Maxillary Sinus Augmentation and Implant Placement Using Venous Blood Without Graft Material: A Case Letter

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INTRODUCTION

Dental implant placement in the edentulous posterior maxilla can present difficulties because of a horizontal or vertical alveolar ridge deficiency, unfavorable bone quality, or increased pneumatization of the maxillary sinus.[1,2] Restoration of lost dentition has been successfully treated with sinus augmentation techniques and installation of dental implants. It is well-accepted that sinus lifting techniques require space makers such as autografts or allografts[3,4] for new bone generation. There are many reports comparing the efficacy of different graft materials,[5,6] window opening techniques and barrier membrane usage to close the cavity.[7]

The use of graft material is thought to be necessary; however, recent studies have demonstrated that the mere lifting of the sinus mucosal lining and simultaneous placement of implants without using a grafting material has resulted in sufficient bone development.[8–10] It is proposed that a blood clot can stimulate bone formation in secluded spaces below the sinus membrane. According to Simion et al,[11] the survival rates for implants in vertical ridges augmented with guided bone regeneration and a blood clot are comparable to those of implants in bone augmented with autografts and/or alloplasts. A previous study explained that the blood clot has the potential for stimulation of bone formation in secluded spaces at bone surfaces.[12]

The purpose of this case letter was to investigate the effect of using venous blood with sinus membrane elevation and the simultaneous insertion of titanium implants without additional graft material for bone augmentation of the maxillary sinus floor.

DESCRIPTION OF THE CASE

A 35-year-old female patient had been referred to the Department of Oral and Maxillofacial Surgery, Gulhane Military Medical Academy, Ankara, Turkey, for dental implant treatment in the left posterior maxilla. Presurgical clinical and radiologic examinations (panoramic radiograph and dental cone-beam computed tomographic scans) revealed the subantral residual bone was $\leq$5 mm as measured on CT scans and a sinus lift procedure was considered (Figure 1a and b).

Surgery was performed under local anesthesia. Incision was made, full thickness mucoperiosteal flap elevated, and the lateral wall of the maxillary sinus exposed. Using a diamond round burr with a diameter of 2 mm, the osteotomy was finished and a bony window was outlined under continuous cooling with sterile saline solution irrigation (Figure 2). The infractured lateral bony window was rotated medially and the Schneiderian membrane was gently elevated to make sure there was space enough for implant placement in the sinus. This design of antrostomy facilitates the precise replacement of the bony window as a barrier over injected venous blood in the maxillary sinus. Two IDI implants (Implants Diffusion International System, France), 3.5 mm and 4.2 mm in diameter and both 15 mm in length, could be placed simultaneously with better primary stability after elevation of the sinus membrane (Figure 3). The collected peripheral venous blood sampled from the brachial vein of patient's arm was injected anterior to the implant

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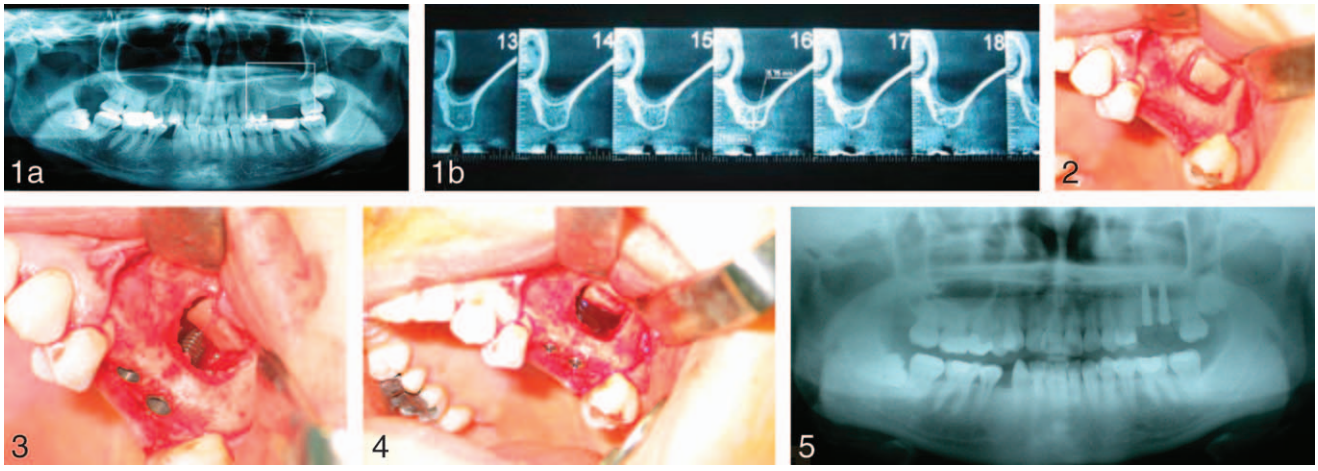


