Successful Use of Leukocyte Platelet-Rich Fibrin in the Healing of Sinus Membrane Perforation: A Case Report

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Purpose: *The aim of this case report was to demonstrate the repair of a large sinus membrane perforation related to a sinus floor augmentation procedure, using leukocyte platelet-rich fibrin (L-PRF), for subsequent rehabilitation of a partially edentulous patient.*

Materials and Methods: *The patient presented the absence of teeth numbers 18, 17, and 16, associated with insufficient bone height because of the maxillary sinus pneumatization. A maxillary inlay bone graft was proposed, however, during the sinus floor augmentation procedure, a large portion of the sinus membrane was ruptured. To avoid interruption of the surgical procedure, membrane mending was proposed using L-PRF and collagen membranes.*

Results: *After 8 months, 2 external hexagon connection dental implants were placed in the 16 and 17 teeth regions, and a screw-retained implant-supported prosthesis was installed.*

Conclusion: *The use of L-PRF associated with collagen membrane was efficient for the sealing of the sinus membrane perforation and enabled bone formation for subsequent implant installation. (Implant Dent 2018;27:1–6)*

Key Words: dental implants, bone regeneration, bone substitutes, leukocyte platelet-rich fibrin (L-PRF), sinus membrane perforation, sinus floor augmentation

Management of partially and fully edentulous patients with dental implants has become a common and well-accepted treatment modality.[1] However, difficulties in dental implants placement in posterior maxilla can occur due to insufficient bone volume and the presence of the maxillary sinus.[2] Maxillary sinus cavity presents floor inclinations, bone septa, and possible pneumatization, which limit the proper implant placement.[3,4] Based on that, the sinus floor augmentation procedure, either through the lateral window or the transalveolar technique, has frequently been proposed for achieving sufficient bone height and volume in the posterior maxilla.[5,6] This treatment approach has been well documented by clinical studies supporting the use of a variety of graft materials involving autogenic, xenogeneic, allogeneic, and alloplastic materials.[7,8]

Complications associated with the sinus floor augmentation technique may occur, including postoperative wound infection, maxillary sinusitis development, loss of the graft material, edema, bleeding, and perforation of the sinus membrane.[9,10] Membrane perforation is the most common intraoperative complication with a prevalence rate ranging from 3.6% to 56%.[11–14] Inadequate thickness of the membrane and variation in the sinus morphology may lead to technical difficulties during the membrane elevation, increasing the perforation risk.[15,16] Studies have showed that this complication could be appropriately handled with an absorbable collagen membrane, without interfering in bone formation or implant survival.[17–19] However, in cases of large perforations and those located in unfavorable areas, the surgery procedure should be aborted to avoid graft contamination or migration, which could lead to postoperative sinus infection. In cases of surgery abortion, re-entry has to be considered.[9] According to Chanavaz,[20] this second

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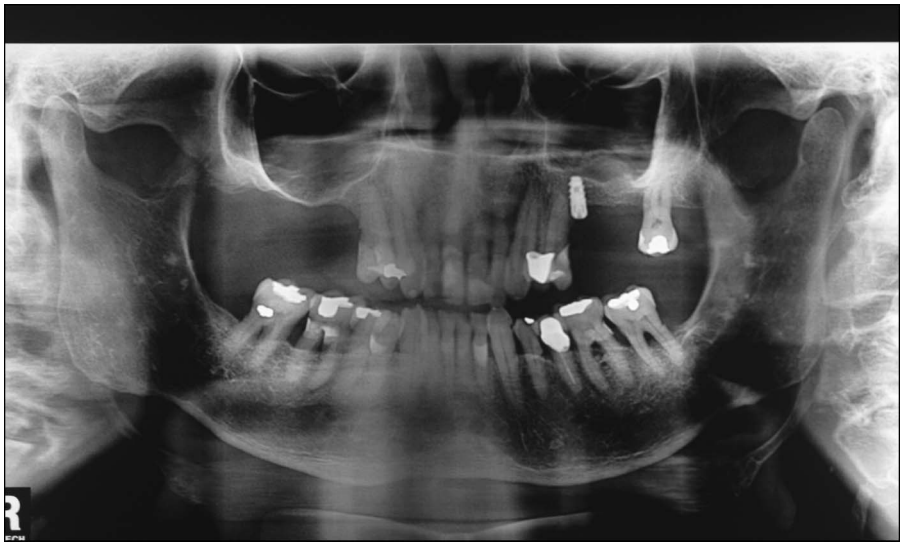

Fig. 1. Initial panoramic radiograph revealing the insufficient bone height for dental implants placement because of pneumatization of the right maxillary sinus associated with a severe crestal resorption on the right side of the maxilla.

