augmentation before dental implantation.

Figure 2 lists the symptoms and signs of the patients. Purulent rhinorrhea/postnasal dripping was the most frequent complaint and was seen in nearly all of the patients. Figure 3 lists the CT findings of the maxillary sinus. All patients had findings of maxillary sinus floor penetration or perforation (Figs. 4–6).

All of the patients had received medication for at least 4 weeks but without success, after which ESS was suggested. However, three patients refused an operation and were lost to follow-up. Therefore, 15 patients with 17 sinuses received ESS to treat their CRS. The operative findings are listed in Fig. 7. Polypoid change of the maxillary sinus wall was the most frequently observed finding. No complications during or after the operations were noted. The mean follow-up time was 19.6 months.

Two patients had their dental implants removed in dental clinics before ESS, and neither experienced recurrence. In the other 13 patients, 4 had recurrence and received revised surgery. The dental implants were removed before or during the operation with the repair of oral antral fistulas, and no recurrence was noted after the revised surgery. The dental implants of the remaining nine patients with 11 sinuses were not removed, and none of them experienced recurrence during follow-up.

DISCUSSION

Since Dr. Leonard Linkow placed the first dental implant in 1952, various materials and techniques such as sinus augmentation have been invented to improve outcomes and decrease the rate of complications of dental implantations. During the Sinus Consensus Conference in 1996, sinus augmentation was described as a "safe and predictable" procedure for increasing alveolar bone height to restore the masticatory function by means of dental implantation in patients with extensive resorption of the maxillary alveolar ridge and functional denture problems.

Maxillary sinusitis is a possible complication after dental implantation, regardless of sinus augmentation. The majority of these cases is of the acute or subacute type and often responds well to antibiotic treatment. Chronic maxillary sinusitis has been reported to occur only in 1.3% of patients after dental implantation with sinus augmentation, and these patients may be transferred to ear, nose, and throat clinics for additional surgical intervention. According to our study and a review of the literature, the possible causes for chronic maxillary sinusitis after dental implantation include implant penetration into the sinus, oral antral fistulas, uncontrolled graft infections, dislodged bone grafts or dental implants with foreign body reaction, Schneiderian membrane perforation, postoperative obliteration of the ostium, and preoperative CRS.

The most frequent cause of DIrCRS in this study was implant penetration into the maxillary sinus, which was evident in all of our patients (Fig. 4). Among them, six had thin maxillary floors but did not receive sinus augmentation. However, even in those who received sinus augmentation before dental implantation, this finding was still found in 12 patients. In patients with uncontrolled graft infection or perimplantitis, resorption of the surrounding bone or bone graft may occur and expose the dental implant to the maxillary sinus. In addition, a minimum of 10 mm of vertical alveolar bone height is usually required for predictable implant success, and insufficient bone graft height or placing the dental implant too deep may lead to penetration of the maxillary sinus floor. Chronic maxillary sinusitis
Figure 4. (1 and 2) Case 1—the dental implant penetrated into the maxillary sinus and caused dental implant–related chronic rhinosinusitis (DIrCRS). (3 and 4) Case 2—DIrCRS persisted and an oral antral fistula formed after the dental implant was removed.

Figure 5. (1, 2, and 3) Case 3—bilateral dental implants penetrated into the maxillary sinus. However, only left dental implant–related chronic rhinosinusitis (DIrCRS) developed. (4) Case 4—another case showed similar conditions.
may then occur as a result of foreign body reaction to the exposed dental implant, penetration as a route for infection from the oral cavity to the sinus, or oral antral fistula caused by removal of the penetrated dental implant.

Jung et al. performed a retrospective study to investigate whether exposure of dental implants to the maxillary sinus would always result in sinus complications.\textsuperscript{15} They collected 9 patients with 23 implants that had penetrated into the maxillary sinus by >4 millimeter. A questionnaire and sinus CT were used to evaluate sinus complications 6–10 months after insertion of the implants. They did not find any clinical signs of sinusitis and only mucous membrane thickening around 14 of the 23 implants. Therefore, only some patients with implants penetrating into the maxillary sinus had maxillary sinusitis, even though it was the predominant cause of DIrCRS in our study (Fig. 5).

