

Clinical and Radiographic Evaluation of Socket Preservation Using Autologous Concentrated Growth Factors Enriched Bone Graft Matrix (Sticky Bone): A Case Report

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Abstract

The extraction socket preservation technique conserves the alveolar architecture and prevents hard and soft tissue collapse that minimizes the necessity for further augmentation procedures. Also, using platelets concentrate derivatives enriched with growth factors and leukocytes which enhance osteogenic differentiation and bone formation. This article describes socket preservation using autologous concentrated growth factors enriched bone graft matrix (sticky bone).

Keywords: *Extraction; Sticky bone; Socket preservation; Platelets concentrate*

Introduction

Alveolar bone resorption may be owing to many factors, such as endodontic pathology, periodontal disease, trauma and aggressive steps during extractions [1]. Whether due to any of those factors, tooth extraction and subsequent healing of the socket commonly result in osseous deformities of the alveolar ridge, including reduced height and reduced width of the residual ridge. The severity of the changes occurring during healing may pose a problem for the practitioner in 2 ways: it creates an esthetic problem in the manufacturing of an implant-supported restoration or a conventional prosthesis; and it may make the placement of an implant challenging if not unfeasible [2]. However, it is possible to minimize such problems by simply carrying out socket preservation procedures in extraction sockets using grafting materials with or without barrier membranes [3,4].

Most importantly, socket preservation helps to maintain the alveolar ridge architecture and significantly reduces the external changes in the form of loss of ridge width and height following tooth removal [5-9]. The result is that more costly secondary augmentation procedures are generally not necessary [7]. At time of implants placement, the site will be more perfect and if bone augmentation is required, then it will be a simpler procedure. Furthermore, minimizing post extraction bone loss will also result in better esthetics whether the area will be restored with an implant or a traditional fixed bridge. Also, socket preservation will allow for a preferable pontic-ridge relationship with a more esthetic emergence profile or an implant crown that will mimic natural dentition.

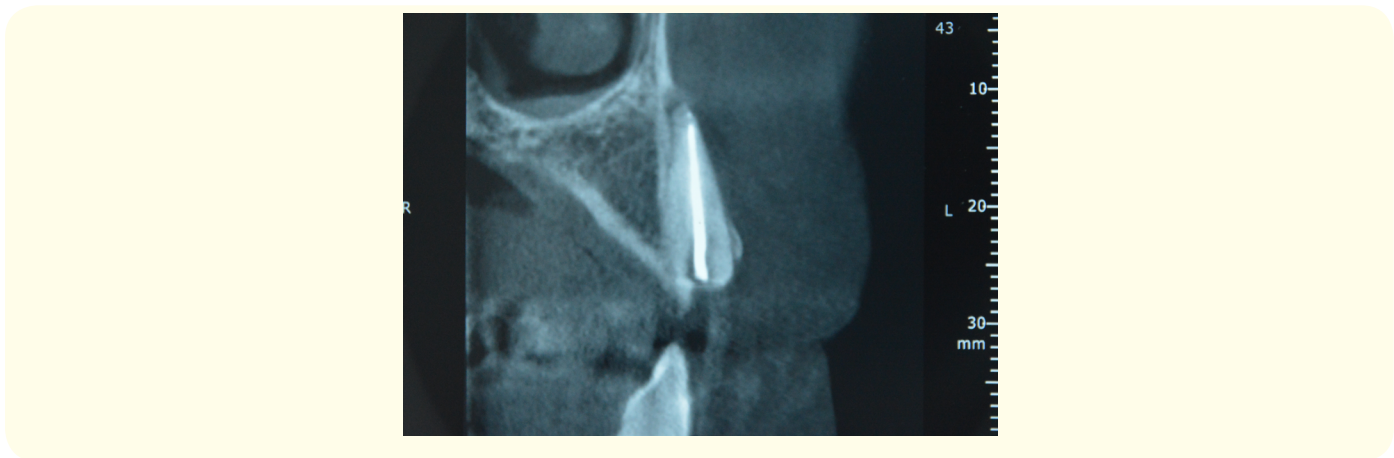
The various regenerative biomaterials used for socket preservation are bone grafts, membranes, biologic modifiers, and platelet concentrates [10]. Platelets are known to be the factory of release several growth factors which initiate tissue healing and regeneration. Techniques for platelet concentrates have been introduced in surgical field for the prevention of hemorrhage and acceleration of tissue regeneration. Platelet rich plasma (PRP) and plasma rich in growth factors (PRGF) are the first generation of platelet concentrates. PRP and PRGF require chemical additives such as anticoagulants and thrombin or calcium chloride to induce fibrin polymerization before applying to the surgical site [11,12]. Platelet rich fibrin (PRF) and concentrated growth factors (CGF), as second generation of platelet

