



Effect of Sinus Membrane Perforation on Dental Implant Integration: A Retrospective Study on 128 Patients

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Sinus augmentation as reported by Boyne and James¹ and, later, Tatum² facilitates placement of dental implants in the posterior maxilla when the native bone is inadequate to support masticatory load on endosteal implants. The maxillary sinus is lined with periosteum and Schneiderian membrane, which is a pseudostratified ciliated epithelium that functions by removing debris and bacteria from the sinus.³ Sinus augmentation is accomplished by elevating the sinus membrane from the osseous floor and filling that void with graft material.

Perforation of the Schneiderian membrane has been reported as a complication occurring 10% to 60% of the time during sinus augmentation.^{4–12} Various methods of treating the perforation have been published. The objective of this retrospective case review is to evaluate the effect of sinus membrane perforation on the success of the bone grafts and dental implants placed into these grafts.

PATIENTS AND METHODS

Patients

In 2007, a total of 128 patients underwent sinus augmentation with

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A common complication of sinus augmentation is perforation of the sinus membrane during augmentation and/or implant placement. This retrospective study examines the effect of sinus membrane perforation with regard to graft survival and implant integration. A total of 175 sinuses were augmented with 115 of the membranes being reported intact at the time of surgery. A total of three infections occurred in patients who sustained perforated sinuses and one infection occurred in a

patient who had an intact sinus. All four infections resolved after culture sensitivity and placement of the patient on an appropriate antibiotic for 10 days.

Of 438 dental implants placed in the augmented sinuses, five implants failed, four of which were associated with perforated sinuses and one which was not associated with a perforated grafted sinus. (Implant Dent 2011;20:13–19)

Key Words: sinus membrane, perforation, osseointegration

placement of dental implants at our institution. One hundred fifteen patients were partially edentulous and 13 patients were completely edentulous. A total of 175 sinus augmentations were performed, and a total of 438 dental implants were placed in the augmented bone. Sinus augmentation and implant placement were performed simultaneously in 124 patients, in whom 429 implants were placed. A two-stage approach was performed in four patients in whom nine implants were placed after 8 months of graft maturation. Two hundred forty-eight Nobel Biocare Replace Select (Nobel Biocare, Yorba Linda, CA) implants and 190 Implant Direct (Implant Direct, Calabasas Hills, CA) implants were placed. All patients were followed up for 1 year after final restorations.

Methods

All sinus augmentation procedures were performed under intrave-

nous sedation. The graft material used was porous hydroxyapatite (Pro Osteen R, Interpore Cross International, Irvine, CA) and platelet rich plasma prepared per Harvest Technology (Harvest Technologies, Plymouth, MA) protocol. Patients received 20 mg of dexamethasone and 2 g of ampicillin (Zithromax was used in PCN allergic patients). A full thickness buccal flap was elevated to expose the lateral maxillary sinus wall and a 1.2-cm cortical window was removed using a #8 surgical round bur. The Schneiderian membrane was carefully elevated and found to be either intact or perforated. Surgicel (Johnson & Johnson, New Brunswick, NJ) was used to repair small to moderate perforations, and a long-lasting collagen membrane (Ace Surgical, Boston, MA) was used to repair large perforations. Implant Direct or Nobel BioCare Replace Select implants⁵ were surgically placed. Surgical sites were coated with platelet rich plasma and



Fig. 1. Panoramic of intact bilateral sinus membrane.

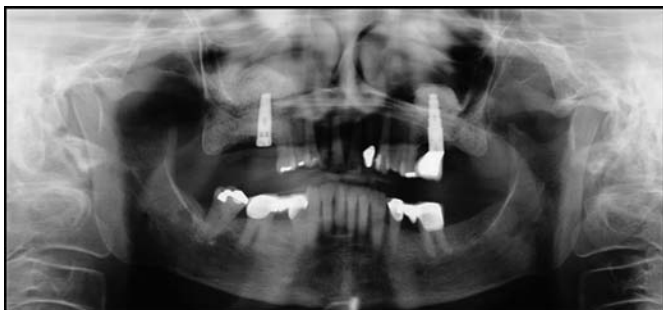


Fig. 2. Panoramic of intact bilateral sinus membrane.



Fig. 3. Panoramic of intact left sinus membrane.



Fig. 4. Panoramic of intact right sinus membrane.

the flap closed primarily with 3-O Chromic gut and 3-O Vicryl sutures.

