Multilayered Platelet-rich Fibrin as a Barrier Membrane in Guided Bone Regeneration with Simultaneous Implant Placement: A 3-year Follow-up

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ABSTRACT

Aim: To demonstrate the use of multilayered platelet-rich fibrin (PRF) membranes as a barrier membrane in the guided bone regeneration (GBR) procedure.

Background: Ridge deformities, defects, and insufficient volume at the intended implant sites are common challenge. Simultaneous implant placement along with GBR gives benefits of reduced treatment cost, time, and need of additional surgical procedure. Platelet-rich fibrin has a versatile nature and is a regenerative tool in both hard and soft tissue surgery. This case report presented an alternative approach using PRF as a membrane (multilayered) in GBR to correct buccal wall defect in conjunction with implant placement.

Case description: A 23-year-old male was referred for rehabilitation of edentulous area concerning to 32 and 33 regions. After clinical and radiological evaluation and discussion of various treatment modalities, GBR with simultaneous implant placement was planned. Ridge augmentation was done in defect using sticky bone formed by bio-oss bone granules of particle size 1.0–2.0 mm and PRF membranes after implant placement. A proper surgical procedure was followed and postoperative follow-up was done from time to time.

Conclusion: Sufficient bone volume was achieved through GBR as shown clinically at second-stage surgery done after 4 months. Three years’ follow-up reveals stable implant prosthesis and healthy interdental papilla and gingival tissue. The multilayered PRF membrane is safe, more economical, and may be feasible as a barrier membrane and could be used in some selected scenarios.

Clinical significance: Platelet-rich fibrin membranes can act as resorbable barrier and allow faster healing, improve bone formation, provide soft tissue regeneration, and improve the soft tissue profile.

Keywords: Dental implant, Guided bone regeneration, Platelet-rich fibrin.

BACKGROUND

Extensive loss of the alveolar bone when encountered presents a challenge for reconstruction. Either simultaneous implant placement is done or not, the guided bone regeneration (GBR) procedure should be done when bone augmentation is needed. Membranes used with GBR fall under two main categories. They are either resorbable membranes or nonresorbable membranes. The main disadvantage of nonresorbable membrane is membrane exposure, which may result in bacterial contamination and early removal of the membrane.1,2

To avoid these problems, clinicians are advocating the benefits of using biodegradable barriers. Platelet-rich fibrin (PRF) is a second generation of the platelet derivative, which is prepared in single step and does not require any additives.3 It provides a fibrin matrix enriched with platelets, leukocytes, and growth factors.4 The fibrin network provides efficient cell proliferation, migration, and acts as a scaffold for tissue regeneration and restoration of bony defects.5

The platelet-rich fibrin (PRF) production process requires no anticoagulants during blood withdrawal and no materials are needed to be added for platelet activation or fibrin polymerization. Platelet-rich fibrin releases an array of growth factors, such as PDGF, TGF β-1, VEGF, EGF, FGF, etc. It is reported that the growth factors (GFs) are sustainably released for at least 1 week up to 28 days.6 This slow and sustainable release of GFs allows the PRF membrane to help in a faster wound healing process and due to its strong fibrin matrix, it acts as a natural barrier in guided tissue regeneration.5

CASE DESCRIPTION

A 23-year-old male in good general health, nonsmoker, and with adequate oral hygiene was referred to the Outpatient Department of Prosthodontics and Crown and Bridge of our faculty for the rehabilitation of lost teeth concerning to 32 and 33 regions. Initial radiographic evaluation by orthopanorography (OPG) revealed defect area w.r.t. to 32 and 33 region (Fig. 1). Different treatment procedures should be done when bone augmentation is needed. Membranes used with GBR fall under two main categories. They are either resorbable membranes or nonresorbable membranes. The main disadvantage of nonresorbable membrane is membrane exposure, which may result in bacterial contamination and early removal of the membrane.1,2

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modalities were properly discussed with the patient and his attendees. Placement of implant and the GBR procedure using PRF membranes were planned at the same sitting.

After diagnostic workout, an informed consent was taken before the surgical procedure and initial periodontal therapy was done. Surgical area was scrubbed by betadine scrub and the patient was draped. The surgical site was anesthetized by inferior alveolar nerve block on both sides with local infiltration of 2% lignocaine with 1:80,000 adrenaline. After adequate anesthesia was achieved, crestal incision was done on the edentulous region and the incision was continued as the crevicular incision on both sides w.r.t. tooth 31, 41 and 34, 35 and then releasing incision was given. After full-thickness mucoperiosteal flap reflection, buccal plate defect was seen, which was thoroughly debrided and irrigated with saline (Fig. 2A). Consequently, implants (double piece, ADIN; Touareg - S, 3.75 × 13 mm w.r.t. tooth 32 and 4.2 × 16 mm w.r.t. tooth 33) were placed w.r.t. 32 and 33 region (Fig. 2B). In between the surgical procedure, a chairside procedure for fabrication of A-PRF and I-PRF was carried out. Two silica-coated red cap tubes of 10 mL without anticoagulant were used for A-PRF membrane formation and two yellow cap tubes of 10 mL were used for obtaining I-PRF. Patient’s blood was withdrawn directly into tubes by vacutainers, and tubes were transferred to the centrifugation machine (DUO Quattro Centrifuge, Nice, France) for obtaining I-PRF and A-PRF one by one. For obtaining I-PRF, centrifugation was done at 700 revolutions per minute (rpm) for 3 minutes; the yellow upper part was obtained by a syringe and mixed with the particulate bone graft (Bio-oss bone granules; natural bovine bone graft, particle size 1.0–2.0 mm) to form sticky bone for improved handling to improve graft stability.9 For obtaining A-PRF, centrifugation was done at 1300 rpm for 8 minutes.9 The PRF clot was retrieved from the tubes, placed in the PRF box, and transformed into a membrane. The sticky bone was placed into the defect and over the exposed implant threads and multilayered PRF membranes were used as a barrier membrane (Fig. 3). Primary closure was done by interrupted sutures (3-0 silk suture). Postoperative instructions were given and the patient medications were prescribed for 7 days. The patient was recalled after 7 days for removal of suture and further evaluation.