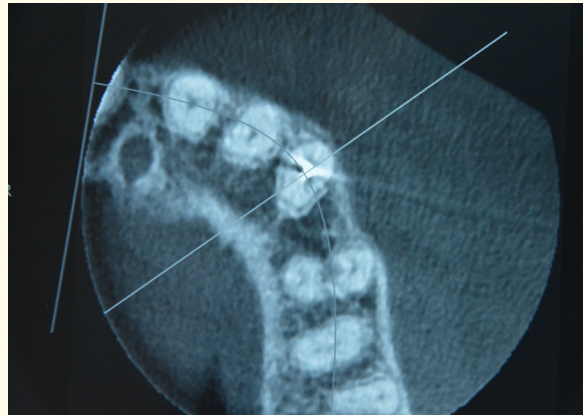
concentrate, utilizes patient’s venous blood alone to trigger platelet activation and fibrin polymerization [13-15]. CGF preparation utilizes altered centrifugation speed to produce much larger, denser and richer fibrin matrix releasing several growth factors. A newly developed product of fabricating growth factors-enriched bone graft matrix (also known as “sticky bone”) using autologous fibrin glue has been introduced. Sticky bone provides stabilization of bone graft in the defect, and therefore, accelerates tissue healing and minimizes bone loss during healing period [16].

As alternative to titanium mesh or block bone procedure, sticky bone was introduced in 2010 by *Sohn DS* [16]. Sticky bone is bone graft material which is entrapped in fibrin mesh. Sticky bone graft doesn’t scatter even upon being shaken with cotton plier because particulate bone powders are strongly interconnected each other by fibrin network. Sticky bone has numerous advantages: 1) it is flexible and compressible, so well adapted over various shape of bony defect; 2) Stability of grafted bone is granted against any motion. So, the volume of augmentation is maintained during healing period, therefore the need of block bone and titanium mesh is minimized; 3) Fibrin network entraps platelets and leukocytes to release growth factors, so bone regeneration and soft tissue healing are hurried; 4) No chemical additives are needed to fabricate sticky bone unlike PRP or PRGF; 5) Fibrin meshwork minimizes soft tissue integration into the sticky bone.

Case Description

A 23 year old female patient presented with remaining root of previously endodontically treated tooth (upper left canine) (Figure 1). She required an implant supported fixed restoration. Upon clinical and radiological examination (using CBCT) (Figure 2 and 3), we found that there was a soft tissue deficiency and a significant labial bone lose “fenestrated labial bone”. Immediate implant placement was not possible, so extraction and socket preservation using sticky bone was planned. A prophylactic oral antibiotic, Augmentin@ 625 mg t.i.d. was used routinely, beginning one day prior to the procedure and continuing for five days postoperatively.

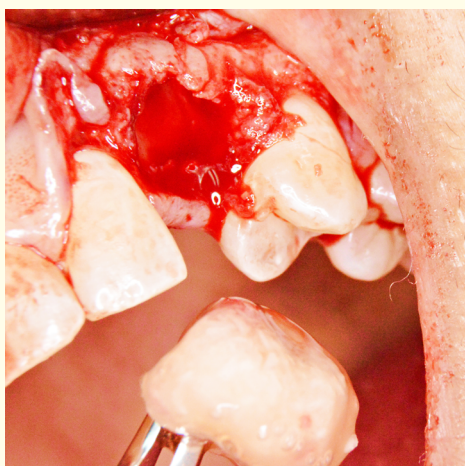
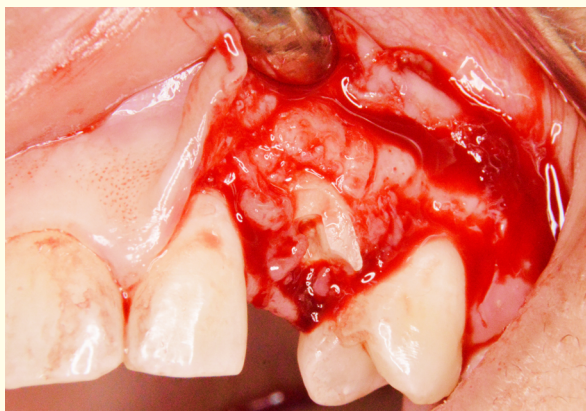




Before extraction and ridge preservation surgery was performed, 20 - 60CC of patient's venous blood was taken from patients' vein, and the blood was divided to two non-coated tubes to obtain autologous fibrin glue (AFG), which made sticky bone. The blood in the test tubes was centrifuged at 2700 rpm using specific centrifuge. To get higher growth factors concentration, the centrifuge was stopped after 2 minutes and eliminated AFG tube out of the centrifuge. The non-coated tube showed 2 different layers. The upper layer was autologous fibrin glue (AFG) layer and red blood cell was collected in bottom layer which had been discarded. The upper AFG was obtained with syringe and mixed with particulate bone powder (Albumin coated bone allograft manufactured by OrthoSera@) and allowed for 5-10 minutes for polymerization in order to produce sticky bone which was yellow colored. A homogenous mixture of fibrin network with integrated bone graft particles inside was obtained which was rich in platelets, leukocytes and mesenchymal cells (Figure 4).



