Survival rate of INNO^{TM} implants placed in the site of sinus membrane perforation:

Daehee Lee DDS PhD

ABSTRACT

Purpose: This study evaluated the survival rate of INNO implants placed simultaneously in the site of sinus membrane perforation at the time of the sinus floor elevation procedure at sites where native bone height was more than 4 mm.

Methods: Sinus membrane perforations were detected in 4 patients, and 6 INNO implants were inserted in 4 sinus sites with simultaneous placement. Panoramic radiographs were obtained from each patient as follows: before surgery, immediately after implant placement, 6 months after surgery, and after 1 year. Clinical and radiographic examinations were performed at every visit.

Results: All implants were stable functionally, as well as clinically and radiographically, during the follow-up. No infection occurred in all sites, and all implants succeeded in the observation follow-up period. There was a 100% survival rate of implant in perforated sinuses, the same as in intact sinuses.

Conclusions: perforation of the sinus membrane does not compromise the short-term survival of INNO implants placed in combination with the crestal approach of sinus bone augmentation

Key Words: clinical prospective study; implant survival; maxillary sinus floor elevation; short dental implants; simultaneous implant placement

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INTRODUCTION

Often, the edentulous posterior maxilla presents clinicians with the need to increase the available bone to facilitate dental implant placement and provide long-term success. Sinus elevation may be indicated when the distance from the sinus floor to the top of the alveolar ridge is less than 8 to 10 mm. In 1994, Summers [1] introduced the osteotome sinus floor elevation (OSFE). In this technique, the Schneiderian membrane is elevated using osteotome through a crestal approach, and implants are simultaneously inserted. The use of the OSFE procedure improves implant primary stability and bone-to-implant contact.[2] In comparison with the lateral window access and sinus lift technique, the OSFE procedure is less invasive and less time consuming; furthermore, it reduces postoperative discomfort and morbidity. Recent meta-analyses indicate that implants placed using the OSFE technique have the same prognosis as implants placed using conventional techniques.[3,4] For OSFE is considered to be less invasive and less traumatic compared with the window technique, it had been widely applied to sinus lift for augmentation of the height of posterior maxillary bone. Furthermore, the bone density around the osteotomy site can be increased because of the compaction and condensation effect of the osteotome.

The most frequently occurring complication of OSFE is perforation of the sinus membrane during augmentation and/or graft material placement. Perforation of the sinus membrane may cause further complication such as increased risk of infection due to communication with other sinuses or risk of migration of graft particles into the sinus where they induce polyps or other sinus diseases.[7,14] Some studies report abandoning sinus lifting procedure because of the wide perforation.[12,13,15] However, Schneiderian membrane perforation is not an absolute indication for abandoning the procedure unless the membrane is largely destroyed.[8,14] At present, few studies

describe the effect of sinus membrane perforation in implants placed in combination with OSFE, and it will lead to the failure of implants. The objective of this retrospective case review is to evaluate the effect of sinus membrane perforation on the survival of dental implants.

MATERIALS AND METHODS

Patients

From June 2010 to March 2013, a total of 42 patients were treated with implants inserted with the OSFE technique at our department. All 42 patients (23 men and 19 women), at the time of treatment, were mainly healthy and ranged in age from 29 to 71 years; none of them displayed signs and symptoms of sinus disease. Panoramic radiographs were taken of all patients. The residual alveolar height was measured on the panoramic radiographs. Computed tomography was performed when it was difficult to define the sinus floor on the panoramic radiograph. The indication for OSFE was that bone height below the maxillary sinus, at the primary examination, was considered to be less than 8 mm. Sinus membrane perforations were detected in 4 patients, and 6 INNO implants were inserted in 4 sinus sites with simultaneous placement. Panoramic radiographs were obtained from each patient as follows: before surgery, immediately after implant placement, 6 months after surgery, and after 1 year. Clinical and radiographic examinations were performed at every visit.

