Platelet-Rich Plasma and Bone Graft Combined with Partial Thickness Mucosal Flap Technique in the Treatment of Deep Intrabony Defects

Introduction

During the past decades, treatment modalities like grafting of biomaterials and application of biological agents have been used with varying success to accomplish the reconstruction of lost attachment apparatus in deep intraosseous defects. However, retention of the graft matrix can present a clinical challenge and graft containment would seem necessary for an optimal regenerative response to occur. Autologous platelet rich plasma (PRP) is a novel method for obtaining autologous platelet growth factors (PGFs), especially for platelet derived growth factor (PDGF) and transforming growth factor β (TGF β). PRP use is a way to accelerate and enhance body’s natural wound-healing mechanisms. The added benefit of PRP is its ability to form a biologic gel that may provide containment, clot stability and function as an adhesive. An important decrease in healing time of bone grafts was shown when they are used in combination with PRP. Numerous reports have shown that the use of PRP facilitates clinical handling of graft material.

In periodontal diseases, the graft material and/or regenerative potential of biological agents are not the only factors that have an influence on the variety in the management of intrabony defect fill. Clinically, several factors, including the patient selection, defect morphology, biological and physiochemical characteristic of grafted biomaterials/biomimetic substances, as well as surgical variables and postoperative maintenance, may influence the extent of clinical attachment gain and bone re-growth following a grafting procedure. Periodontal reconstructive surgery for intraosseous defects is a technically sensitive procedure. Selection of a specific flap design in relation to anatomical characteristics of interdental space and location/morphology of bony lesion and proper suturing technique may significantly contribute in determining the amount of soft and hard tissue changes following surgery. Preservation of the flap tissue is important for regenerative techniques to ensure coverage and containment of the graft post surgically. The goal of flap management is to obtain tension-free primary closure over the entire graft or defect complex. While most clinicians agree that primary soft tissue closure, which is maintained throughout the course of regeneration, is ideal; opinions vary greatly concerning how best to accomplish this goal.
The purposes of this article were to describe a surgical technique modification, which is appropriate to the anatomical features of the operation site and which allows for the primary closure of huge intrabony defects, and also to evaluate the obtained regenerative outcomes using this procedure. For these purposes, we report 2 patients in whom previous biomaterial applications had failed and resulted in a progressive alveolar bone loss leading to a huge cavity around the involved region.

Case 1

A 45-year-old female was referred to the Department of Periodontology at University of Ege, Faculty of Dentistry, for periodontal diagnosis and treatment. The patient complained about a swelling around the missing mandibular left canine area on which there was a 3 unit fixed adhesive restoration between mandibular left second incisor (32) and left first premolar (34). Clinical examination revealed an abscess formation under the pontic, which was deeply seated on the alveolar mucosa (Fig. 1). She stated that biomaterial application was performed in the region 4 years ago. Radiographic examination revealed a biomaterial application failure, which resulted with abscess formation causing to an increase in alveolar bone loss. A huge intrabony defect was observed involving the mesial aspect of mandibular left first premolar and the alveolar area under the pontic (Fig. 2). The clinical measurements for mandibular left first premolar including probing pocket depth (PPD), probing attachment level (PAL) and the position of gingival margin recession (REC) were obtained by a graded periodontal probe (CP-15UNC HU-FRIEDY). During initial therapy (root planning and scaling) individual acrylic occlusal stents were prepared for standardized intraoral radiographs (Ekta-speed, Eastman Kodak Co, Rochester, NY, USA). An individualized film holder consisting of a Rinn bite block (KKD, Ellwangen/ Jast, Germany), which was rigidly connected to the acrylic dental stent and X-ray tube was used (10 mA, 70 kVp, Trophy Radiologie, Vincennes, France). Before surgery, the pontic of prosthetic restoration was shortened to expose the incision line.

Figure 1. Abscess formation around missing mandibular left canine

Surgical Technique

The main objective of the following flap design is to allow passive advancement of both lingual and buccal flaps on the defect side. The surgical technique is outlined in drawing 1.

