Paranasal sinus complications caused by dental implants and complementary procedures

N. Segal*, I. Woldenberg**, and M. Puterman*

*Department of Otolaryngology-Head & Neck Surgery, Soroka University Medical Center, Ben Gurion University of the Negev, Israel; **Maxillofacial Surgery Unit, Soroka University Medical Center, Ben Gurion University of the Negev, Israel

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Abstract. Paranasal sinus complications caused by dental implants and complementary procedures. Objective: To describe the paranasal complications that may occur after dental implantation. Study design: A literature search was performed in order to review currently available information about the complications of dental implantations and complementary procedures. Results: The use of dental implants has gained great popularity due to their convenience, natural look, and better speech and chewing efficiency, as well as their potential to slow and even stop jawbone atrophy. Nevertheless, an increasing number of publications have drawn attention to the possible complications of the procedure for the paranasal sinuses. Both short-term and long-term complications have been described that should be familiar to otolaryngologists. Conclusions: Although the procedure is performed by dentists, dental implantations may also have a major impact on the paranasal sinuses. Complications may necessitate the knowledge and cooperation of both dentists and otolaryngologists.

Introduction

Paranasal sinus diseases of dental origin are common and familiar to otolaryngologists. About 10% of chronic maxillary sinusitis, for example, is caused by dental diseases.1

Since the introduction of dental implants in the late 1970s, this method of artificial tooth root replacement has gained great popularity. The basic principle of dental implants is to introduce a cylinder that will osteointegrate within the living bone in order to fix a dental fixed or a removable prosthesis. A typical implant consists of a titanium screw (resembling a tooth root) with a roughened surface that increases its osteointegration potential. Implantation includes an ostectomy or a precision hole that is drilled into the jawbone, and installation of the implant in the ostectomy.2 Several other procedures are sometimes needed to facilitate the implantation. They can include guided osseous regeneration by means of biological membranes, sinus lifting and bone grafting or biomaterial implantation. These procedures use bone transplantation or bone to enlarge the maxilla in cases of inadequate bone depth or vertical deficiency.3

In recent years, several publications have addressed the complications of dental implants involving the paranasal sinuses, and the different treatment options. We have reviewed the literature on this subject, and provide several clinical demonstrations from our experience.

Complications of dental implants

The overall success and survival rate of dental implants is about 95%.4 The complications of implantation include infection, incision line opening, peri-implantitis, implant overload and failure, nerve damage (mainly to the inferior alveolar nerve) and even rare reports of implant-related malignancy.5,6 Complications involving the paranasal sinuses can arise from the implant itself or the complementary procedures.

Complications caused by the implant

The most frequently reported complication associated with the dental implant itself involving the surrounding maxillary bone is peri-implantitis. This inflammatory reaction involves the loss of supporting bone in the tissues surrounding the implant and it occurs in 28%-56% of the patients, necessitating antimicrobial treatment (both systemic and using
mouth rinses) and – not infrequently – surgical intervention.\(^7\)

In the case of implants in the posterior maxilla, the implant may migrate to the paranasal sinuses, either during surgery or after a period of functioning.\(^8\) The implant may be displaced to the maxillary sinus (Figure 1), ethmoids and even the sphenoid sinus.\(^9,10\)

Infection of the paranasal sinuses can occur in several ways. Anavi \textit{et al.}\(^{11}\) described 13 patients with late complications of maxillary sinus augmentation procedures: all of them had maxillary sinusitis and 10 patients presented with oroantral fistulae. A review of the files of the referring practitioner revealed the pre-operative presence of chronic maxillary sinusitis in 4 patients and an odontogenic cyst in one patient. These researchers recommended total elimination of sinusitis and other pathological conditions before all maxillary sinus augmentation and implant surgery. The exposure of dental implants in the maxillary sinus was also found to predispose to sinus infections.\(^{12}\) Jung \textit{et al.}\(^{13}\) found that protrusion of dental implants by more than 4 mm into the maxillary sinus may cause mucosal thickening, as demonstrated by CT scan. Raghoebert \textit{et al.}\(^{14}\) described a case of rhinosinusitis after dental implantation due to implant protrusion into the maxillary sinus. The inflammatory process resolved completely after the surgical removal of the protruding parts. Although not described yet in regard to dental implants, \textit{Aspergillus’s} sinus infection has been associated with oro-sinusal fistula and/or the perforation of the maxillary sinus by root canal-filling material.\(^{15}\) This entity should be familiar and suspected in cases of maxillary opacification after any surgical intervention that might create sinus-oral communication of any kind.

