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Case Report

Clinical and histologic evaluations of healing in an extraction socket filled with platelet-rich fibrin

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Abstract Platelet-rich fibrin (PRF) is an immune and platelet concentrate that contains all constituents of a blood sample favorable to healing and immunity on a single fibrin membrane. However, limited information is currently available concerning the histologic healing of extraction sockets using PRF. This report presents the clinical and histologic characteristics of a patient who underwent a tooth extraction which was filled with PRF. The right mandibular second molar was removed from a 47-year-old male patient, and the socket was filled with PRF as the sole grafting material in preparation for placing an implant after wound healing. The extraction site was reentered surgically for implant placement. A cylindrical sample core of the newly formed tissue was collected from the socket for histological evaluation. During clinical healing, neither infectious episodes nor untoward clinical symptoms were seen. At the time of implant insertion, the socket was completely filled by a hard material, which on probing exhibited the consistency of bone. A histological examination of the core taken from the socket revealed new bone formation. There was also no evidence of inflammatory infiltrates. The clinical and histological findings suggest that filling a fresh extraction socket with PRF provides a viable therapeutic alternative for implant site preparation.

Introduction

Healing of extraction sockets involves resorption and remodeling of the alveolar crest.[1] The repair process may result in marked changes in the height and width of the

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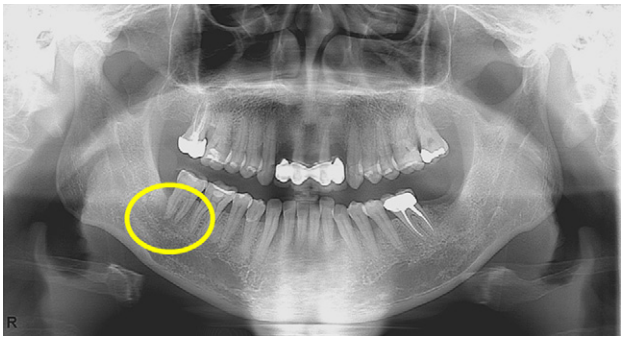

Figure 1 The circle indicates distal bone loss and a radiolucent shadow over the furcation area and the apex of the right mandibular 2nd molar (tooth 47) as examined by panoramic radiography.

alveolar ridge.[2] An average of 0.7—1.5 mm of vertical bone resorption[3,4] and 4.0—4.5 mm of horizontal bone resportion[3,5] were reported following extraction procedures. Most of the dimensional alterations take place in the first 3 months following tooth extraction.[6,7] Alveolar ridge resorption and remodeling may affect implant placement.[8] Preservation of the residual alveolar socket at the time of tooth extraction was evaluated in many studies in an attempt to improve areas intended for future implant placement.

Platelet-rich fibrin (PRF), described by Choukroun et al.,[9] is a second-generation platelet concentrate which consist of fibrin membranes enriched with platelets and growth factors that originate from anticoagulant-free blood harvest.[10,11] PRF looks like a fibrin network and leads to more-efficient cell migration, proliferation, and thus angiogenesis. PRF was initially used in implant surgery to improve bone healing.[9] However, little information is available on clinical and histologic evaluations of extraction sockets with PRF. In this report, we present the clinical and histological characteristics of a patient who received a tooth extraction, and then the socket was filled with PRF as the sole grafting material in preparation to place an implant.

Case report

A 47-year-old male was referred to the Department of Periodontics, Chung Shan Medical University Hospital with the complaint of a toothache of the right mandibular second molar (tooth 47). He was in good health and had taken no long-term anti-inflammatory medication or antibiotics. A panoramic film examination revealed distal bone loss and a radiolucent shadow over the furcation area and apex (Fig. 1). This tooth was diagnosed as a combined perio-endo lesion. The tooth was slated to be removed, and PRF was used to fill in the socket in preparation to place an implant after wound healing.

After approval by the Hospital Review Board, blood samples were treated according to the PRF protocol with a PC-02 table centrifuge and collection kits provided by Process (Nice, France).[9—11] Briefly, samples were taken from the patient without an anticoagulant in 10-ml glass-coated plastic tubes (Becton Dickinson Vacutainer, Franklin Lakes, NJ, USA) and immediately centrifuged at 3000 rpm for 12 min. A fibrin clot formed in the middle part of the tube, whereas the upper part contained acellular plasma, and the bottom part contained red corpuscles. The fibrin clot was easily separated from the lower part of the centrifuged blood (Fig. 2A). The PRF clot was gently pressed into a membrane with sterile dry gauze (Fig. 2B). PRF was placed into the socket as graft material, and the outer surface was covered by a membrane.

