

Differential application of a repair technique for large perforations of the Schneiderian membrane: case report

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Sinus membrane perforation arising during the sinus lift procedure is a very severe complication that can induce the failure of vital bone formation in the bone-graft area, the failure of dental implant osseointegration and sinusitis. In most cases, the size of the perforation was small; therefore, various techniques can be applied to treat sinus membrane perforation. However, the variability in anatomy of the sinus cavity and related surgical miscalculations frequently result in tearing of the Schneiderian membrane. In the case of an extremely thin maxillary sinus membrane, achieving a membrane lift that does not involve membrane tearing is difficult. Sometimes, a pre-existing membrane perforation must be repaired prior to implant restoration; however, in this case, the perforated area may be too large to manage simply. In this report, two cases in which large perforations of the maxillary sinus were repaired through the lateral window approach are reviewed. Pre-existing oro-antral perforations were observed in both cases. In one case, the perforation area was so large that the torn membrane of the maxillary sinus was sealed and supported with a bilayered collagen membrane. In the other case, the size of the oro-antral perforation was extremely large, and the destruction of the sinus bony floor was severe. Block bone grafting and a collagen membrane were used for support and sealing of the torn membrane and for the bone supporting maxillary sinus floor. The successful repair of sinus membrane perforation was verified by radiographic examination, and a clinically good prognosis was observed during follow-up period. (**JOURNAL OF DENTAL IMPLANT RESEARCH 2012;31(3):73-78**)

Key Words: Maxillary sinus lift, Dental implants, Repair, Sinus membrane, Tearing

INTRODUCTION

The creation of a large sinus membrane perforation during the sinus lift procedure could prevent the completion of a successful implant therapy. The particle of grafted bone could not be immobilized. The amount of new bone formation may be limited by the absence of Schneiderian membrane in the area superior to graft, and this limited new bone formation may increase the risk of infection at the graft site¹.

In the case of maxillary sinus perforation, a single layer of a fast-resorbing collagen membrane such as Collatape or tissue adhesive such as fibrin glue can be applied for repair². In the case of a large perforation, a collagen membrane can also be used to repair a sinus membrane perforation. Delayed sinus grafting is also recommended².

However, the application of a single layer of collagen membrane over a large perforation could cause extensive fibrosis and inflammatory infiltration². Maintaining the position of the collagen membrane at the site of a large perforation can also be difficult. The tissue adhesive should be applied to the torn membrane edges³; therefore, the use of a single layer of collagen membrane or tissue adhesive is not sufficient for the repair of large perforations of the sinus membrane. In cases when oro-antral communication results from extensive inflammation of the sinus and alveolar bone, the torn sinus membrane must be sealed more carefully, and the sinus floor bony structure must be reconstructed.

This case report describes patients with extensive sinus membrane perforation, and proposes a new technique to repair the membrane perforation.

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CASE REPORTS

1. Case 1

A 38-year-old woman was referred to the author's clinic for the removal of an implant fixture within the left maxillary sinus cavity. She had undergone dental implant surgery performed according to the crestal approach, but the fixture fell into the sinus cavity through the sinus membrane.

The position of the implant fixture was confirmed by radiographic examination. Local anesthesia was carried out with 2% lidocaine containing 1 : 100,000 epinephrine. Two vertical incisions were made at both ends of the horizontal incision, while the distance between the upper left first premolar and the starting point of the anterior vertical incision was sufficient to extrude a dental implant fixture previously installed at the second premolar from the mucoperiosteal flap. Oroantral communication was verified at the crestal area after the elevation of the mucoperiosteal flap. The lateral wall of the left maxillary sinus was exposed, and a bony window was prepared and detached from the sinus membrane. To remove the fixture that had invaded the sinus cavity, a horizontal incision of 1 cm in length was created at the exposed sinus membrane with a no. 15 blade. The fixture was removed with long tissue forceps through the incision made in the sinus membrane.

The entire membrane associated with the left maxillary sinus was lifted from the sinus floor for repair of the sinus membrane perforation, which extended into both the crestal area and the lateral incision area. A collagen membrane was used to create a new membrane because of the large size of the perforation.

Two holes were made 1 mm above the superior margin of the lateral window. A stiff collagen membrane (Bio-Mend, Zimmer Dental, Carlsbad, CA) was sutured into the holes using resorbable suture material. A collagen membrane was inserted buccopalatally into the sinus floor under the elevated Schneiderian membrane, and a fast-resorbing collagen membrane (Collatape) was inserted anteroposteriorly beneath the Bio-Mend for complete support and sealing of the sinus membrane.