Fig. 2. Initial image of the site previous to sinus lifting showing the absence of teeth numbers 16, 17, and 18 associated with a severe crestal resorption on the right side of the maxilla.

procedure should not be performed until 6 to 8 weeks after the first surgical attempt.

In this context, the leukocyte platelet-rich fibrin (L-PRF) or the second-generation platelet concentrate have been proposed to cover large perforations because of the good adherence of this material to the sinus membrane.[21] Furthermore, the L-PRF membrane consists an autologous fibrin matrix, produced from the blood of the patient, with "trapped" platelets and cytokines, which ensures a slow release of growth factors.[22] Based on these membrane biological and mechanical features, recent systematic reviews have showed favorable clinical results of the L-PRF on periodontal surgery, bone regeneration, and osseointegration.[23,24]

Nonetheless, evidence regarding the use of L-PRF to manage sinus membrane perforations are still limited. This case report demonstrates the repair of a large sinus membrane perforation, occurred during a sinus floor augmentation procedure, using L-PRF, for subsequent rehabilitation of a partially edentulous patient with dental implants.

CASE REPORT

A 70-year-old male patient, in good general health, was admitted to the School of Dentistry at Araraquara, UNESP, for oral rehabilitation with dental implants. Clinical and radiograph examination showed that the patient exhibited the absence of teeth numbers 16, 17, and 18 (Figs. 1 and 2). Insufficient bone height for dental implants placement in this region was also revealed because of pneumatization of the right maxillary sinus associated with a severe crestal resorption on the right side of the maxilla. Based on that, a maxillary inlay bone graft using the maxillary sinus augmentation technique was thus proposed to allow dental implant placement in this region in an adequate tridimensional position and afford adequate esthetic and function for the final rehabilitation.

One hour before surgery, a single dose of antibiotics (Amoxicillin—2 g) associated with a steroidal anti-inflammatory agent (Dexamethasone—4 mg) were prophylactically administered. The intra and extra-oral asepsis were

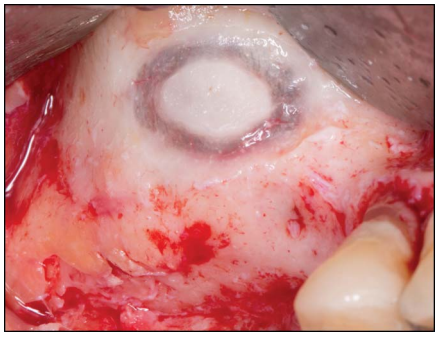

Fig. 3. Osteotomy on the lateral wall using diamond round burs to access the maxillary sinus trying to preserve the sinus membrane integrity.

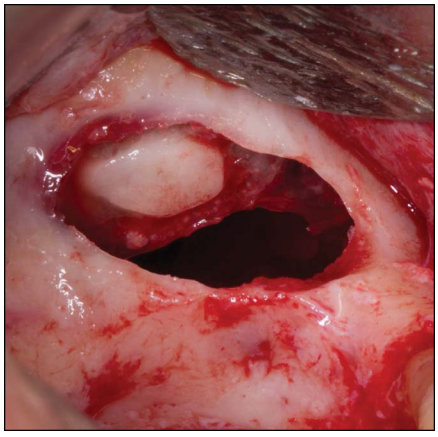

Fig. 4. Large fenestration of the sinus membrane during the elevation process due the thin morphological characteristic of the patient's sinus membrane.

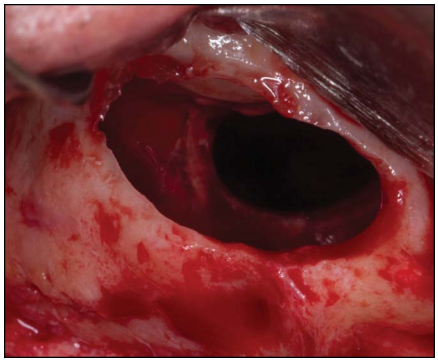

Fig. 5. Detachment of the sinusal membrane around all the border of the fenestration to isolated the patient's sinus membrane perforation.

Fig. 6. Final aspect of L-PRF after centrifugation and each L-PRF clot was compressed into membranes.

