Noticeable Bone Regeneration beyond the Implant Tip after A Crestal Approach Sinus Lift Using Only Platelet Rich Fibrin: A Report of Two Cases

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Abstract

Purpose: To present two cases with noticeable bone gain beyond the implant tip after a crestal approach sinus lift using PRF as the sole grafting material.

Materials and Methods: Two PRFs were packed into each implant hole to elevate the Schneiderian membrane and sandblasted acid-etched implants were inserted simultaneously.

Results: The follow-up panoramic radiographs and CTs showed that the new sinus floor was above the implant tip and the cortical outline was clear.

Conclusion: The findings from both cases suggest that the PRF can promote noticeable bone gain in the crestal approach sinus lift procedure. A greater number of patients and a longer follow-up period are needed to investigate the reliability of this technique.

Key Words: Sinus floor elevation, PRF, Bone gain.

Introduction

The crestal approach sinus lift is one of the most frequently performed bone graft procedures in implant dentistry [1]. In the conventional method, bone grafting materials are used to elevate the Shneidelian membrane and to maintain the space for bone generation [2]. A number of bone grafting materials are used, including allografts, xenografts, or alloplastic materials. However, there is no consensus on the best choice of bone grafting materials for the crestal approach sinus lift [3-6].

Recently, platelet-rich fibrin (PRF), a second-generation platelet concentrate, has come to be used as the sole grafting material in sinus floor elevation procedures by both lateral [7–9] and crestal approaches [10-13]. These reports indicate that the use of PRF is associated with noticeable bone gain; however, the PRF itself does not have mechanical strength enough to protect the bone regenerative compartment. An implant needs to be installed simultaneously to act as a tent peg to maintain the space for bone generation. Thus, in cases where a sinus lift has been performed with PRF, new bone generation has only occurred under the level of the implant tip [7-11,13].

We herein report two cases with noticeable bone gain beyond the implant tip after a crestal approach sinus lift using PRF as the sole grafting material.

PRF Preparation

PRFs were prepared as described by Dohan et al. [14] Before surgery, 20 mL (2 tubes) of whole blood were drawn into 10 mL glass tubes without anticoagulant and immediately centrifuged at 400 g for 10 minutes. The platelets were immediately activated, thus triggering a coagulation cascade. The result was a fibrin clot located in the middle of each tube (*Figure 1A*).

Each clot was removed from the tube and separated from the red blood cell base with pliers (*Figure. 1B*). Two PRFs were thus generally produced for the treatment of each sinus.

Case 1

A 63-year-old Japanese male, who desired a dental implant prosthesis for the left first molar of the maxilla, was managed as a private practice patient. A panoramic radiograph obtained before surgery showed thin residual bone of only 4.5 mm in height. Under local anesthesia, a mid-crestal incision was made at the anticipated site of the implant. The buccal and palatal mucoperiosteal flaps were reflected with a full-thickness approach. An implant hole was prepared using a CAS kit (HIOSSEN, Philadelphia, U.S.A), which enabled drilling into the bone until the drill tip reached the Schneiderian membrane (*Figure 2A*). After reaching the Schneiderian membrane with

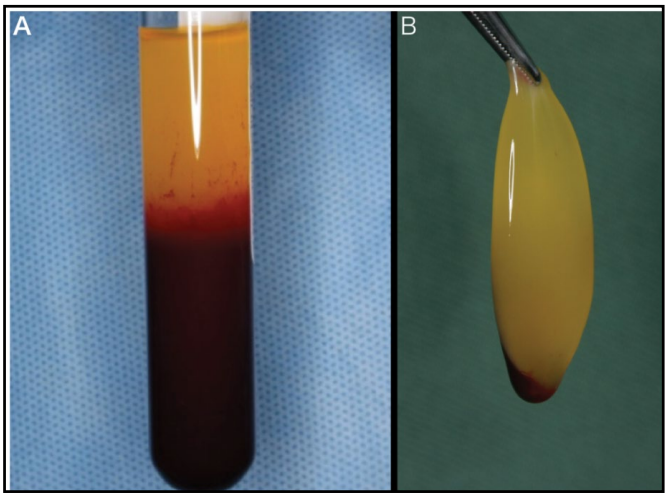

Figure 1*. (A) Blood centrifugation immediately after collection results in a structured and resistant fibrin clot in the middle of the tube, just between the red corpuscles at the bottom and acellular plasma at the top. (B) The middle fraction is taken out from the tube, 2 mm below to the lower dividing line, which is the PRF.*