After 4 months at the second-stage surgery, a surgical reentry was performed and it was seen that the buccal bone was satisfactorily regenerated at 32 and 33 regions, covering all implant threads (Fig. 4A). Slight cleft was visible over the newly formed bone (Fig. 4A), so additional grafting was done by bio-oss granules (Fig. 4B). Healing abutments were placed and sutures were performed. The medication was prescribed and oral hygiene measures were explained. After second-stage surgery when healing was obtained, abutments were prepared and final prosthesis (zirconia crown) was delivered (Fig. 5A). Stability of implants was checked at the time of delivery of prosthesis. Regular follow-up was done; implant prosthesis was stable and functional at 3rd-year follow-up with healthy gingival tissue and good papillary adaptation (Fig. 5B). Orthopantomography revealed favorable bone regeneration and successful implant outcomes with the absence of peri-implant defects (Fig. 6).

**Discussion**

During the GBR procedure with simultaneous implant placement, it is necessary to create a space between the implant and surrounding soft tissues and it should be maintained for an appropriate period of time to prevent migration of nonosteogenic tissues into the
Platelet-rich fibrin is a second-generation platelet concentrate and is considered as fibrin biomaterial, which acts as a reservoir of growth factors. It has a natural fibrin framework, which favors microvascularization and promotes migration of cells to its surface. Furthermore, this fibrin matrix contains leukocytes and promotes their migration. Platelet-rich fibrin serves as a scaffold for stem cells due to its fibrin matrix. Leukocytic cytokines are trapped within the fibrin meshes of PRF and is slowly released. Platelet-rich fibrin releases an array of GFs, such as PDGF, TGF β-1, VEGF, EGF, FGF, etc. Platelet-rich fibrin is known to release GFs for at least 7 days. Platelet-rich fibrin assists in bone formation by influencing expression of osteoblastic gene. Platelet-rich fibrin helps in healing and bone regeneration by generating platelet and leukocyte components, which play important roles in immune response and angiogenesis.

In this present case study, a multilayered PRF membrane was used to cover the bone defect and bone graft placed in it. The multilayered PRF membranes used as a covering for the graft material and provided a barrier effect for new bone regeneration. Despite bone defect, a good bone volume was obtained after the application of bone graft and multilayered PRF membranes. After 4 months, gingival tissues were in good health and showed good maturation. In a study done by Hafez et al., the PRF membrane was utilized to cover the peri-implant defect in immediate implants in the maxillary anterior region and clinical and radiographic evaluation was performed to evaluate soft tissue healing and crestal bone stability, which showed that PRF provided adequate soft tissue coverage over the immediate implants and strengthened bone stability. The result of our present case study showed that the application of multilayered PRF membranes may be successful to serve as a resorbable barrier membrane when performing GBR procedures. These findings are also consistent with the study by Gassling et al., who evaluated the vital bone formation and bone quality in maxillary sinus floor augmentation after placement of two different absorbable membranes (PRF vs collagen) at the site of the lateral sinus wall osteotomy.
the bone quality and bone formation was the same for both the groups. Another randomized controlled study by Mehta et al.\textsuperscript{15} compared PRF and the collagen membrane in the treatment of furcation defects in which the PRF group showed better results both clinically and radiographically.\textsuperscript{15} From the abovementioned findings, we can extrapolate that the use of the PRF membrane as a barrier membrane in the GBR approach is inexpensive, easily obtained, and without any risk of foreign body reactions. We can summarize the advantages of the PRF membrane over the collagen membrane as follows:

- Autogenous source.
- No additives or anticoagulants required in fabrication.
- Acts as a reservoir of growth factors.
- After compression into a membrane form, PRF have good consistency to be used as a barrier membrane.
- Inexpensive and easy to prepare.
- Peri-implant hard and soft tissue enhancement.

**Conclusion**

The results of our case study showed that multilayered PRF membranes can be adequately and successfully used over immediately placed implants and in GBR. The use of PRF as membranes can induce and improve bone formation and also provide good esthetic results by improving the soft tissue profile. The approach of using multilayered PRF membranes as a resorbable membrane for GBR as described in this case report is safe, more economical, and could be used in some selected scenarios.

**Clinical Significance**

The use of PRF as a membrane in GBR can act as a resorbable barrier, allowing faster healing, improving bone formation, providing soft tissue regeneration, and improving the soft tissue profile.

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