\textbf{Complications caused by complementary procedures}

Sinus grafting, which was first performed by Tatum in 1986, is usually required when there is maxillary alveolar ridge resorption and, in these cases, the bone may not support implant placement.\(^{16}\) The procedure can be performed via a lateral window approach (opening a window in the buccal bone),\(^{17}\) the crestal approach (cracking the crestal bone with osteotomes)\(^{18}\) or the hydraulic sinus condensing method (drilling a hole into crestal bone).\(^{19}\) In all of these approaches, the mucosa of the maxillary sinus is lifted to enable the introduction of bone grafting material. Several studies have described the effects of maxillary sinus floor elevation surgery on maxillary sinus physiology. Timmenga \textit{et al.}\(^{20}\) demonstrated a significant increase in bacterial growth from sinus cultures three months after sinus
floor elevation surgery with iliac crest bone grafts. This increase was accompanied by an increase in goblet cell numbers in the epithelial layer and resolved after 9 months. Peleg et al.\(^{21}\) showed that the vast majority of patients with sinus mucosal thickening on computerised tomography after sinus lift heal spontaneously without sequelae.

The most common complication of sinus lifting, a perforation of the Schneiderian membrane, occurred in about 11% of patients.\(^{22}\) Although small perforations have not been associated with higher implant failure, violation of the membrane may predispose to misplacement of the implant materials.\(^{23}\) The injected grafting material may cause mucosal thickening and may dislodge into the maxillary lumen and cause maxillary sinusitis\(^{24}\) (Figure 2).

Recent publications have placed great emphasis on a detailed knowledge of the anatomic structures inherent to the maxillary sinus and require full ENT assessment in the integrated management of candidates for maxillary sinus lift. Zijderveld et al.\(^{22}\) examined one hundred consecutive patients scheduled for a lateral window approach to maxillary sinus floor elevation. Most of the cases forced a deviation from Tatum’s standard procedure due to the anatomical structure of the maxillary sinus. A thin or thick lateral maxillary sinus wall, strong convexity of the lateral sinus wall and bony septa required changes to the original surgical plan. Pignataro et al.\(^{25}\) described a three-step evaluation of patients undergoing maxillary sinus lift: the first step (preventive-diagnostic) includes the careful identification of any situations contra-indicating the procedure, like malignant neoplasia and bony defects. If naso-sinusal disease is suspected, a full ear, nose and throat evaluation should be performed, including nasal endoscopy and, if necessary, a computed tomography scan of the maxillofacial district, particularly the osteomeatal complex. The second step (preventive-therapeutic) is aimed at correcting any potentially reversible pathologies such as middle-meatal anatomical structural impairments, infective diseases and benign naso-sinusal neoplasms. The third (diagnostic-therapeutic) step is only required if sinusal complications arise after sinus lift surgery. The aim is to ensure the early diagnosis and prompt treatment of maxillary rhino-sinusitis in order to avoid, if possible, implant loss and, in particular, the related major complications. Mucoceles that once demanded evacuation prior to implantation are no longer dealt with in this way as long as the distance between the top of the mucocele with sinus augmentation and the osteomeatal complex (OMC) is 22 mm, or if the mucocele is no larger than 18 mm.\(^{26}\)

Although malignant neoplasia in metal implanted biomaterials has been reported as a rare complication with orthopaedic hardware, only one case has recently been reported of maxillary osteosarcoma 11 months after dental implantation.\(^{6}\) With the increased use of dental implants, dentists and otolaryngologists need to be aware of this rare but devastating complication.

**Treatment options**

Since both types of complications described above relate to the paranasal sinuses, the surgical treatment options involve either a Caldwell-Luc approach or an endoscopic nasal approach. The

![Bone window coronal computerised tomography of a 49-year-old patient after right maxillary sinus lift. The bone grafting material has migrated into the maxillary sinus lumen with secondary sinus opacification due to superinfection.](image)
advantages of the Caldwell-Luc approach are the possibility of closing oroantral fistula, and direct access to the facial skeleton when wide exposure is needed. Pagella et al. described the intra-oral endoscopic extraction of a metallic foreign body from the maxillary sinus using this approach.

The endonasal endoscopic approach is now the optimal technique for most dental complications involving the paranasal sinuses. The endoscopic approach allows for the good visualisation of the paranasal cavities, the removal of any foreign material and the restoration of the normal aeration of the sinuses with minimal bone destruction and trauma.29,30

Conclusions

Dental implantation is an increasingly popular approach for the rehabilitation of partially or totally edentulous patients. It is becoming steadily clearer that otorhinolaryngological factors may be the key to a successful outcome of the procedure. A precise knowledge of the facial skeleton anatomy and diseases is crucial to avoid complications. We feel that pre-operative CT imaging of the paranasal sinuses should be performed in order to avoid post-transplantation complications, although no prospective cost-effect studies have yet been performed on this issue. The endoscopic endonasal approach is the preferred procedure for treating paranasal complications arising from dental implants.

References

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Segal Nili
Department of Otolaryngology – Head & Neck Surgery
Box 151
Soroka University Medical Center
Beer-Sheva 84101, Israel
Tel.: +972-54-4268202
Fax: +972-8-6400635
E-mail: segalnil@gmail.com