Alloplastic bone-grafting material (beta-tricalcium phosphate, Cerasorb, Curasan, Kleinostheim, Germany) was packed under the Collatape to facilitate new bone formation.

Additional bone grafting was carried out in the oroantral communication area of the crestal region, and the detached bony window was repositioned. The sutures were created with 4-0 nylon.

Dome-shaped packing of the grafting bone under the elevated sinus membrane was verified by radiographic examination, which indicated the complete sealing of the perforation.(Fig. 1)

2. Case 2

A 47-year-old woman visited our dental clinic for the treatment of a periodontal abscess in the upper right molar area. Severe periodontitis of the upper right first molar and premolars was confirmed by clinical and radiographic examinations, and severe bony destruction of the upper right second molar area was observed.

The mobile teeth with periodontitis were extracted under local anesthesia. A horizontal incision was created with a no. 12 blade from the distal point of the upper right canine to the maxillary tuberosity. A vertical incision was created with a no. 15 blade on the mesial point of the upper right first premolar. Extensive bony destruction and sinus membrane perforation were found after periosteal elevation.

A lateral bony window was prepared, and the sinus membrane was thoroughly lifted from the sinus floor with the bony window lifted upward and inward. The position of the Schneiderian membrane at the maxillary tuberosity was lost because of the loss of bony support induced by a severe inflammatory response. The patient wanted to undergo dental implant surgery and sinus grafting concomitantly. Therefore the drilling required for fixture installation was performed in the crestal area.

The large sinus membrane perforation at the maxillary tuberosity region was covered with Collatape, and block bone acquired from the mandibular chin area was inserted beneath the Collatape to reconstruct bony support for the sinus membrane. Alloplastic grafting material (Cerasorb) was packed around the block bone through the lateral window, and an implant fixture was installed. The gaps between the implant fixture and extraction socket margin were filled with Cerasorb and Bio-Oss. All the grafting areas observed at the alveolar crest and maxillary tuberosity were covered with collagen membrane (Bio-Gide[®], Osteohealth, Shirley, NY). The lateral window area was covered with Collatape,