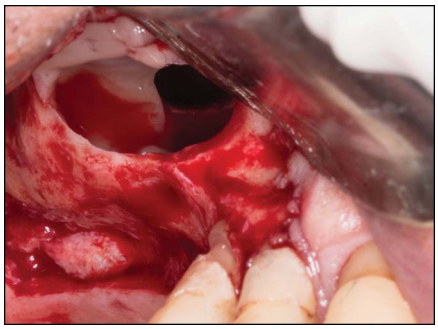

Fig. 7. Adaptation of L-PRF membrane over the sinus membrane fenestration to ensure the perforation sealing.

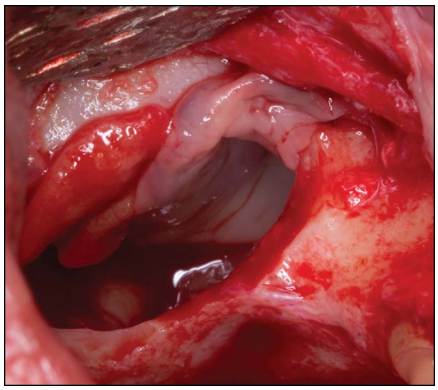

Fig. 8. Final aspect after full obliteration of the sinus membrane fenestration with the L-PRF membrane ensuring the perforation sealing.

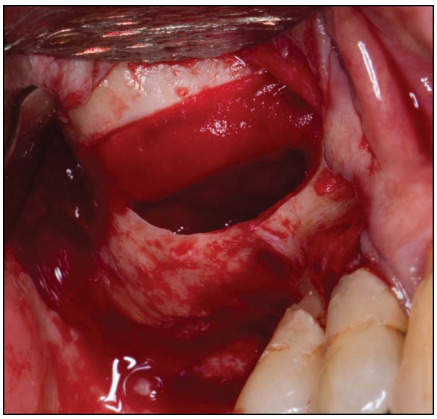

Fig. 9. Final aspect after collagen membrane insertion over the L-PRF membrane reinforcing the perforation sealing.

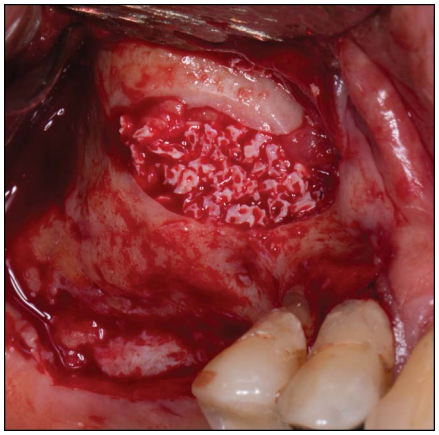

Fig. 10. Insertion of the grafting biomaterial (Bio-Oss) into the sinus cavities to ensure the bone formation and appropriated dental implants placement.

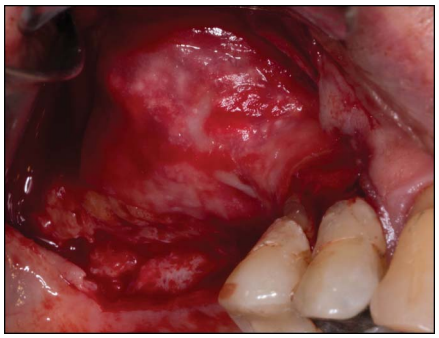

Fig. 11. Insertion of collagen membrane over the grafting material to prevent the graft overflow to oral cavity.

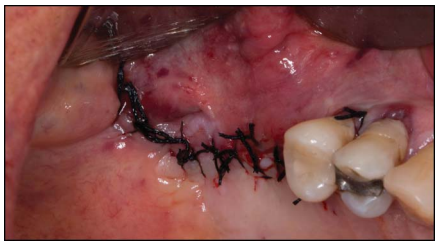

Fig. 12. Suture of the surgical site using 4.0-silk interrupted sutures.

made with 0.12% and 2% chlorhexidine gluconate, respectively. Local anesthesia was induced using a 4% articaine solution with epinephrine 1:100.000 (Nova DFL). Initially, a palate-oriented incision was performed on the crest of the ridge, followed by vertical incision on the maxillary tuberosity region. A full-thickness muco-periosteal flap was raised to gain access to the lateral wall of the sinus. The cortical bone on the lateral wall of the sinus was removed using diamond round burs, making circular movements, with sterile saline irrigation, trying to preserve the sinus membrane integrity (Fig. 3). After osteotomy, the sinus membrane was carefully elevated with special curettes (Cureta para levantamento de seio; Neodent). However, due the thin morphological characteristic of the patient's sinus membrane, a large portion of it was ruptured during the elevation process (Fig. 4).