Under inferior alveolar nerve block anesthesia, a sulcus incision was made, full-thickness flaps were reflected, and then tooth 47 was extracted with forceps and curetted for apical granulation tissues (Fig. 3A and B). The extraction socket was filled with PRF. PRF was packed in layers until the extraction socket was completely filled to the gingival margin (Fig. 3C and D). A suture of black silk was used to secure the PRF in the socket during the early healing process (Fig. 3D). No surgical dressing material was used. Postoperatively, the patient was prescribed systemic antibiotics (250 mg cephalosporin, q.i.d. for 3 days), non-steroidal anti-inflammatory drugs (25 mg, cataflam, q.i.d. for 3 days), and 0.12% chlorhexidine rinse (twice a day for

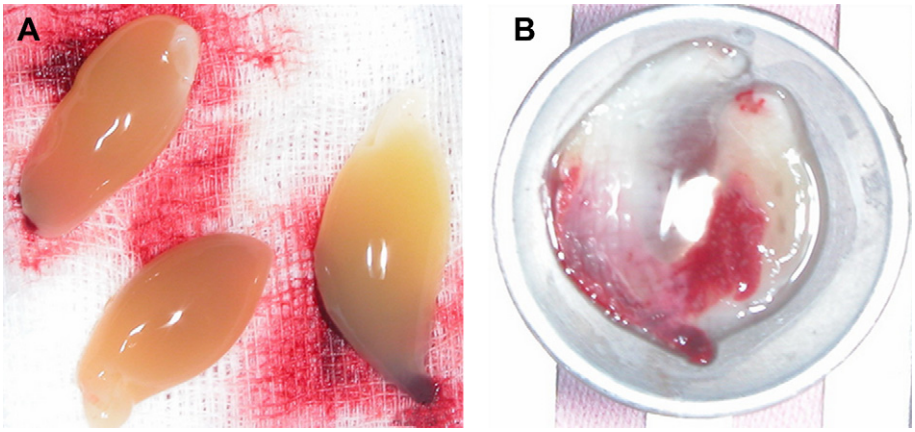

Figure 2 (A) The fibrin clot was easily separated from the lower part of the centrifuged blood. (B) The platelet-rich fibrin (PRF) clot was gently pressed between 2 layers of sterile dry gauze to form a membrane.