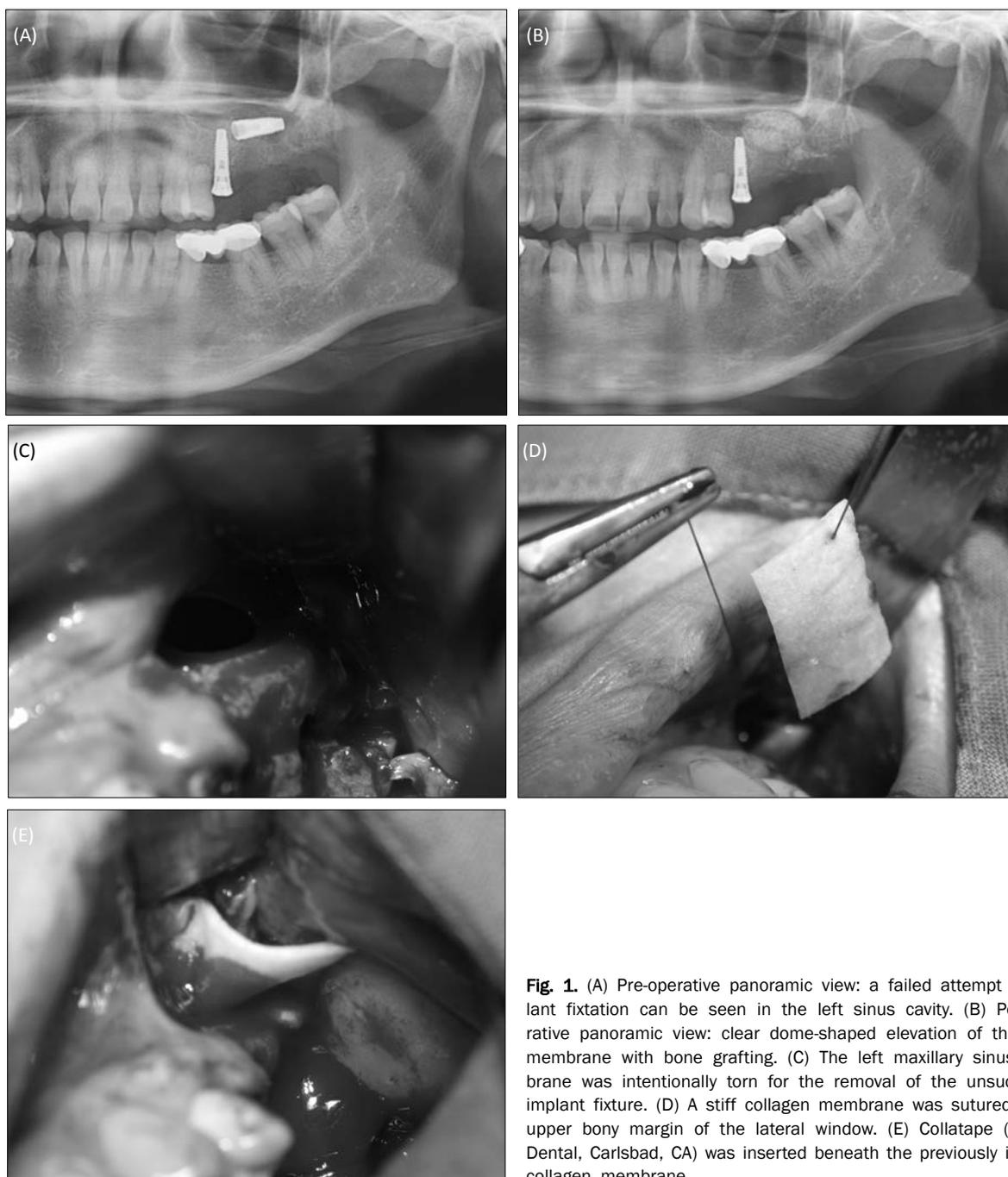


Fig. 1. (A) Pre-operative panoramic view: a failed attempt at implant fixation can be seen in the left sinus cavity. (B) Post-operative panoramic view: clear dome-shaped elevation of the sinus membrane with bone grafting. (C) The left maxillary sinus membrane was intentionally torn for the removal of the unsuccessful implant fixture. (D) A stiff collagen membrane was sutured to the upper bony margin of the lateral window. (E) Collatape (Zimmer Dental, Carlsbad, CA) was inserted beneath the previously inserted collagen membrane.

and the flap was sutured with 4-0 Nylon.

Postoperative radiography performed 4 years after surgery showed that the bone graft was maintained well around the implant fixture. No clinical or radiographic problem related to implant fixture was observed.(Fig. 2)

DISCUSSION

The occurrence of maxillary sinus perforation during the sinus lift procedure has been reported to be a common complication. The incidence has been reported to range from 11% to 56% in previous studies⁴⁻⁶. There are many risk factors for perforations such as sinus floor irregularities, septa, the existence of a thin membrane, previous sinus operations,