RESULTS

One hundred twenty-eight patients received sinus augmentation and dental implants in 2007. There was a total of 175 sinus augmentations: 47 were bilateral (Figs. 1 and 2) and 81 were unilateral (Figs. 3 and 4). The surgeon noted 115 intact sinuses and 60 (34%) perforated sinuses (Figs. 5–8) during the surgeries. There were four (2.2%) sinus infections (Table 1). Three infections occurred in patients who had sustained a perforated sinus and one in a patient who had an intact sinus. All four infections resolved after culture and sensitivity and placement of the patient on Avelox (moxifloxacin hydrochloride) (Bayer, Wayne, NJ), 400 mg daily for 10 days plus Flonase (fluticasone propionate) (Glaxo Smith Kline, Triangle Park, NC), two sprays in each nostril daily for 21 days.

There was a total of 438 dental implants placed in the bone-augmented sinus. Three hundred four implants were placed in intact sinuses, and 134 implants were placed in perforated sinuses. A total of five implants failed: four implants from perforated sinus and one implant from an intact sinus. These data result in a 99% success rate of implant integration in intact sinuses compared with 97% success rate in perforated sinuses (Table 2).

Two hundred forty-eight implants were Noble Biocare Replace Select and 190 were Implant Direct. Noble Biocare had two (1%) failures compared with three (2%) failures for Implant Direct (Table 3).

Immediately-loaded implants were compared. There were 47 implants placed in augmented sinuses, 36 implants placed in intact sinuses, and 11 implants placed in perforated sinuses. Nineteen implants were Implant Direct and 28 implants were Nobel Biocare. One implant (Nobel Biocare) failed from an intact sinus (Table 4).

DISCUSSION

The literature states that there are many complications with sinus aug-



Fig. 5. Panoramic of right perforated sinus membrane.



Fig. 6. Panoramic of left perforated sinus membrane.



Fig. 7. Panoramic of right perforated and left intact sinus membrane.



Fig. 8. Panoramic of right perforated sinus membrane.

mentation, including perforation of sinus membrane, acute or chronic sinusitis, cyst, mucocele, delayed wound healing, hematoma, and loss/sequestrum of bone. The most frequently occurring complication is perforation of the sinus membrane, which is reported in from 10% to 60% of cases.⁴⁻⁷ 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 where they induce polyps or other sinus diseases.^{12,13} Some studies report abandoning sinus lifting procedure because of the wide perforation^{8,14-18} However, Schneiderian membrane perforation is not an absolute indication for abandoning the procedure unless the membrane is largely destroyed.^{12,19}

There are many options for treating perforation of the Schneiderian membrane. The most common method is the placement of resorbable membrane under the perforated Schneiderian membrane.^{13,19,20,21} Other methods for treating perforation include folding the membrane up against itself,²² using sutures,¹² or using fibrin glue^{10,23} to close the perforation. At our institution, we routinely use 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. Previous reports indicate that using Surgicel is technically simple, fast, reliable, and economical. It shows limited bactericidal qualities, and has no contraindications in the maxillary sinus.²⁴⁻²⁶

Factors that can influence the chance of Schneiderian membrane perforation include anatomical variations, surgeon's experience, and previous sinus infection or surgery. Anatomical factors consist of thickness of the lateral maxillary sinus wall, convex lateral sinus wall, connection between Schneiderian membrane and oral mucosa, narrow and wide sinus, maxillary sinus septa, longitudinal septum, and root-shape configuration.^{3,9-11} It is also suggested that previous sinus surgery and absence of alveolar bone are risk factors for a

Table 1. Infection Rate on Condition of Sinus Membrane

| | | |
|------------------------|--|---|
| 175 sinus augmentation | 115 intact 1 infected sinus (0.87%) | 60 perforation 3 infected sinus (5%) |
|------------------------|--|---|

Table 2. Implant Success Rate on Condition of Sinus Membrane

| | | |
|---------------------|---------------------------------------|---|
| 438 dental implants | 304 in intact sinus 1 failed (99%) | 134 in perforated sinus 4 failed (97%) |
|---------------------|---------------------------------------|---|

Table 3. Implant Success Rate on Implant Brand

| | | |
|---------------------|-------------------------------------|--------------------------------------|
| 438 dental implants | 248 Noble Biocare 2 failed (99%) | 190 Implant Direct 3 failed (98%) |
|---------------------|-------------------------------------|--------------------------------------|

Table 4. Immediate Loaded Implant Success Rate on Condition of Sinus Membrane

| | | |
|------------------------------|--------------------------------------|---|
| 47 immediate loaded implants | 36 in intact sinus 1 failed (97%) | 11 in perforated sinus 0 failed (100%) |
|------------------------------|--------------------------------------|---|

higher chance of Schneiderian membrane perforation.¹⁰ Therefore, imaging studies such as CT scan may be required to reveal sinus anatomy to further assist in recognizing possible variations.

CONCLUSION

This study demonstrates that perforation of the Schneiderian membrane does not cause negative long-term effects on sinus bone grafts and dental implants. However, more studies correlating the size of sinus membrane perforation with the type of repair performed are needed.

Disclosure

The authors claim to have no financial interest in any company or any of the products mentioned in this article.

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