Considering the size of the perforation, a repair was proposed using L-PRF and collagen membranes. To define the limits of the rupture, detachment of the entire border of the perforation was performed (Fig. 5), and the PRF membrane was produced using an established technique.[25] Immediately after drawing blood (6 blood vacutainers), the vacutainers were centrifuged at approximately 3000 rpm for 10 minutes (Labofuge 300, Kendro Laboratory Products GmbH, Osterrode, Germany). Acellular plasma platelet-poor plasma was concentrated at the top of the tube, and the red corpuscles were concentrated at the bottom. A fibrin clot was obtained in the middle of the tube. The fibrin clot was removed from the tube and was gently separated from red corpuscles with a scalpel preserving the intermediate part composed by a large platelet concentration (Buffy

Fig. 13. Panoramic radiograph after implant installation on the grafted area, showing the adequate dental implant position.

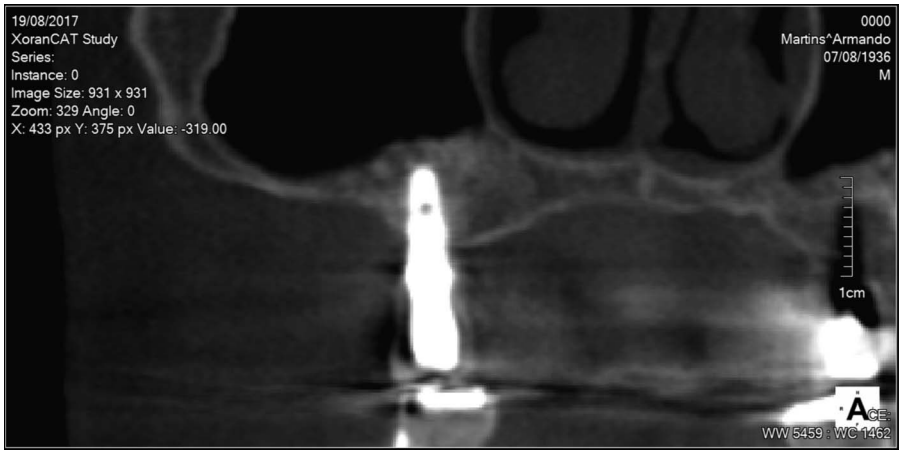

Fig. 14. Tomographic slice of implant installed into the grafted site showing the adequate bone formation around the dental implant.

Fig. 15. Final aspect of implant-supported fixed prosthesis installed replacing the teeth 16 and 17 after 6 months of function.

Coat). Each L-PRF clot was compressed into membranes and inserted into the maxillary sinus to ensure the perforation sealing (Figs. 6–8). Thereafter, a collagen membrane was placed on top of the L-PRF membranes to offer greater mechanical resistance to this region (Fig. 9). This approach allowed the surgical procedure continuity without the risk of bone graft particles displacement to the maxillary sinus. The sinus cavities were filled with deproteinized bovine bone mineral (DBBM) (Geistlich Bio-Oss) (Fig. 10), and a collagen membrane was positioned on the access window before flap closure (Fig. 11), which was completed using 4.0-silk interrupted sutures (ETHILON; Ethicon) (Fig. 12). Standard sinus-lifting postoperative instructions were prescribed. The patient was instructed to perform gentle mouth rinses with 0.12% chlorhexidine gluconate twice daily for 15 days. The postoperative prescription included antibiotics (Amoxicillin, 500 mg, 8/8 hours for 7 days), nonsteroidal anti-inflammatory (Nimesulide, 100 mg, 12/12 hours for 3 days), and analgesics (Dipyrone, 500 mg, 6/6 hours for 3 days). The sutures were removed 10 days after the surgery. A healing time of 8 months was recommended so that adequate bone formation could be assured.

After 8 months, a cone-beam computerized tomography of the posterior maxilla revealed that all the bone graft inserted in the maxillary sinus was well delimited to the area of interest and ensured adequate bone formation for implant installation. Based on that, following the same approach described in the first surgical phase, 2 external hexagon connection implants (Neodent) were placed (3.75 × 11 mm) in the 16 and 17 teeth regions (Figs. 13 and 14). Definitive impressions and abutment selections were made 6 months after implant healing. The screw-retained implant-supported prosthesis was installed, and occlusion was adjusted, avoiding any premature contacts. Follow-up visits were scheduled to evaluate the patient's oral hygiene and adaptation. On the last follow-up visit, after 6 months of function, no prosthesis failure or radiograph signs of periimplantitis were found (Fig. 15).