Figures 1–5. Figure 1. (a) Panoramic image before sinus augmentation procedure, (b) Cone beam computerized image of the residual alveolar bone. **Figure 2.** Preparation of the bony window with a round bur. **Figure 3.** Medial rotation of the bone flap, elevation of the mucosa of the maxillary sinus and implant placement. **Figure 4.** Filling the sinus space with the patient's own venous blood. **Figure 5.** Panoramic image of the implants taken 7 days after surgery

site, posterior to the sites, and directly above the placed implant apex to support bone (Figure 4). The volume of inserted venous blood was 4 mL, depending on sinus anatomy and the number of implants placed. Mucoperiosteal flap were repositioned, sutured to achieve passive primary closure and to promote new bone formation from the lateral wall of the maxillary sinus.

The patients were instructed not to blow their noses for 2 weeks after the surgery and to cough or sneeze with an open mouth. Amoxicillin (1 g) was continued postoperatively twice a day for 7 days. Postoperative panoramic radiograph was taken 7 days after the surgery (Figure 5). After the osseointegration period of 6 months, cone-beam computed tomography scans showed complete healing of the bone. Figure 6 presented the height of the residual alveolar process below the maxillary sinus and bone formation from the coagulum around the implants. Healing caps were placed, and final prosthetic restorations were applied with satisfactory and aesthetic results (Figures 7, and 8). The case is followed up for over 6 months through the restorative phase.

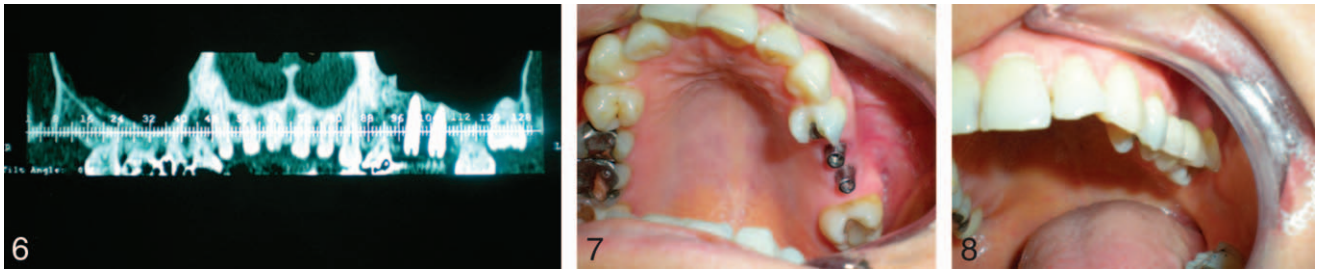
Discussion

The current study describes a new maxillary sinus augmentation method using the patients' own blood collected from a brachial vein, without any bone graft material, for the implant treatment of posterior maxillary atrophy.

According to the previous study about this technique, Lundgren et al demonstrated that wherein the maxillary sinus membrane was elevated and bone was spontaneously formed in the blood clot around implants, which had been placed in the residual alveolar bone.[12] In an animal study, Xu et al[13] reported that newly-formed bone in the augmented space after grafting with blood clot is unstable during the early stage of bony regeneration. Significant decrease of bone height and area was evident as early as between weeks 2 and 6.