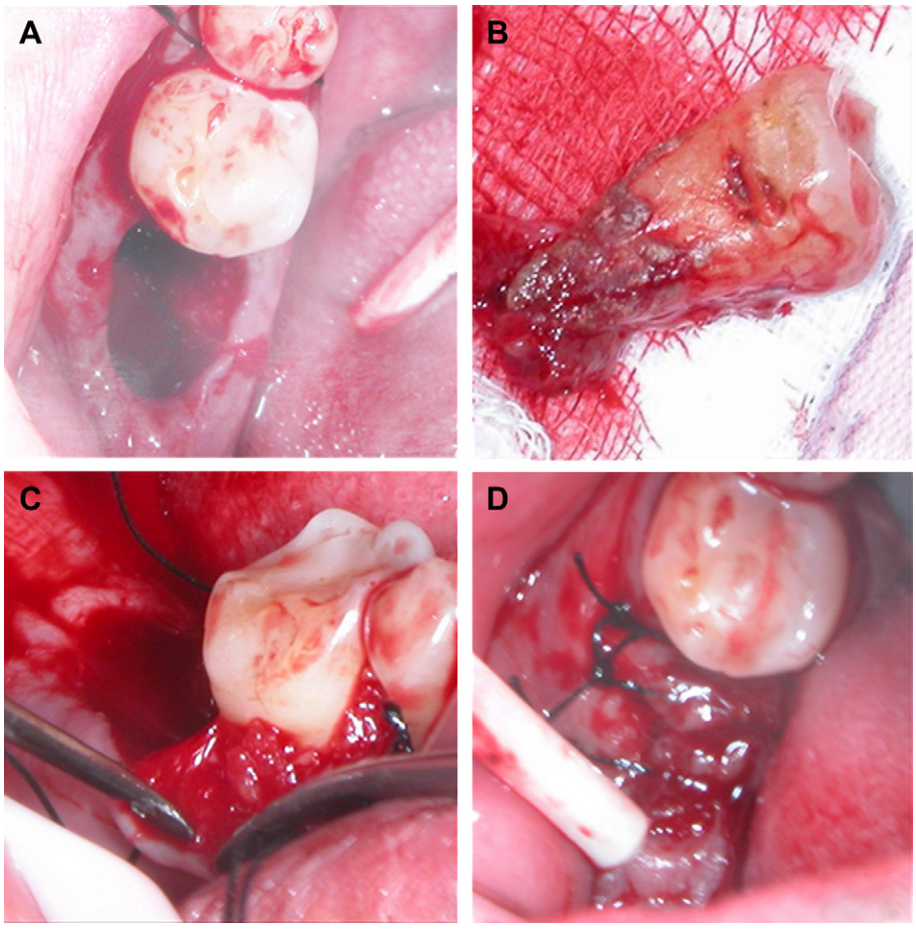

Figure 3 (A) Clinical photograph of the tooth 47 extraction socket. (B) The calculus and apical granulation tissues on the tooth 47 root surface. (C) Platelet-rich fibrin (PRF) as graft material used to fill the tooth 47 extraction socket. (D) PRF as a membrane covering the tooth 47 extraction socket which was sutured with black silk.

2 weeks). Sutures were removed after 7 days. The healing process was monitored for 7 days after the surgery (Fig. 4A), then at 21 days and each month therefore until implant placement. During clinical healing, neither infectious episodes nor untoward clinical symptoms were noted. Complete epithelial closure of the PRF was achieved after 21 days (Fig. 4B).

After 3 months, the extraction site was surgically reentered for implant placement (Fig. 4C). At the time of implant insertion, the socket was completely filled by a hard material, which exhibited the consistency of bone on probing (Fig. 4D). An image with bone-like density was found within the extraction socket by panoramic radiography (Fig. 5). An almost completely preserved alveolar volume was measured by a periodontal probe (Fig. 6A). An osteotomy for implant insertion was performed in an axial apicocoronal direction using a trephine bur. A cylindrical sample core of newly formed tissue was collected from the socket. The trephined core was immediately placed in formalin before being sent to the Department of Pathology, Chung Shan Medical University Hospital for histologic processing. Site preparation was completed, and the implant was inserted (Fig. 6B) and documented by panoramic radiography (Fig. 6C). For hematoxylin and eosin (H&E)-stained sections, tissue specimens were fixed with 10% buffered formalin overnight, dehydrated in an ascending graded alcohol series, embedded in paraffin, and examined by light microscopy.[12–14]

At low-power magnification, the histological exanimation of the trephined core taken from the healed socket revealed new bone formation and fibrovascular stromal tissue (Fig. 7A). Higher magnification on the right-hand top of the same section is shown in Fig. 7B. There was no evidence of any inflammatory infiltrate. Fibrous tissues and blood vessels were also found in the trephined core. Osteocytes were found to be regularly dispersed in the newly formed bone tissue. Osteoblasts were evident on the bone surface (Fig. 7C).

Discussion

PRF is an immune and platelet concentrate collected on a single fibrin membrane that contains all the constituents of a blood sample favorable to healing and immunity.[9,10] PRF can be considered a natural fibrin-based biomaterial favorable to the development of microvascularization and able to guide cell migration into a wound. Such a membrane can accelerate wound healing. Furthermore, this matrix