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3.8 mm in diameter CAS drill (HIOSSEN, Philadelphia, U.S.A), 1 mL of saline was slowly injected into the prepared hole via pumping to detatch the Schneiderian membrane by hydraulic pressure using a hydraulic lifter (HIOSSEN, Philadelphia, U.S.A) (*Figure 2B*). No perforation was observed upon retrieved saline during the pull action. Two PRFs were then packed into the space below the elevated Schneiderian membrane (*Figure 2C*). After the placement of the PRFs and the elevation of the sinus membrane, a sandblasted acid-etched implant of 5 mm in diameter and 8.5 mm in length (TSIII, OSSTEM, Osaka, Korea) was installed (*Figure 2D*) with an insertion torque of approximately 30 Ncm. After cover screw connection, the flap was repositioned and sutured.

After surgery, the patient received oral antibiotics for 3 days, and nonsteroidal analgesics for 5 days. The patient had a good postoperative response, and there was no hemorrhage from the left side of the nose.

At four months after surgery, a screw-retained provisional restoration was performed. One month later, at five months after surgery, a screw-retained final restoration was delivered.

Figures 3 and 4 show panoramic radiographs and CTs, respectively, which were obtained before and after the insertion of the implant. Immediately after surgery, the Shneiderian membrane was elevated in a dome shape (*Figures 3B, 4A-1, 4A-2*). At three-months after surgery, the elevation of the membrane had decreased, however, it was still positioned above the implant tip (*Figure 3C*). At six months after surgery, the position of the elevated membrane remained above the implant tip and was stable (*Figures 3D, 4D-1, 4D-2*). At twelve months after surgery, newly-formed mineralized tissue was clearly visible (*Figure 3E*). At eighteen months after the surgery, the new sinus floor line was stable above the implant tip and was becoming obvious (*Figures 3F, 4C-1, 4C-2*). The new sinus floor was above the implant tip and the cortical outline was clear.

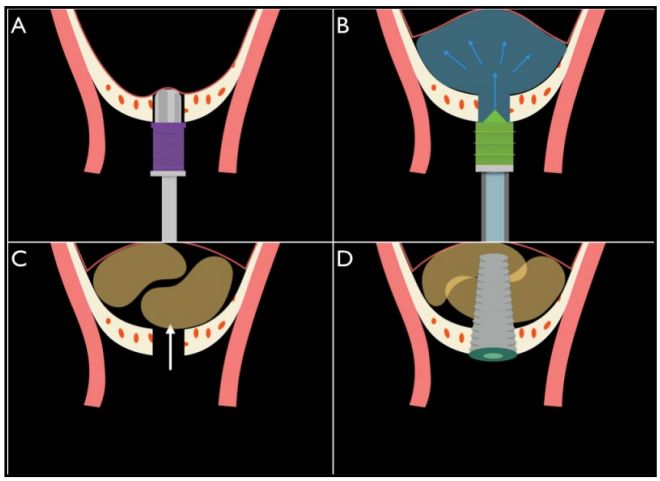

Figure 2. *(A) Surgical procedure.The implant hole was prepared using a CAS drill (HIOSSEN), which allows for drilling into the bone until the drill tip reaches the Schneiderian membrane. (B) Saline was slowly injected into the implant hole with hydraulic lifter (HIOSSEN). The sinus membrane was separated from the bone and lifted by hydraulic pressure. (C) Then the saline was ejected. Two PRF clots were carefully pushed into the sinus cavity. (D) After the placement of the PRF clots and the elevation of the sinus membrane, the implant was installed.*