Surgical techniques

Local anesthesia was administered before surgery. A bone height of about 4 mm was required for an implant in the sinus region. After local anesthesia and midcrestal incision, buccal and palatal full-thickness flaps were reflected. The pilot drill ended approximately 1 mm below the sinus floor calculated from the presurgical x-ray. Preparation of the recipient sites was either performed stepwise with appropriate spiral drills. If perforation of the Schneiderian membrane was detected in the sites where native bone height was more than 4 mm, the implant insertion procedure was accomplished without bone grafting. Postoperatively, patients were instructed to

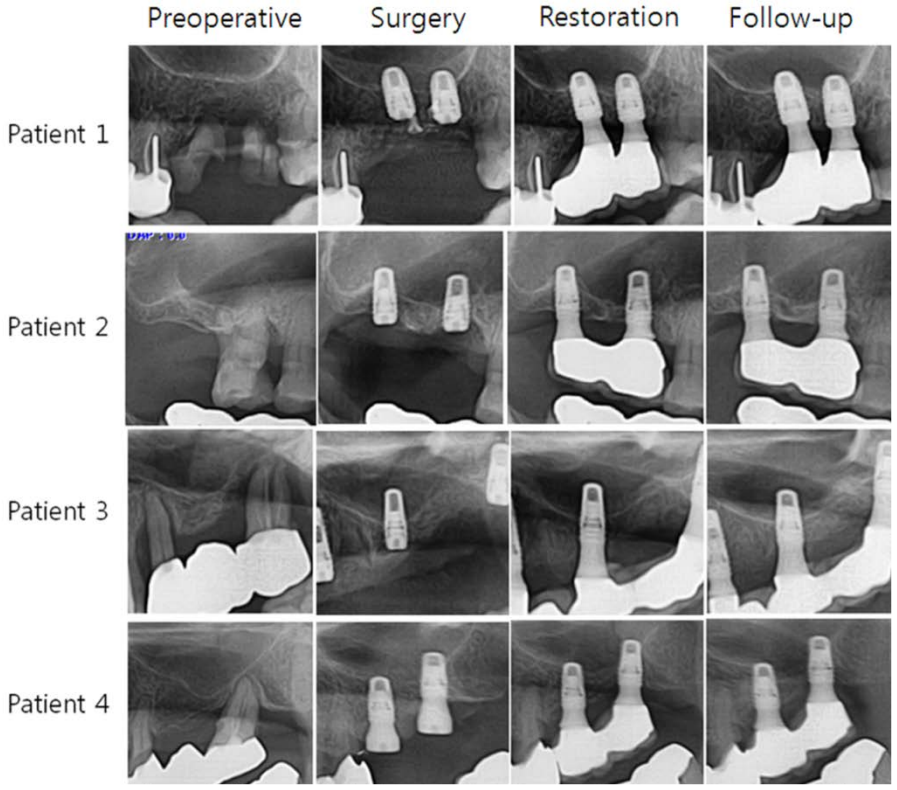

Figure 1. Panoramic X-ray of each patient at every visit during 1 year. At preoperative visit, postsurgery, restoration on 6 months after surgery, and the last follow-up

rinse their mouth twice a day with a 0.12% chlorhexidine solution, Hexamedin (Bukwang Pharmaceutical Co., Seoul, Korea) for 2 weeks after surgery. Antibiotics were prescribed for 7 days, and sutures were removed after 10 days. After a mean healing period of 6 months, all patients were rehabilitated with fixed crowns or bridges.

After inserting the implants, the patients received follow-up care at 1 and 2 weeks, at 3, and 6 months, and every 12 months thereafter. Clinical and radiological evaluations were performed using standardized radiographs according to the following schedule: prior to surgery, immediately after surgery, 6 months after surgery, and then every year after surgery .

Radiographic analysis of the grafted bone height

Radiographic examinations were performed at every visit (Figure 2). Radiographic changes in graft height were calculated with respect to the implant's known length and the natural bone height(NBH) with Easydent viewer version 4.5 software (Vatec, Anseong, Korea) (Figure 3).

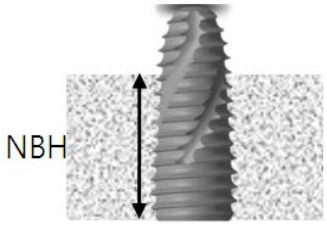

Figure 3. Schematic drawing of the measured parameters of the natural bone height(NBH).