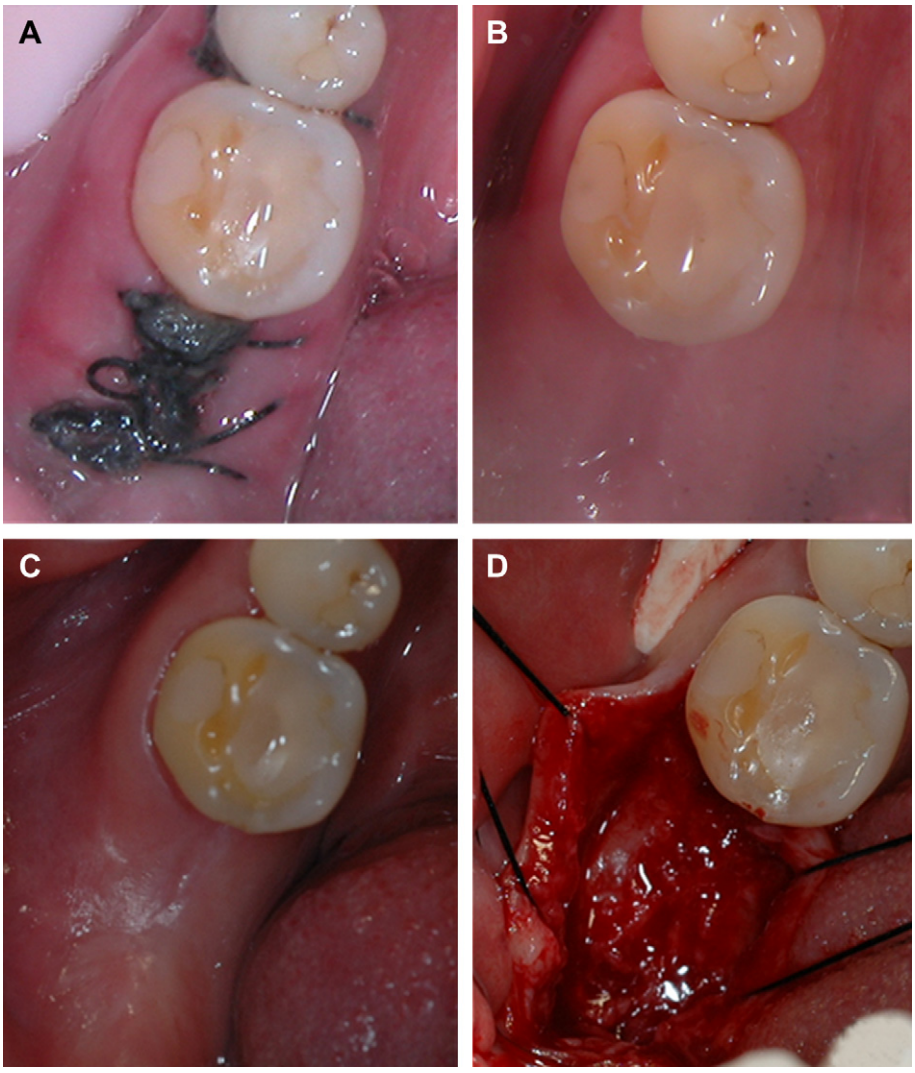

Figure 4 (A) Clinical photograph of the tooth 47 extraction socket after 7 days before suture removal. (B) Clinical photograph of the tooth 47 extraction socket after 21 days. Complete epithelial closure of the platelet-rich fibrin (PRF) was achieved. (C) Clinical photograph of the tooth 47 extraction socket after 3 months. (D) At the time of implant insertion, the socket was completely filled with a hard material, which on probing exhibited the consistency of bone.

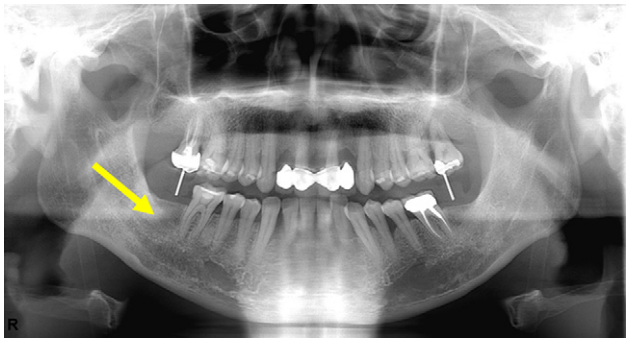

Figure 5 The arrow indicates an image with bone-like density within the tooth 47 extraction socket before implant placement on panoramic radiography.

contains leukocytes and promotes their migration. Its usage seems to be of high interest in cases of infected wounds.[11,15]

Recently, Choukroun et al.[15] reported a clinical example of the filling of a tooth socket by PRF. Clinically, neovascularization forms through the PRF clot, and an epithelial covering develops. Finally, in spite of the infectious and inflammatory [statement/potential? potential] of such sockets, rapid healing of the wound is observed without pain, dryness, or purulent complications.[15] Similar clinical results were found in this case report, in which clinical healing occurred with neither infectious episodes nor untoward clinical symptoms. Taken together, the use of PRF for grafting may improve the clinical healing of a fresh extraction socket.