Hatano et al[7] and Moon et al[8] revealed that the creation of a secluded space in the maxillary sinus simultaneously installed dental implants and filling with venous blood as a graft material results in new bone formation.

The importance of the presence of a blood clot in healing of circumscribed bone defects was reported in 1962.[14] Although this mechanism was not clear, it can be explained that the injection of collected venous blood could be a scaffold for new bone formation and the controlled trauma when lifting the sinus membrane resulted in the formation of a blood clot. The displacement of the membrane probably triggers a series of events, including blood and fibrin clot formation, cellular migration and differentiation, angiogenesis, and osteogenesis. The increased thrombin generation on the surfaces of titanium implants may also



Figures 6–8. Figure 6. Postoperative cone-beam computed tomographic scans taken 6 months after implant placement. **Figure 7.** Clinical view of the implants. **Figure 8.** Final prosthetic restoration at 6 months follow-up.

stimulate proliferation and inhibit apoptosis of osteoblasts.[15]

An increasing number of reports in the literature have demonstrated that the use of platelet-rich plasma (PRP) in combination with or without various bone graft materials in sinus membrane lift procedures may lead to improved early bone apposition around the implant, thus resulting in increased rate of osseointegration.[16,17] Moreover, Rutkowski et al[18] suggested that techniques that produce small quantities of PRP can be time efficient, cost efficient, and easily used in implant dentistry. However, in the previous animal study, Grageda et al[19] has used PRP combined with a bone allograft in the maxillary sinus of the sheep, and it was reported that PRP failed to enhance or accelerate bone regeneration in the maxillary sinus, due to the thrombin activation.

It may be thought that the implant must be placed in an osteogenic environment where the blood clot formed following surgery and its relation with the implant surface has an important role. According to the current case, growth factors capable of stimulating bone formation are present in blood. It can be suggested that placement of additional venous blood collected from the patient during surgery may further facilitate and improve the results from new bone formation due to the presence of growth factors in blood platelets.

Successful new bone formation and osseointegration of implants were recently reported without the use of any graft material directly on and around the implants.[20–22] The maxillary sinus has a great potential for bone formation, as seen in the present patient, and a grafting material is not a prerequisite for predictable bone formation.[23] In an experimental study in primates, Palma et al[23] presented that the histologic outcomes between the sinus membrane elevation and the simultaneous placement of implants with and without autogenous bone grafts. There were no significant difference regarding implant stability, bone-implant contact percentage or bone area around the implants.

As described in the literature, one factor that could have influenced the implant failure was insufficient primary stability.[24,25] Primary stability depends on adequate preparation of the bone site to receive the implant. Implants with deficient initial stability are susceptible to micromotion at the bone-to-implant interface and increased stresses at the sinus membrane-to-implant interface, which may affect the bone healing process and result in fibrous encapsulation.[26]

Some studies have shown that the application of a barrier membrane over the lateral window has advantages, such as reducing the invagination of soft tissue, increasing vital bone formation, and achieving a higher survival rate for implants.[27] Sohn et al[28] studied that there were no clinical differences in new bone formation between the group using nonresorbable membranes and the group using replaceable bony windows. In the present study, a barrier membrane was not used on the lateral sinus window. Repositioning of the lateral bony window offers more advantages over using resorbable or nonresorbable membranes to occlude the window. In addition, the cost to purchase the material and the surgical time for stabilization of the membrane could be reduced.

According to our observations, the application of bone graft material may not be a requirement for maxillary sinus augmentation and new bone formation with peripheral venous blood as a filler material could be an alternative treatment modality for the implant treatment. Further long-term studies are needed to evaluate the predictability of this maxillary sinus floor augmentation protocol using membrane elevation and peripheral blood.

Abbreviation

PRP: platelet-rich plasma

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