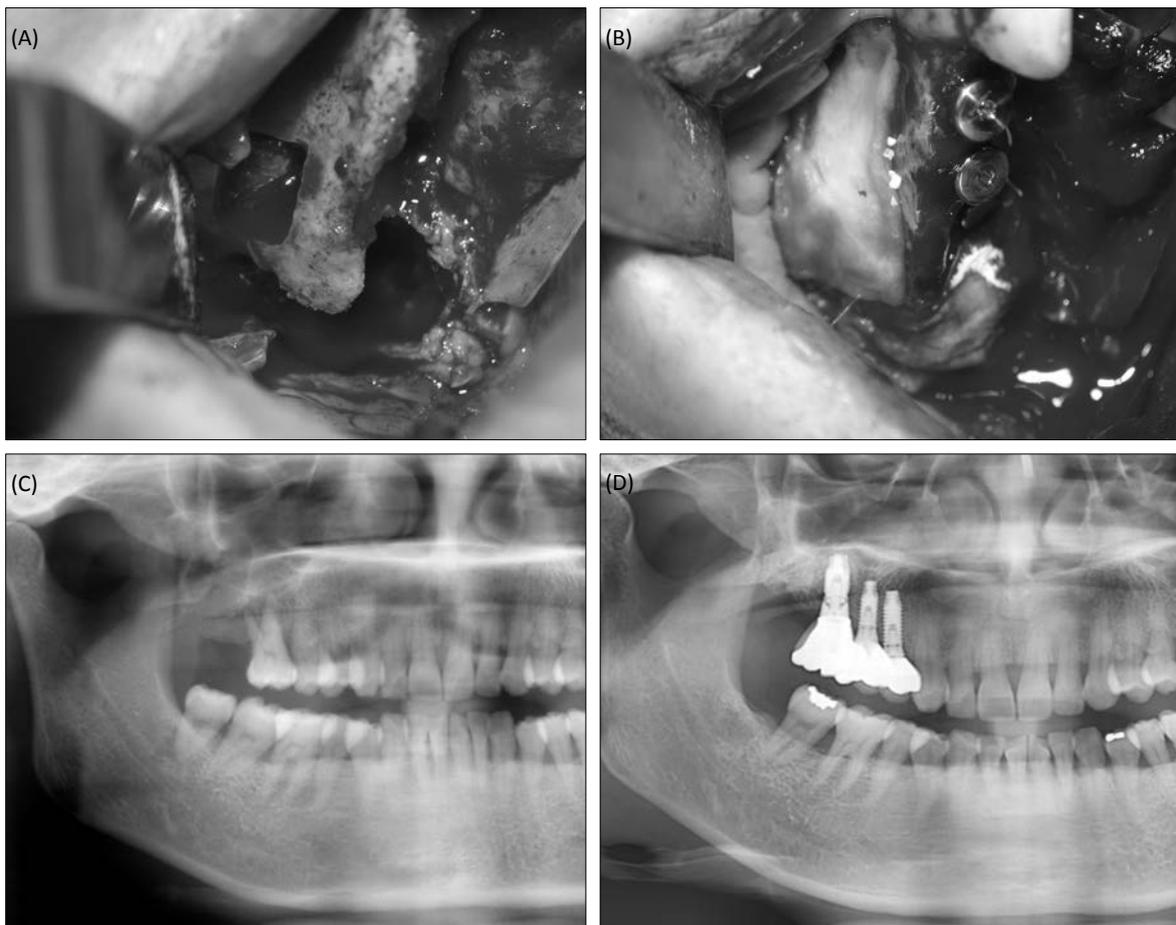


Fig. 2. (A) A lateral bony window was prepared, and hinged inward and upward to lift the sinus membrane. Extensive sinus membrane tearing due to the presence of severe infection can be seen. (B) The lateral window was covered with Collatape. (C) The pre-operative panoramic view: extensive loss of the right maxillary tuberosity can be seen. (D) 9-month post-operative view: the new bony floor formation in the sinus was radiographically stable.

adhesion of the Schneiderian membrane and the absence of bone between the sinus mucosa and oral mucosa⁷⁻¹⁰.

Although Boyne reported that minor membrane tears might not represent a significant clinical hazard¹¹, a large perforation should be repaired because of its possible sequelae, such as maxillary sinusitis and failure of the graft. The displacement of biomaterial through the sinus membrane can lead to transient or chronic sinusitis in 10 ~ 20% of sinus elevation cases. These dislocated bone particles might also initiate local inflammation and severe resorption of the graft material¹². Proussaefs et al.¹ reported that the perforated sinuses displayed less vital bone formation than non-perforated sinuses.

There are many studies and reports on repair techniques. However, most of these reports recommended delayed installation of the dental implant fixture. Khoury et

al.¹³ recommended that simultaneous implant placement should be avoided in cases with severe perforations because new bone formation around the fixture within the sinus cavity is unpredictable.

On the other hand, some reports propose that bone grafting would not be affected if the repair is adequate¹⁴. The authors in the current study also performed simultaneous (immediate) implantation, although there was perforation at the sinus membrane.

Large perforations of the sinus membrane often require complex repairs. In the case of large perforations, the collagen membrane that covered the perforation could not be supported by surrounding intact Schneiderian membrane. It is therefore impossible to maintain the position of the collagen membrane. Graft material can invade the sinus cavity through the perforation area. Especially in cases with perfo-

rations at the meeting of neighboring cavity walls, the collagen membrane, which was inserted to repair the perforation, cannot be supported by intact sinus membrane for repair. This anatomical limitation was reported by Fugazzoto and Vlassis¹⁵.

The cross-stabilization technique was introduced in cases 1 and 2 to repair large perforations. When the perforation was large, the Schneiderian membrane (including the perforation) was lifted. Although additional tearing of the membrane was inevitable during lifting, there should be no remnants of Schneiderian membrane upon the sinus floor to maintain the blood supply from the bony surface. After membrane lifting, the implant site was prepared.