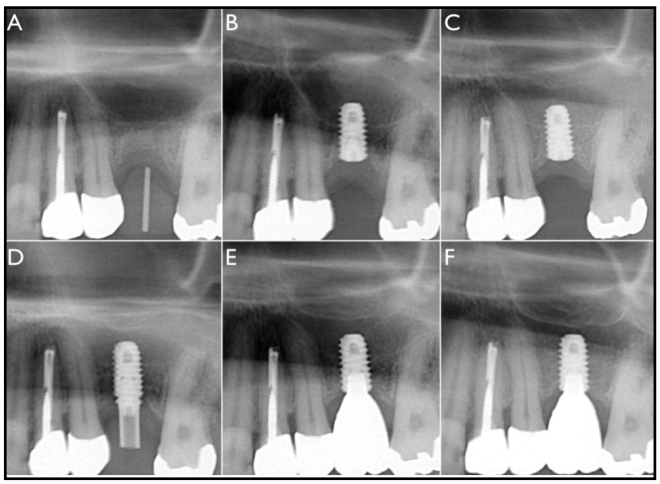

Figure 3. *Panoramic X-ray photograph examinations of Case 1. (A) Before surgery with the surgical template. The residual bone height was 4.5 mm. (B) Immediately after surgery. The Shneiderian membrane was elevated in a dome shape. (C) Three months after surgery. The elevation of the Shneiderian membrane had decreased; however it remained above the implant tip. (D) Six months after surgery. The position of new sinus floor line was still above the implant tip. (E) Twelve months after surgery. (F) Eighteen months after surgery. From 6-month to 18-month, new sinus floor line was stable and becoming obvious.*

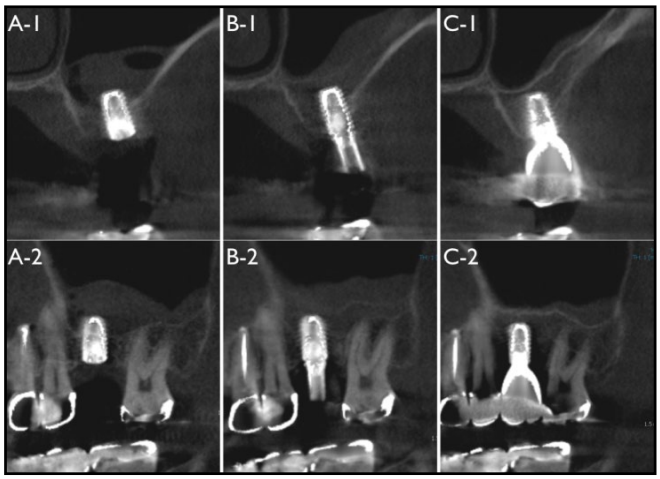

Figure 4. *CT of Case 1. (A-1,2) Coronal and sagittal images immediately after the surgery, respectively. The Shneiderian membrane was elevated in a dome shape. (B-1,2) Six months after surgery. (C-1,2) Eighteen months after the surgery. The newly formed sinus floor line above the implant tip was obvious. The bone gains in the regions buccal, palatal (C-1), medial, and distal (C-2) to the implant were prominent.*

Case 2

A 61-year-old Japanese female, who desired dental implant prosthesis for the left second premolar and first molar region of the maxilla, was referred to the private practice. This case report only discusses the first molar region, to which crestal-approach sinus floor elevation was performed in the same manner as Case 1. A sandblasted acid-etched implant of 4.5 mm in diameter and 10 mm in length (TSIII, OSSTEM, Osaka, Korea) was installed with an insertion torque of approximately 30 Ncm. The postoperative healing was uneventful.

Six months postoperatively, the implant had an abutment placed at 25 N-cm. An impression was taken, and the final restoration was delivered 2 weeks later.

Figure 5 shows panoramic radiographs obtained after the

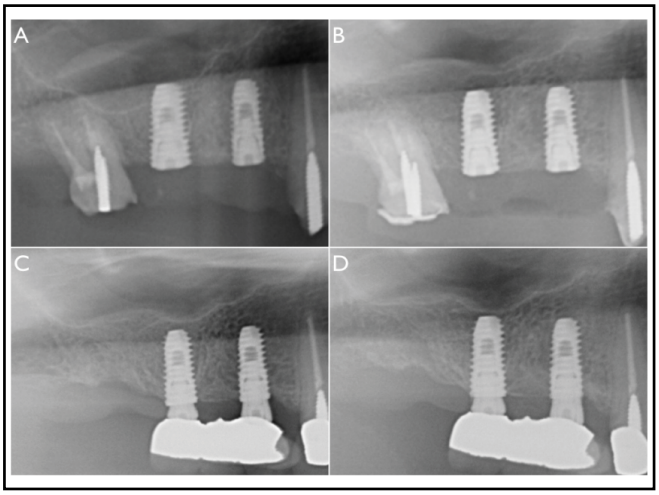

Figure 5. *Panoramic X-ray photographs of Case 2. (A) Right after surgery. Shneiderian membrane was elevated in dome shape. (B) Six months after surgery. The position of new sinus floor line was still above the implant tip. (C) Twelve months after surgery. (D) Twenty four months after surgery. Bone gain in the distal region to the implant was prominent.*

insertion of the implant. Newly-formed mineralized tissue was clearly visible on the 6-month radiographs. The new sinus floor was above the implant tip and there was prominent bone gain distal to the implant.