Figure 2. Intrabony defect involving the mesial aspect of premolar and the alveolar ridge under the pontic

Drawing 1. (1) Intrasulcular incisions were performed lingually and extended interproximally; (2) The incision followed the mucogingival line extending to 2 adjacent teeth on either side of the defect; (3) Horizontal releasing incisions were later continued by 2 vertical releasing incisions which were connected horizontally through the vestibular sulcus

1. Starting lingually 1 or 2 teeth from each side of the defect, intrasulcular incisions were performed lingually and extended interproximally, which were later followed on the buccal aspect by oblique/vertical incisions terminating at mucogingival line;
2. From this point, the incision followed the mucogingival line extending to 2 adjacent teeth on either side of the defect;
3. These horizontal releasing incisions were later continued by 2 vertical releasing incisions that were connected horizontally through the vestibular sulcus. Starting from the most apical position, a partial-thickness mucosal flap was carefully elevated. This preparation ran apico-coronary over the defect and ended up at lingual alveolar crest. Here the blade was positioned slightly deeper, touching the bone, so that a full-thickness flap could be elevated on the lingual aspect of the mandible.
This combined partial-full thickness flap was inverted lingually in apico-coronal direction passing through the wide pontic area (Fig. 3). All granulomatous tissue was eliminated until sound bony margins were exposed in the area adjacent to the interproximal defect. A sequestrization area of the bone on the mesial aspect of premolar was observed after the granulation tissue was removed (Fig. 4). Osteo-conductive and partially osteo-inductive DFDBA and osteo-conductive HA graft materials were used in combination to enhance the management of defect fill. Platelet rich plasma (PRP) was used to increase the vascularization of the operation site and the adhesion between graft particles (Fig. 5). The split thickness flap was sutured trying to achieve primary closure and tension free flap area on the defect side.

Postoperative medications included an antibiotic for 1-week (1g amoxicillin per day), an analgesic and antimicrobial mouth rinse. The sutures were removed after 1 week and the patient was placed on monthly recall visits including supragingival cleaning. The clinical and radiographic appearance of the operation site at 12th months are shown in figures 6 and 7. Preoperative and postoperative radiographs were transferred into a computer software programme (UTHSCSA Image Tool Version 3.0, San Antonio, Texas) after digitization with a flatbed scanner with a transparency module (Hewlett Packard Scanjet XPA 7400c). The distances between cemento-enamel junction and base of the defect (CEJ-BD), cemento-enamel junction and alveolar crest (CEJ-AC), alveolar crest and base of the defect (AC-BD) were measured using a known distance. The position of the CEJ was identified as described by Schei et al12. The effectiveness of the treatment 12 months after the operation was evaluated by analyzing the reduction in periodontal pocket depth, gain of clinical attachment level and radiographic bone fill. The operation area healed uneventfully with no clinically detectable or subjectively reported side effects. Clinical postoperative measurements showed a decrease from 12 mm to 6 mm in PPD and from 14 mm to 9 mm in PAL, while a 1 mm increase in REC was recorded (2 mm to 3 mm). As for the radiographic assessment, the CEJ-BD distance showed a decrease from 12.3 mm to 6.82 mm (44.5% defect fill).

Case 2

A 53-year-old woman complained about pus formation in the mandibular left canine area. She stated that a biomaterial application was performed to the area of complaint 3 years ago. Generalized moderate periodontitis with localized severe bone destruction on the mesial aspect of the mandibular left canine was recorded. Radiographic
examination revealed a biomaterial application failure around mandibular right canine, which resulted with abscess formation causing to an increase in alveolar bone loss (Fig. 8). PAL, PPD and REC measurements were performed and recorded. Individual stents were prepared, the same radiography technique and instruments were used during radiographic evaluation. No decrease in the probing depths was observed after initial periodontal therapy indicating a regenerative surgical treatment.

**Surgical Technique**

A para-crestal lingual incision, releasing one tooth mesially and distally, was performed at the defect site (Drawing 2a);

This was followed by intra-sulcular incisions at each side of the defect, terminating buccally at mesial and distal line angles of the adjacent teeth (Drawing 2b);

Afterwards, a lingual flap was raised, which was first performed as a full thickness and later continued as a split thickness flap over the defect site. This full/split thickness combination flap was later inverted buccally, passing through the wide interdental area (Drawing 2c);

At this point, a split thickness flap, including one adjacent intact papilla from each side, was raised terminating at the vestibular sulcus. So a split thickness flap passing over the defect site in a corono-apical direction has left the granulation tissue untouched (Drawing 2d);

This granulation tissue was first removed by using 15 C blades, which was followed by the use of curettes until sound bony margins were exposed (Drawing 2e).
In this case, regarding the morphological potential of the intrabony defect, osteo-conductive and partially osteo-inductive DFDBA and PRP was used in combination to enhance the management of defect fill (Fig. 9). Tensile-free primary flap closure was performed.