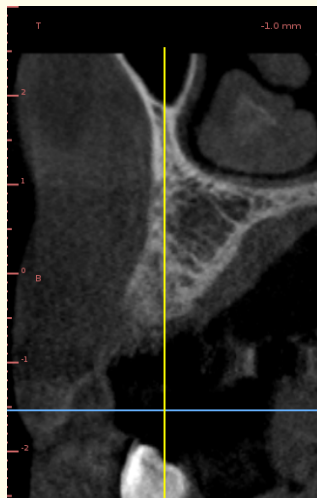
The remaining root site was then exposed under local anesthesia with a labial triangular conventional flap, with distal vertical incision, in order to expose the bony defect with minimal flap incisions (Figure 5). Atraumatic extraction was carried out without damaging the surrounding remaining bone, and the site was thoroughly debrided by mechanical means "curettage & irrigation" to remove granulated tissue (Figure 6 and 7).



The MPM, which has been obtained, was placed in the extraction socket; the edges of the mucosal flaps were approximated to each other and sutured using 3-0 Monocryl sutures. Working time was approximately 30 minutes (Figure 8).



After ten days, sutures removal was carried out. After four month, clinical and radiographic evaluation was carried out, which revealed excellent soft tissue healing and fully keratinized and radiographic evidence of bone fill were recorded (Figure 9). Deficiency in the soft tissue thickness was noticed, which should be treated during implant placement.



Discussion

The management of extraction sites is a daily issue since bone resorption following tooth removal can compromise both implantation and aesthetic results. For this reason, it is often recommended to insert a filling material inside the residual socket to maintain adequate bone volume. Dealing with a defected socket is much more challenging, as usually we face problems in hard and/or soft tissue restoring [17].

Platelets concentrate in socket preservation have been used in many studies, due to the platelets ability to release high concentrations of growth factors such as platelet-derived growth factor (PDGF), transforming growth factor- β 1 (TGF- β 1) and β 2 (TGF- β 2), fibroblast growth factor (FGF), vascular endothelial growth factor (VEGF), and insulin-like growth factor (IGF), which stimulate cell proliferation, matrix remodeling, and angiogenesis [18]. Several techniques to collect platelet aggregate have been utilized to accelerate tissue healing in dental and medical field [14].

Choukron's PRF and Sacco's CGF are second generation of platelet aggregation. The concept of the two methods is to collect leukocyte and platelet rich fibrin gel using a natural coagulation process. PRF and CGF are simple to make and doesn't require any chemicals or biomaterials, such as bovine thrombin and calcium chloride, to make gel condition, so it is free from the risk of toxicity and cross-contamination [19]. Fibrin rich gel is known to release slowly growth factors such as TGF- β 1, PDGF and VEGF to accelerate new bone formation when it mixed with bone graft [20,21].

Additionally, the monocytes have been detected in those concentrate, which are very important in bone regeneration as they allow a regulation of production of bone morphogenic protein (BMPs) which are highly important proteins in the induction of bone formation [22]. However, owing to the cytokine poor mechanical properties and its short duration of action have resulted in the search of a new material with adequate properties for clinical application and ease of preparation. Sticky bone has found a place in the regenerative field owing to its advantages over the solo use of PRF or CGF [23].

The "Sticky bone" is a homogeneous product that contains important elements for bone formation. It contains the mineral scaffold for bone cells necessary for bone formation. And it also contains growth factors necessary for the stimulation of differentiation or migration of cells [24].

The use of bone filler combined with fibrin, platelets and leukocytes have shown a better histological evidence of hard bone formation as evidenced by its high osteoblastic activity and maturation than the use of PRF as sole filling material for the extraction socket after 4 months [25].

Conclusion

Sticky bone is a simple procedure, a cost-effective source of growth factors and is easy to prepare. It is effective, as judged by reference to the experience with PRP and PRF documented work. Furthermore, work with more patients, however, is necessary, and the biologic qualities of Sticky bone must be better defined.

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