Discussion

At present three methods are used to perform crestal approach sinus lifts: graft-free, with PRF, and with grafting materials (*Figure 6*). The use of grafting materials is often preferred [15,16] as it ensures sufficient height between the Schneiderian membrane and the floor of the sinus cavity, which lead to endo-sinus bone gain (*Figure 6D*). On the other hand, bone formation after a graft-free sinus lift has now been well documented [17- 21]. The rationale behind omitting the grafting material is to maintain the Schneiderian membrane in the highest possible position by the tip of the inserted implant, which essentially functions as a tent peg (*Figure 6A*). The subsinus cavity, a natural bone regenerative chamber, is covered by the Schneiderian membrane which has highly osteogenic periosteum-like properties [22,23]. In such a closed cavity, the blood clot can promote bone cell migration and proliferation. The PRF method is theoretically identical to the graft-free sinus lift (*Figure 6B*) because PRF is a blood clot, which is prepared outside the surgical site. The main difference with the graft-free method is that clinicians can handle and place "a natural optimized blood clot" at the right moment and in the right location using the PRF method [23]. Since natural bleeding, which clinicians cannot control, is the key of efficient bone healing, the use of PRF is an efficient means of promoting large-scale bone regeneration around the implant.

To the best of our knowledge, this is the first report to show cases with noticeable bone gain beyond implant tip

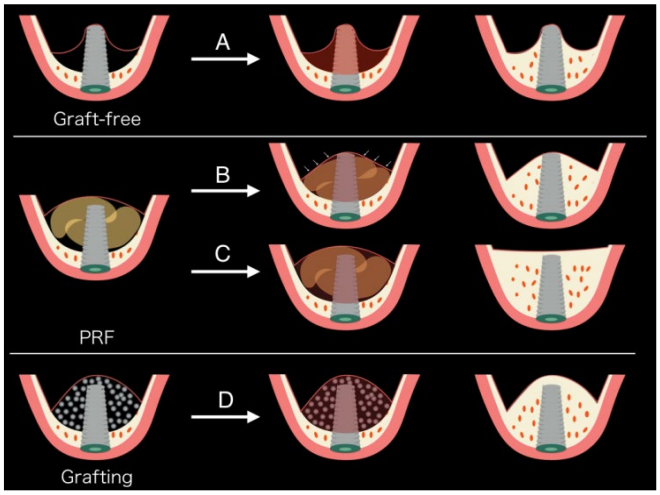

Figure 6. *The three methods for a crestal approach sinus lift. (A) The graft-free method. The tip of implant acts as tent peg and maintains the space for bone regeneration. (B) The PRF method is theoretically identical to the graft-free method. (C) In some cases, PRF itself could maintain the elevation of the membrane (in a high position). (D) The grafting method. Particle grafting materials are effective in maintaining the Schneiderian membrane at a high position because of their physical properties.*

after a crestal approach sinus lift using only PRF. Even if PRF could lead to greater endo-sinus bone gain than that achieved by the graft-free method, previous reports indicated that new bone generation only occurred under the level of the implant tip [10,11,13] (*Figure 6B*). Our two cases indicated that PRF itself could maintain the elevation of the membrane (in a high position) until new bone was generated (*Figure 6C*). PRF could also stimulate both the bone and the periosteum through the long-term slow release of growth factors and matrix proteins [23], which lead to more endo-sinus bone gain than the graft-free method. PRF may be a strong and secure biomaterial which can be widely applied to enable bone formation.

Conclusion

Although only two patients were presented, our X-ray and CT follow-up results demonstrated that PRF can promote noticeable bone gain in the crestal approach sinus lift procedure. However, many factors have the potential to affect the results including the shape of the sinus cavity, the presence or absence of adjacent teeth and other factors. The clinical aspects of PRF in this method require further investigation with a larger number of cases and a longer follow-up period.

Disclosure

The authors declare that they have no financial interests in any company or with any of the products mentioned in this article.

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