The displacement of dental implants or bone grafts into the maxillary sinus is another cause of DIrCRS.\textsuperscript{16} They can act as a foreign body or obstruction to the natural ostium, which subsequently leads to chronic sinusitis.\textsuperscript{6} In this study, three patients developed maxillary sinusitis due to this reason (Fig. 6). Facial swelling with tenderness was noted a few months after dental implantation and the diagnosis was made by sinus CT, which showed dislodged augmentation occluding the natural maxillary ostium. The reasons for dental implant migration are unknown. It is likely that scanty thickness of the maxillary sinus floor and edentulism induce inadequate implant anchorage leading to a lack of primary stability.\textsuperscript{17} However, it may simply be a technical issue related to poor surgical planning or inadequate surgical technique. If the implant migrates into the maxillary sinus, it should be removed, regardless of the presence of symptoms or signs, to avoid sinus pathology.

Preoperative CRS and sinuses with thick mucosa have been reported to be associated with DIrCRS.\textsuperscript{6} Varying degrees of maxillary sinusitis ranging from small cysts to pansinusitis may be noted occasionally on craniofacial CT or panorex x ray before dental implantation or sinus augmentation. The major concern for the dentist is the potential of developing postimplant CRS in these patients. Pansinusitis or severe polyoid change of the maxillary sinus must be treated before sinus augmentation and dental implantation or they will lead to the development of postimplant CRS.\textsuperscript{6} However, in patients with maxillary cysts or polyps, or just mucosal thickening, the necessity of ESS before sinus augmentation or dental implantation is still controversial because the patients do not usually have any related nasal symptoms or signs.\textsuperscript{18} Our principle is that preventive ESS is not necessary if the height of the thickened mucosa or polyp is less than one-half of the maxillary sinus. The reasoning for this is that the average height of the maxillary sinus is 25 mm and the ostium of the maxillary sinus will not be obstructed with an additional height of 10 mm, which is usually necessary for sinus augmentation,\textsuperscript{14} as long as the height of the thickened mucosa or polyp is less than one-half that of the maxillary sinus. This hypothesis is partially sustained by this study.

Figure 6. (1 and 2) Case 5—the dislodged bone graft occluded the maxillary sinus ostium. (3 and 4) Case 6—the displacement of the bone graft fell into the maxillary sinus and caused dental implant–related chronic rhinosinusitis (DIrCRS).

Figure 7. Operative findings. MS, maxillary sinus; OMC, osteomeatal complex.
where, although it is the most frequently asked question by dentists, none of our patients with DIrCRS were classified into this category.

Perforation of the Schneiderian membrane is a frequent complication and has been reported to occur in 9.6–44% of patients during sinus augmentation.19,20 Several studies have supported the assump-

Figure 8. (1) Case 7—dental implant penetrated into the left maxillary sinus and caused dental implant–related chronic rhinosinusitis (DIrCRS). (2 and 3) Postoperation 1-year follow-up. No recurrence was seen in the CT study and endoscopic findings. (4) The mucosal thickening covered the dental implant protrusion into the maxillary sinus and blocked the effect of a foreign body reaction or infectious route from the dental implants.

Figure 9. (1 and 2) Case 8—fungal sinusitis occurred after dental implantation. CT showed focal areas of hyperattenuation and calcification in the maxillary sinus. (3) A fungal ball was seen during operation. (4) Case 9—another case developed fungal sinusitis after dental implantation without classic CT findings.
tion that small perforations during sinus floor elevation have a minimal influence on sinus physiology. Becker reported that with appropriate treatment, intraoperative sinus membrane perforations did not represent an elevated risk for infectious complications or displacement of graft material.21 Manor reported that membrane perforation during sinus augmentation was not related to the occurrence of postoperative CRS.6 Timmenga also reached the same conclusion.22 However, tears >5 mm need to be repaired or they can cause sinusitis, graft infection, or graft displacement into the sinus.21,23

Many oral maxillofacial surgeons believe that the Caldwell-Luc operation is the definitive surgical treatment for DlrCRS.23 However, ESS has the advantages of being less traumatic with a shorter hospital stay compared with the Caldwell-Luc operation. Several studies have supported ESS and canine fossa puncture technique to be reliable methods in the treatment of chronic maxillary sinusitis of dental origin such as odontogenic cysts or displaced tooth roots;7,24; however, outcomes in cases of DlrCRS have only been reported in sporadic case reports.8–10 In our study, all of the patients received ESS as first

Figure 10. The flowchart and principles for treatment of dental implant–related chronic rhinosinusitis (DlrCRS).
surgical choice, and the surgical outcomes were good regardless of the etiology of DIrCRS. Although four patients had recurrence after surgery, the main cause of recurrence was related to the unremoved implant. After removal of the infectious dental implants, ESS still had a good prognosis without any postoperative recurrence, and none of our patients required a Caldwell-Luc operation. Therefore, in our opinion, ESS can treat most cases of DIrCRS with less morbidity and good surgical results. It can be used as the first surgical choice for DIrCRS, and the Caldwell-Luc operation may be used as the second choice if ESS fails.