The reason why PRF can improve extraction socket healing can be explained as follows. Many growth factors

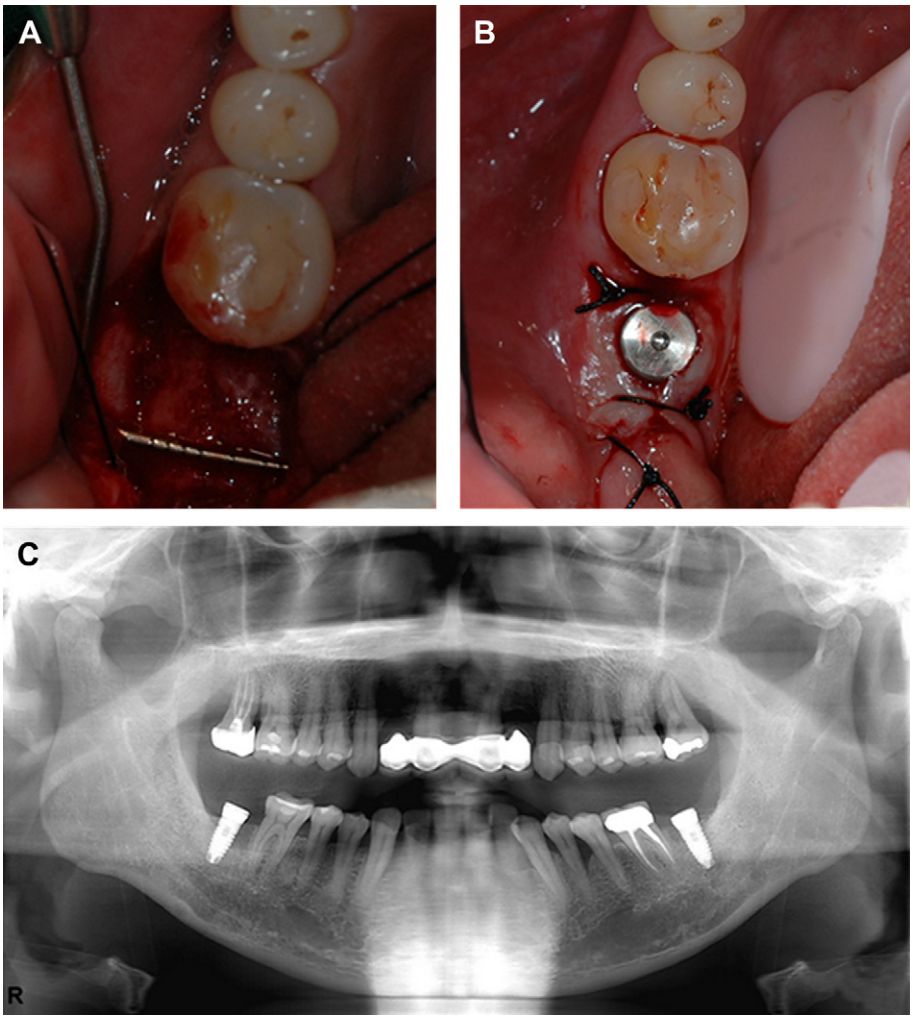

Figure 6 (A) Clinical photograph of the healed tooth 47 socket before implant placement. An almost completely preserved alveolar volume was observed. (B) Clinical photograph after tooth 47 implant placement. (C) Panoramic image after tooth 47 implant placement.

such as platelet-derived growth factor and transforming growth factor are released from PRF.[10,11,16,17] Recent studies demonstrated that the PRF membrane has a very significant slow sustained release of key growth factors for at least 7[16] and up to 28 days,[17] which means that the membrane stimulates its environment for a significant time during remodeling. The properties of this natural fibrin biomaterial thus offer great potential during wound healing.

A histological exanimation of the cores taken from the socket revealed new bone formation, but no evidence of inflammatory infiltrates. The mechanism responsible for these phenomena by PRF can be explained as follows. Recent studies showed that PRF can stimulate human osteoblast proliferation[18,19] and induce strong differentiation of osteoblasts.[19] It was clearly demonstrated that the fibrin matrix leads directly to angiogenesis.[15] Fibrin provides natural support for immunity and reduces inflammatory processes.[11] PRF itself can be considered an autologous biomaterial, and not merely improved fibrin glue.