Postoperative medications included a 1-week regimen of antibiotic (1g amoxicillin BID) and antimicrobial mouth rinse. The sutures were removed 10 days after the surgery and the patient was placed on monthly recall visits including supragingival cleaning. The second standardized radiographs were taken 12 months after the operation (Fig. 10). Previously described radiographic measurements were performed on preoperative and postoperative radiographs. The effectiveness of the treatment was evaluated by analyzing reduction of periodontal pocket depths, gain of clinical attachment level and radiographic bone fill. The operation area healed uneventfully. No clinically detectable or subjectively reported side effects were noted (Fig. 11). Clinically, PPD decreased from 10 mm to 3 mm, and PAL from 13 mm to 8 mm, while REC increased from 3 mm to 5 mm. Radiographic assessment showed an improvement of 13.83 mm to 6.07 mm (63.08% defect fill) in the CEJ-BD distance.

Discussion

These data appear to emphasize the clinical importance of adapting surgical approach to the anatomy of the treated area, as well as to the physical/chemical characteristics of the regenerative material. Incision design critically influences the postoperative wound healing process in terms of blood supply and flap survival. A surgical procedure especially designed to preserve the interdental tissues and to obtain primary closure of the flaps over the membranes in GTR was introduced by Cortellini et al. In the present surgical study, the primary closure of the flaps in the interdental space was not obtained as described by Cortellini et al, i.e. by not releasing the flap coronally with a periosteal incision.

It is well known that healing and regeneration results are seriously compromised when the complete closure of the flap is not maintained. This problem can be solved with primary flap coverage and adequate passive flap adaptation and vertical tensile force distribution during healing. Wang et al and Obarrio et al preferred split thickness flaps for primarily closure in order to provide the flap to be tension-free. Apart from these investigators who combined reflected full and partial thickness flaps during the operation, we reflected partial thickness flaps without involving the adjacent periosteum and only the wall components of the defect area were exposed after granulation tissue was removed. Blank et al stated the importance of an adequate zone of gingiva in the combined treatment of large defects, and emphasized that gingival recession and a lack of keratinized gingiva were present after healing in their cases. Positioning the flap coronary to achieve primary closure over the membrane and graft may have created these mucogingival problems. They performed a second surgical procedure, a sub-epithelial connective tissue graft, to treat the gingival recession and lack of attached gingiva. In our cases, the technique we applied avoided the coronal repositioning of the marginal gingiva and did not disturb the normal relationship of the existing surrounding tissues nor reduced the vestibular depth. Trombelli et al reported that selection of a specific flap design in relation to anatomical characteristics of interdental space and location/morphology of intrabony defect, and proper suturing technique, may contribute in limiting the apical shift of gingival margin.

Wound stabilization appears to be a critical factor for success in regeneration procedures. Movement of only 10 to 20 μm during early stages of fracture healing is enough to divert the differentiation of mesenchymal cells into fibroblasts instead of osteoblasts. This enables organization of coagulum and graft material during the early phases of wound healing and thereby maximum bone regeneration may be achieved. Confirming previously reports, our results also showed that PRP can serve both in haemostasis and adhesion of graft material, as well as contributing physiologically to provide rapid healing of
the surgical site. PRP, while improving angiogenesis (new blood vessel formation), is a potent mitogen (stimulator of cell proliferation) and chemotactic (causes directed cell migration) protein for PDL fibroblasts and alveolar bone cells, while bone allograft offers a biological matrix conducive to cell growth and may contribute osteoinductive bone matrix proteins. The present aim was to combine the mentioned properties of these 2 materials. As declared by Lindhe et al, the clinician should be aware that graft material, intra-osseous defect morphology, technical factors and selection of patient may account for variability in clinical performance. Regenerative potential of the graft material is not the only factor to account for the variability of clinical results about the defect fill and the elimination of pocket depth.

In conclusion, selection of a specific flap design in relation to anatomical characteristics of the treated area is as important as the selection of a biomaterial and/or combination adequate for the morphology of intrabony defects. More research is needed to identify patient, site, choice of material and technique factors associated with successful outcomes of the treatment of intra-osseous defects.

References


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