Two holes were created at the point 5 mm above the superior margin of the bony window. The hole was prepared with a small fissure bur. A stiff collagen membrane of sufficient size, such as Bio-Arm (ACE Surgical Supply Company Inc., Brockton, USA), was sutured into these holes with resorbable suture material (4-0 Vicryl, Ethicon, Norderstedt, Germany). This stiff collagen membrane was folded into the inner side of the sinus cavity. The elevated sinus membrane

was supported by this collagen membrane. Additional collagen membrane (e.g., CollaTape) was attached beneath this stiff membrane. Therefore, the upper stiff collagen membrane was positioned buccopalatally, and the lower, smoother collagen membrane was positioned in an anteroposterior arrangement, which allowed for cross-stabilization. Sinus grafting was preformed, and the bony window was repositioned before fixture installation.(Fig. 3)

If the alveolar bone supporting the sinus membrane is lost, the graft bone is supported not by adjacent bone but rather by sinus membrane. Vital bone formation cannot be achieved without bony support, and alveolar mucosa with greater mobility can inhibit the repair of the sinus membrane.

Therefore, in this case, reconstruction of the bony support of the sinus membrane is important for sinus grafting and implant osseointegration. Considering the size of the bony defect, autogenous block bone grafting may be the optimal choice. As case 2 demonstrates, autogenous block bone grafting may represent the treatment of choice for the support of repaired Schneiderian membrane and vital bone

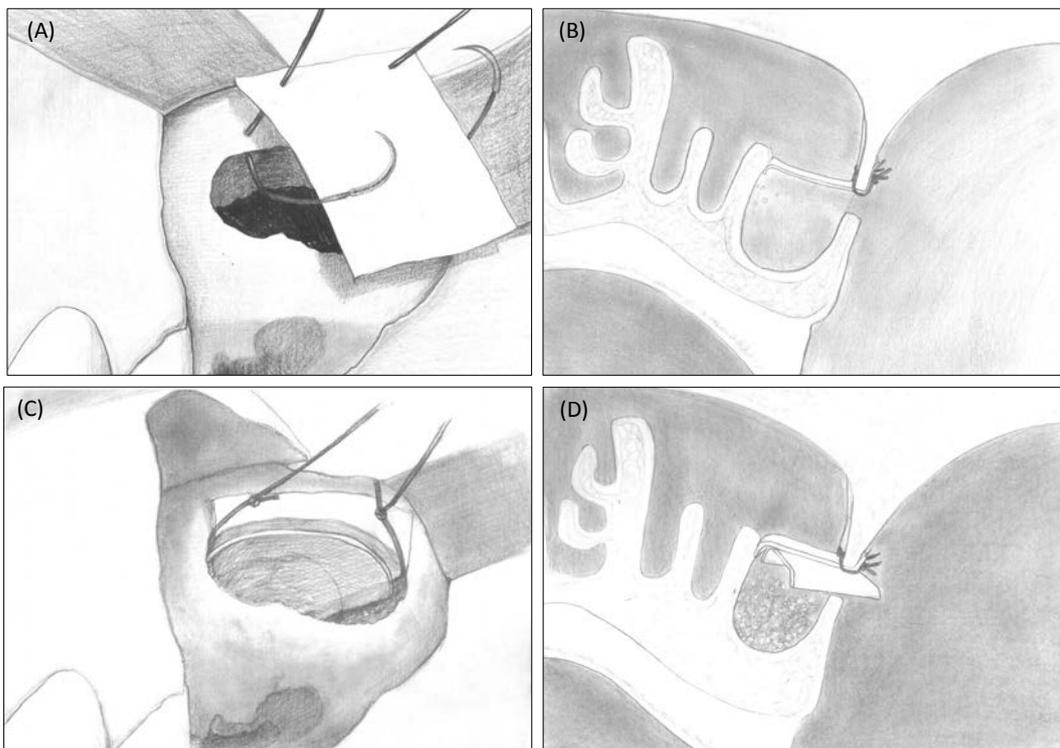


Fig. 3. (A) A stiff collagen membrane was sutured into two holes at the superior margin of lateral window. (B) The stiff collagen membrane was folded into the inner side of the sinus cavity. (C, D) Additional collagen membrane was attached beneath this stiff membrane.

formation from graft material.