From a histological perspective, bone trabeculae were thick and bulky, and the fibrovascular stromal tissue in the sample was also quite abundant. Similar results were found by Mazor et al.,[20] who reported that PRF acted as the sole graft material for sinus floor augmentation in a case series. The specific effect of this method in accelerating bone healing rather than fibrosis is still unknown at this stage. Because case reports and case series were performed without a control group, the interpretation is only based on observations of relevant cases. Parallel observations of a contrasting socket without PRF as a control should be performed in the future to specify the advantages of this method in wound healing.

This case report demonstrates that PRF does not interfere with the clinical healing process when applied to a fresh extraction socket. In addition, it seemed to reduce alveolar ridge resorption following tooth extraction and to positively influence socket healing over a 3-month period. Although this is just a case report, our findings may be clinically relevant.

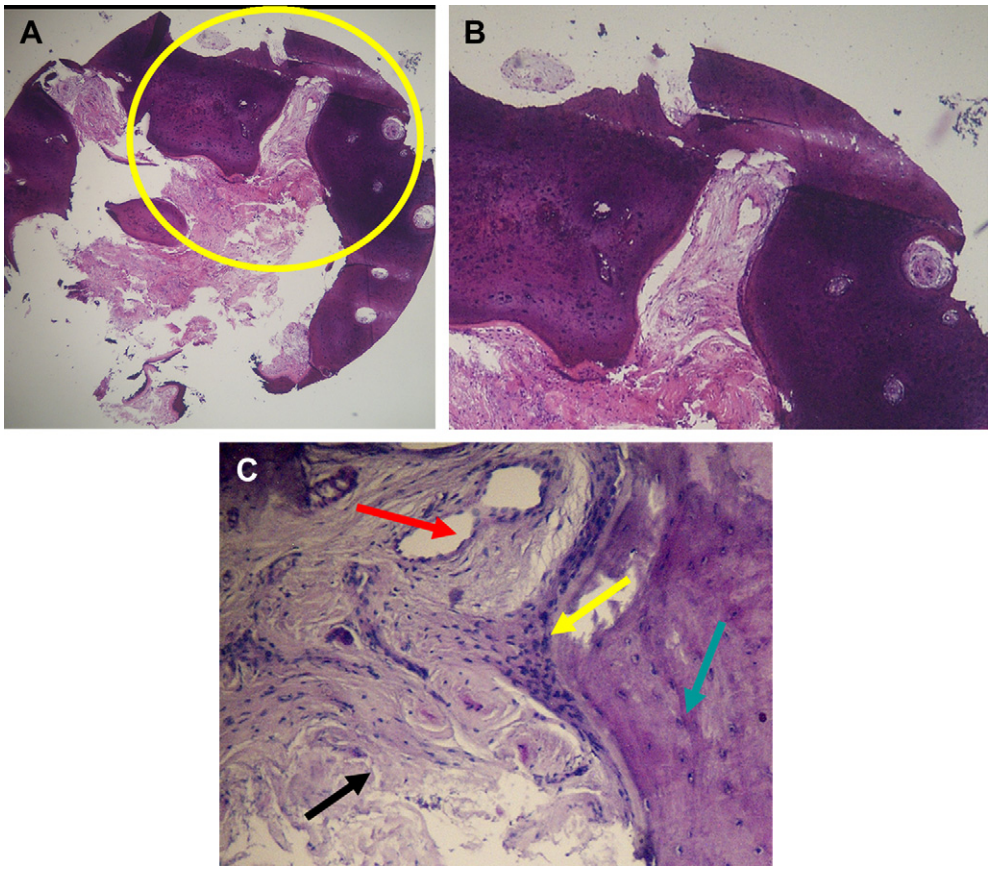

Figure 7 (A) Section of the trephined core showing newly formed bone and fibrovascular stromal tissue. (H&E staining, original magnification ×40) (B) Higher magnification on the right-hand top of the same section. There was no evidence of any inflammatory infiltrate. Fibrous tissues and blood vessels were also found. (H&E staining, original magnification ×100) (C) The yellow arrow indicates osteoblasts, the blue arrow indicates osteocytes, the red arrow indicates blood vessels, and the black arrow indicates fibrous tissues. (H&E staining, original magnification ×400).