One dilemma during the treatment of DIrCRS is the necessity to remove dental implants. Most authors suggest the removal of dental implants for all patients with DIrCRS before or concomitant with sinus surgery.2,18,23 However, some authors have successfully used alternative treatments consisting of partial resection of the grafts.25 In our study, two patients had their dental implants removed before ESS, and neither patient experienced recurrence. The other 13 patients did not have their dental implants removed, and 4 of them experienced recurrence of sinusitis. The dental implants were subsequently removed and oral antral fistulas were repaired before or during revised ESS, and none of these four patients have experienced recurrence to date. It is worth noting that nine patients did not have their dental implants removed at any stage, and none of them have experienced recurrence. Jung et al. found that dental implants that penetrate the maxillary sinus may only cause mucosal thickening without any resulting chronic maxillary sinusitis.19 Therefore, we hypothesize that mucosal thickening covers the dental implant protrusion into the maxillary sinus and therefore blocks the effect of a foreign body reaction or infectious route from the dental implants (Fig. 8). In our study, most of the patients with DIrCRS had mucosal thickening or polyoid change within the maxillary sinus. The polyoid or thickened sinus mucosa was removed with the microdebrider; however, the mucosa above the dental implants was kept intact to prevent direct exposure into the maxillary sinus. Although the removal of penetrating dental implants can reduce the risk of sinusitis recurrence to a minimum, it can also increase the risk of oral antral fistulas. In addition, reimplantation will be more difficult with a destructed sinus floor. Therefore, we suggest that dental implants should be removed if they are mobile or present with severe perimplantitis, as defined by bony destruction or persistent pus formation around the dental implants. The resulting oral antral fistula should also be repaired if the defect is >5 mm.2 Otherwise, dental implants can be preserved unless recurrence of sinusitis is noted, where the implants must then be removed before or during the revision sinus surgery.26

Three patients developed fungal sinusitis after dental implantation in our study (Fig. 9). Although fungal infections account for ~10% of cases of CRS, the relationship between fungal sinusitis and dental implantation is still unclear. Sohn et al. presented a case with right-side sinonasal aspergillosis infection after sinus augmentation.9 They considered that smoking and membrane perforation were possible factors contributing to this problem. However, none of our patients with fungal sinusitis were smokers. In addition, as previously mentioned, sinus membrane perforation is noted in 9.6–44% of patients during sinus augmentation, and the correlation with fungal sinusitis is weak. Some studies have suggested that maxillary sinus aspergillosis is associated with root canal–treated teeth with overextension of the root canal sealer or solid materials into the sinus. Root-filling materials that contain zinc oxide and formaldehyde have been shown to accelerate the growth of aspergillosis in the maxillary sinus and in culture medium.27,28 We hypothesize that because the bone substitutes and implants used for sinus augmentation and dental implantation may contain the same materials, they may induce fungal sinusitis when the dental implant penetrates into the maxillary sinus.

The role of the otolaryngologist should not only be limited to the treatment of complications such as rhinosinusitis after dental implantation, but should also include evaluation and prevention before the implantation. Pignataro et al. also suggested that an otolaryngologist should be a primary figure in the approach to any sinus lift procedure with three steps: a first preventive–diagnostic step, a second preventive–therapeutic step, and a third diagnostic–therapeutic step, to ensure success of the surgery.14 According to our findings, all cases of CRS that develop after dental implantation can be treated by ESS with good results, providing good medicolegal guarantees for both patients and dentists. The principles of treating DIrCRS are summarized in Fig. 10.

The major weakness of this retrospective study is that the preimplant conditions of the affected maxillary sinuses are unknown in some patients. Although craniofacial CT is usually routinely performed before dental implantation to evaluate the conditions of alveolar bone height and maxillary sinus, there are still six patients who do not have preimplant CT and only can be diagnosed as DIrCRS by clinical histories. Additional prospective study will be needed to more precisely define DIrCRS, excluding the possibility of undiagnosed CRS that become apparent after dental implantation.

CONCLUSION

Most cases of DIrCRS are caused by penetration of dental implants into the maxillary sinus. ESS can be used as the first surgical choice for DIrCRS because of its good prognosis and low morbidity. Over 60% of DIrCRS patients with their dental implants preserved did not have recurrence. We suggest that dental implants can be preserved unless they are mobile, with severe infection or under conditions of sinusitis recurrence; however, the sinus mucosa above the dental implants must be kept intact during ESS.

REFERENCES


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