Large perforations can also result from the inappropriate handling of small perforations of the sinus membrane. Periapical infections and severe periodontal infections can also result in large perforations. Intentional perforations should be created to remove mucosal retention cysts and foreign bodies within the sinus cavity. Failed initial attempts at repair of small perforations can enlarge pre-existing perforations in the sinus membrane. Some authors have reported that the application of CollaTape in large perforations can cause extensive fibrosis, inflammatory infiltration, and the loss of epithelium. Therefore, a stiffer collagen membrane, such as Bio-Arm or Bio-Mend, should be used. The semi-rigidity of this stiff collagen membrane would be useful in supporting the elevated sinus membrane¹⁴⁾ but would also prevent the intimate sealing of elevated membrane. Therefore, another rapidly-resorbing absorbable collagen membrane, such as CollaTape, should be used beneath the stiff collagen membrane for intimate sealing. This repair technique might also be useful because of the variability in the anteroposterior length of the membrane tear and the lateral bony window size. Therefore, the initially inserted stiff collagen membrane would be helpful for buccopalatal stabilization of the sinus membrane, and the second collagen membrane would serve as an anteroposterior stabilizer, which would allow for cross-stabilization.

Some authors have reported the application of a bone tag for stabilization of the collagen membrane²⁾. However, in the case of simultaneous implantation with sinus grafting, absorbable suture material would be recommended for stabilization of the collagen membrane to avoid additional surgery for removal. Dome-shaped radiopacity in the maxillary sinus postoperatively was observed on the postoperative radiograph in all cases. This observation indicates a well-repaired perforation of the Schneiderian membrane. Prosthetic restoration of the implant was installed, and good stability was obtained. These sequential approaches can be used widely for the patients who experience sinus membrane perforation.

REFERENCES

1. Proussaefs P, Lozada J, Kim J, Rohrer MD. Repair of the perforated sinus membrane with a resorbable collagen membrane: a human study. *Int J Oral Maxillofac Implants* 2004;19:413-20.
2. Pikos MA. Maxillary sinus membrane repair: update on technique for large and complete perforations. *Implant Dent* 2008;17:24-31.
3. Choi BH, Zhu SJ, Jung JH, Lee SH, Huh JY. The use of autologous fibrin glue for closing sinus membrane perforations during sinus lifts. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2006;101:150-4.
4. Schwartz-Arad D, Herzberg R, Dolev E. The prevalence of surgical complications of the sinus graft procedure and their impact on implant survival. *J Periodontol* 2004;75:511-6.
5. Barone A, Santini S, Sbordone L, Crespi R, Covani U. A clinical study of the outcomes and complications associated with maxillary sinus augmentation. *Int J Oral Maxillofac Implants* 2006;21:81-5.
6. Kasabah S, Krug J, Simunek A, Lecaro MC. Can we predict maxillary sinus mucosa perforation? *Acta Medica* 2003;46:19-23.
7. Becker ST, Terheyden H, Steinriede A, Behrens E, Springer I, Wiltfang J. Prospective observation of 41 perforations of the Schneiderian membrane during sinus floor elevation. *Clin Oral Implants Res* 2008;19:1285-9.
8. van den Bergh JP, ten Bruggenkate CM, Disch FJ, Tuinzing DB. Anatomical aspects of sinus floor elevations. *Clin Oral Implants Res* 2000;11:256-65.
9. Berengo M, Sivolella S, Majzoub Z, Cordioli G. Endoscopic evaluation of the bone-added osteotome sinus floor elevation procedure. *Int J Oral Maxillofac Surg* 2004;33:189-94.
10. Watzak G, Tepper G, Zechner W, Monov G, Busenlechner D, Watzek G. Bony press-fit closure of oro-antral fistulas: a technique for pre-sinus lift repair and secondary closure. *J Oral Maxillofac Surg* 2005;63:1288-94.
11. Boyne PJ. Analysis of performance of root-form endosseous implants placed in the maxillary sinus. *J Long Term Eff Med Implants* 1993;3:143-59.
12. Nkenke E, Schlegel A, Schultze-Mosgau S, Neukam FW, Wiltfang J. The endoscopically controlled osteotome sinus floor elevation: a preliminary prospective study. *Int J Oral Maxillofac Implants* 2002;17:557-66.
13. Khoury F. Augmentation of the sinus floor with mandibular bone block and simultaneous implantation: a 6-year clinical investigation. *Int J Oral Maxillofac Implants* 1999;14:557-64.
14. Karabuda C, Arisan V, Hakan O. Effects of sinus membrane perforations on the success of dental implants placed in the augmented sinus. *J Periodontol* 2006;77:1991-7.
15. Fugazzotto PA, Vlassis J. A simplified classification and repair system for sinus membrane perforations. *J Periodontol* 2003;74:1534-41.