References

1. Sobolik CF. Alveolar bone resorption. *J Prosthet Dent* 1960;10: 612—9.
2. Araujo MG, Lindhe J. Dimensional ridge alterations following tooth extraction. An experimental study in the dog. *J Clin Periodontol* 2005;32:212—8.
3. Lekovic V, Camargo PM, Klokkevold PR, et al. Preservation of alveolar bone in extraction sockets using bioabsorable membranes. *J Periodontol* 1998;69:1044—9.
4. Lasella JM, Greenwell H, Miller RL, et al. Rigde preservation with freeze-dried bone allograft and a collagen membrance following tooth extraction alone for implant sites development: A clinical and histologic study in humans. *J Periodontol* 2003;74:581—6.
5. Lekovic V, Kenney EB, Weinlanender M, et al. A bone regenerative approach to alveolar ridge maintenance following tooth extraction. Report of 10 cases. *J Periodontol* 1997;68: 563—70.
6. Evian CI, Rosenberg ES, Gosslet JG, Com H. The osteogenic activity of bone removed from healing extraction sockets in human. *J Periodontol* 1982;53:81—5.
7. Schropp L, Wenzel A, Kostopoulos L, Karring T. Bone healing and soft tissue contour changes following single-tooth extraction: a clinical and radiographic 12-month prospective study. *Int J Periodontics Restorative Dent* 2003;23:313—23.
8. Mecall RA, Rosenfeld AL. The influence of residual ridge resorption patterns on implant fixture placement and tooth position. Part I. *Int J Periodontics Restorative Dent* 1991;11: 9—23.
9. Choukroun J, Adda F, Schoeffer C, Vervelle A. PRF: an opportunity in perio-implantology (in French). *Implantodontie* 2000; 42:55—62.
10. Dohan DM, Choukroun J, Diss A, et al. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part II: platelet-related biologic features. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2006;101:E45—50.
11. Dohan DM, Choukroun J, Diss A, et al. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part III: leucocyte activation: a new feature for platelet concentrates? *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2006;101:E51—5.
12. Huang FM, Yang SF, Chen YJ, Tsai CH, Chang YC. Tissue type plasminogen activator level and caseinolytic activity in clinical healthy and inflamed human dental pulps. *J Dent Sci* 2007;2: 152—6.
13. Tsai LL, Yang SF, Tsai CH, Chou MY, Chang YC. Concomitant upregulation of matrix metalloproteinase-2 in lesions and circulating plasma of oral lichen planus. *J Dent Sci* 2009;4: 7—12.
14. Tsai CH, Chang TY, Chang YC. Upregulation of lysyl oxidase expression in cyclosporin A-induced gingival overgrowth. *J Dent Sci* 2009;4:13—7.

15. Choukroun J, Diss A, Simonpieri A, et al. Plateletrich fibrin (PRF): a second-generation platelet concentrate. Part IV: clinical effects on tissue healing. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2006;101:E56—60.
16. Dohan DM, de Peppo GM, Doglioli P, Sammartino G. Slow release of growth factors and thrombospondin-1 in Choukroun's platelet-rich fibrin (PRF): a gold standard to achieve for all surgical platelet concentrates technologies. *Growth Factors* 2009;27:63—9.
17. He L, Lin Y, Hu X, Zhang Y, Wu H. A comparative study of platelet-rich fibrin (PRF) and platelet-rich plasma (PRP) on the effect of proliferation and differentiation of rat osteoblasts in vitro. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2009; 108:707—13.
18. Tsai CH, Shen SY, Zhao JH, Chang YC. Platelet-rich fibrin modulates cell proliferation of human periodontally related cells in vitro. *J Dent Sci* 2009;4:130—5.
19. Dohan DM, Diss A, Odin G, Doglioli P, Hippolyte MP, Charrier JB. In vitro effects of Choukroun's PRF (platelet-rich fibrin) on human gingival fibroblasts, dermal prekeratinocytes, preadipocytes, and maxillofacial osteoblasts in primary cultures. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2009;108: 341—52.
20. Mazor Z, Horowitz RA, Del Corso M, Prasad HS, Rohrer MD, Dohan Ehrenfest DM. Sinus floor augmentation with simultaneous implant placement using Choukroun's PRF (Platelet-Rich Fibrin) as sole grafting material: a radiological and histological study at 6 months. *J Periodontol* 2009;80:2056—64.