DISCUSSION

The sinus floor augmentation procedure is a safe and predictable technique and was proposed in this case report to restore bone height in the posterior region of the maxilla and guarantee the adequate tridimensional position of dental implants. However, during the elevation process, because of the extremely thin and fragile condition of the sinus membrane, a large perforation occurred. For the repair of such perforations, the literature has proposed a variety of materials and techniques, including buccal fat pad flap, connective tissue, resorbable collagen membranes, fibro-mucosal grafts, amnion–chorion barriers, and the L-PRF and collagen membranes association.[9,26,27]

Collagen membranes have been frequently used for sinus membrane perforation repair and/or closing the sinus lateral window during sinus

augmentation surgery.[28,29] Considering that around 90% of the bone matrix protein content is type I collagen, the collagen membranes could be capable to stimulate the cell adhesion, proliferation, and orientation and promote a desired chemostatic response.[30] Associated with that, *in vitro* studies have shown that collagen bioabsorbable membranes may promote bone regeneration increasing the transforming growth factor beta (TGF-β) secretion and osteoblasts activity.[31] Clinical studies evaluating the effectiveness of the collagen coatings for sinus membrane repair reveled that they were successful in sinus membrane perforations up to 10 mm,[32] ensuring the repair without any healing problem[28] and showing no significant differences in implants success rates when compare with nonperforated sinus.[33] However, in this case report, the collagen membrane alone was not indicated because of the perforation extension, since it lacks the adequate mechanical resistance to sustain the whole length of a perforation with such dimension. Based on that, the use of a L-PRF membrane was proposed to reinforce the sealing obtained by the collagen membrane.

Obtaining L-PRF consists in a very simple and inexpensive protocol that produces a clot (or a strong membrane after compression) that combines many healing and immunity boosters present in the initial blood harvesting.[34] This autologous material acts as a bioactive bridge, with a strong fibrin architecture, that stimulates the local environment for differentiation and proliferation of stem and progenitor cells.[25,35] Composed mainly of leucocytes and platelets, it promotes the constant release of growth factors such as platelet-derived growth factor, TGF, vascular endothelial growth factor, and insulin-like growth factor for 7 to 14 days.[35,36]

Based on these characteristics, a recent *in vivo* study evaluated the effectiveness of L-PRF in repairing of sinus membrane perforations in rabbit maxillary sinus and showed that both collagen membrane and L-PRF contribute positively to the proliferative phase of the healing.[9] Nonetheless, until recently, there is no clinical study evaluating the efficacy of L-PRF in the repair of sinus membrane perforations. In this case report, the use of L-PRF associated with the collagen membrane for repairing a sinus membrane perforation assured the adequate membrane healing and bone formation for subsequent dental implants placement without any postoperative complications. Moreover, this approach prevented the interruption of the surgical procedure and eliminated the need for later re-entry after the biological repair of the membrane.

DBBM was chosen as the graft material in this clinical case because of the limited intraoral donor area and to avoid the high morbidity associated with harvesting bone from extra-oral sites. In addition, due to its low resorption rate, inorganic bovine bone grafts are well recommended for sinus floor augmentation because it maintains the graft height and improves implant survival.[37,38] Moreover, the collagen membrane was also used to close the lateral sinus window in this case report. This procedure increases the vital bone formation and the dental implant success.[39,40]

Conclusion

In this case report, the (L-PRF) membrane was considered to be an effective alternative material for repairing and healing of a sinus membrane perforation that occurred during a sinus floor augmentation procedure and showed no postoperative complication. Moreover, the sinus floor augmentation using DBBM graft ensured the successful patient rehabilitation with implant-supported fixed prosthesis. Further randomized-clinical-controlled studies should be carried on to establish an eventual protocol regarding the use of (L-PRF) membranes in the transsurgical repair of sinus membrane perforation during sinus floor augmentation procedures.

Disclosure

The authors claim to have no financial interest, either directly or indirectly, in the products or information listed in the article.

Roles/Contributions by Authors

G. D. C. d. S. Pinto: planned the surgical/prosthetics phases, executed the surgical phases, and wrote the article. S. C. Pigossi: participated in the surgical/prosthetics planning, executed the case report documentation, and wrote the article. T. Pessoa: executed the surgical phases and wrote the article. L. G. Nícoli: executed the surgical/prosthetics phases and helped to write the article. R. F. d. S. B. Araújo: executed the prosthetics phase and helped to write the article. C. Marcantonio: planned the surgical/prosthetics phases and revised the article. E. Marcantonio: coordinate the case report, planned the surgical phase, and helped to write the article.

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