RESULTS

During the sinus augmentation with the OSFE technique, 6 sinus membrane perforations were detected with the use of a depth gauge, and 6 implants were placed (Table 1). The mean native bone height was 4.5 mm. Nasal bleeding occurred in 1 patient with perforated sinus. Except for the above episode, healing was uneventful. No infection occurred in all sites, and all implants succeeded in the observation follow-up period of 18 months (range, 14–22 months).

3 of 6 implants in perforated sinuses exhibited periimplant bone formation. Nevertheless, the other 3 of 6 implants in perforated sinuses showed no bone formation (Fig. 1).

Table 1. Radiographic measurements for each patient

Patient no.	Site tooth no.	Bone quality	Implant		NBH (mm)
			D (mm)	L (mm)	
1	26	D3	5.0	8	4.5
	27	D3	5.0	8	5.4
2	16	D2	4.0	8	4.0
	17	D2	4.0	8	4.5
3	26	D2	4.0	8	3.5
4	27	D3	4.0	8	5.0
Mean					4.5

No signs of periimplantitis (probing pocket depth of >=5 mm and bleeding on probing) were found during the follow-up period. These data result in a 100% survival rate of implant.

DISCUSSION

OSFE involves shorter healing and waiting times because the fixture can be placed in the implant recipient sites simultaneously with the ridge augmentation. Complications described with this procedure involve local problems such as tearing of the sinus membrane, infection, bleeding, sinusitis, benign paroxysmal positional vertigo, and loss of bone.[18] The most frequently occurring complication is perforation of the sinus membrane. A perforation was indicated when air bubbles were found. Perforation of the sinus membrane by itself may cause further complications such as increased risk of infection due to communication with other sinuses or risk of migration of graft particles into the sinus. The OSFE procedure described by Summers involves a grafting material that is condensed in the osteotomy site to elevate the sinus membrane. If the Schneiderian membrane is perforated, the filling material can migrate into the sinus and lead to inflammation.[17,19,21] The present protocol, by avoiding the use of a grafting material, has completely eliminated this risk. With this technique, undetected perforations are likely to remain uneventful because the membrane can reform around 4 mm of protruding implants.[11,17] In our study, there was no infection or inflammation that occurred in all patients without a

grafting material, and all implants succeeded in the observation.

Factors that can influence the chance of Schneiderian membrane perforation include anatomical variations, surgeon's experience, and previous sinus infection or surgery.[18,22] Anatomical factors consist of residual alveolar height, bone density, maxillary sinus septa, and morphology of sinus bottom. In addition, it is very important to perform accurate measurements of the available bone height under the maxillary sinus area in the x-ray. It is also suggested that imaging studies such as computed tomography be required to reveal sinus anatomy to further assist in recognizing possible variations.

The importance of the sinus membrane perforation regarding implant survival is still controversial. However, it may be concluded that blood clot formation and subsequent bone healing within the intact sinus membrane should be more predictable and ideal. Various methods of treating the perforation have been published. The most common method is the placement of absorbable membrane under the perforated Schneiderian membrane.[7,21] Many authors have reported another method with Surgicel to cover small-to-moderate–size perforations. Surgicel is an absorbable hemostatic agent made of an oxidized cellulose polymer, and it is usually used to control bleeding.[2] The proper healing in the sinus area depends on the vascularization of the sinus membrane, the surrounding bone walls, and the elevated sinus wall. From this point of view, the size of membrane perforations may play a role on the long-term survival of dental implants placed into the augmented sinus area.[13]

In our study, all dental implants in 4 patients with perforated sinuses were osseointegrated successfully in the observation. The results of our limited study revealed that perforation during the OSFE procedure was not a risk factor for implant survival. Several clinical studies also reported no complications for implants penetrating the maxillary sinus or the nasal cavity.[2,8] The increased predictability of the OSFE technique allows treatment of the posterior maxilla when the residual bone height is 4 mm.[15]

Within the limits of this study, we can conclude that perforation of the sinus membrane does not compromise the short-term survival of INNO implants placed in combination with OSFE. The technique seems to be predictable and allows treating the compromised posterior maxilla with reliable short-term results. However, long-term survival and changes of newly formed bone must be evaluated.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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