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ORIGINAL RESEARCH

Use of a Partial-thickness Flap for Guided Bone Regeneration in the Upper Jaw

[1]Gianluca Porcaro, [2]Alberto Busa, [3]Edoardo Bianco, [4]Gianluigi Caccianiga, [5]Marcello Maddalone

ABSTRACT

Introduction: Guided bone regeneration (GBR) aims to restore adequate bone volume for the placement of implants in an ideal location. In this article, we analyze different surgical techniques for tissue management during GBR and a modified partial-thickness surgical approach.

Materials and methods: In a year's time span, five patients were enrolled in the study: Four women and one man (aged 44–59 years). In four patients, a GBR with simultaneous implant placement was adopted, whereas in another patient, a delayed implant placement was done. The flap was of full thickness and overturned on the side palatal with the aim of a retractor, thus exposing the bone crest. The graft material was covered and protected with a resorbable collagen membrane (Geistlich Bio-Gide®, Switzerland). The periosteal layer of the flap was then positioned above the resorbable membrane without traction. The sutures as vertical mattress were then positioned. Each patient received an intramuscular betamethasone dose (4 mg/50 kg) and antibiotic therapy for 7 days (amoxicillin + clavulanic acid 1 gm every 12 hours) and was instructed to maintain oral hygiene and appropriate wound cleaning. The patients were recalled at different times to monitor the healing.

Results: No cases of tissue dehiscence were observed during the period of wound healing. One patient, however, showed a delayed exposure 4 months after surgery. This occurrence was managed without complications for the patient.

Conclusion: The design of proposed flap seems to be effective in controlling the risk of dehiscence during the healing time in the GBR. The vascular supply was rarely compromised. The results we obtained are encouraging even if further studies on this technique are needed.

Clinical significance: Lateral partial-thickness flaps seem to be effective in controlling tissue tension and consequently the risk of dehiscence. The incision vestibularly performed should favor the soft tissue healing.

Keywords: Flap design, Guided bone regeneration, Partial-thickness flap.

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INTRODUCTION

The GBR is a surgical technique that allows the creation of new bone in atrophic sites with horizontal, vertical, or combined osseous defects. It has the purpose to reestablish a bone volume sufficient to place implants in a proper location.[1] It should be useful in many different clinical circumstances.[2-4] The biological limits that regulate the potential of the GBR are not yet determined precisely. In the literature, there are no sufficient data to evaluate the possibility to regenerate large vertical defects except for large sinus lift procedures. This event requires different surgical approaches, sometimes using mixed techniques.[5] The integration of the graft below the mucosal flap and primary healing of overlying tissues are essential conditions to prevent exposure of the regeneration site and infectious complications which, inevitably, lead to the failure of GBR procedure.[6,7] The primary soft tissue healing is essential to contain the graft material, reduce the mechanical traumatism on the regeneration site, ensure the blood supply, and reduce the risk of bacterial contamination.[8,9] Different papers report, in the case of wound dehiscence with early exposure of the membrane to bacterial contamination, a reduction over 60% of the bone regeneration.[9] The reopening of the wound and

[1-4]Department of Surgery and Translational Medicine, University of Milano Bicocca, Milano, Italy

[5]Department of Orthodontics, S. Gerardo di Monza Hospital University of Milano Bicocca, Milano, Italy

Corresponding Author: Marcello Maddalone, Department of Orthodontics, S. Gerardo di Monza Hospital, University of Milano Bicocca, Milano, Italy, Phone: +393356080227, e-mail: marcello.maddalone@unimib.it

the consequent exposure of the GBR are often the result of a clinical error or a misused surgical technique.[10,11] It is, therefore, mandatory that a thorough preoperative analysis about the factors that may influence the clinical success is performed. Damage or excessive stress of the flap during surgery, a thin tissue biotype, and the lack of experience of the surgeon are conditions that increase the risk of complications.[7] The flap for access must exhibit a sufficiently large surgical field and allow a full coverage of the membrane with soft tissues of adequate thickness and vascularization. The flap reposition should be free of tensions and must not be damaged during the periosteal incisions to prevent the necrosis of the soft tissues.[10] The incision of the full-thickness flap, with access at the top of the alveolar ridge, is the technique more frequently used, and different clinicians believe that this encourages the blood supply more than others.[11] Some surgeons suggest to make vertical releasing incisions to help tissue advancement, while others report that this procedure reduces blood supply.[7,8,12,13] In many cases, the availability of soft tissue limits the potential of bone regeneration, and it becomes necessary to surgically increase the volume of soft tissue prior to dealing with GBR. The main disadvantages coupled with the coronal advancement of the flap are a reduction of the depth of the vestibular fornix, dislocation of the band of keratinized mucosa (KM) and the mucous–gingival junction, and generation of tissue tensions. The reduction of KM band can interfere with the esthetic result of the prosthesis and make it harder to deal with oral hygiene procedures.[5] Furthermore, if crestal incision may be preferred with wide alveolar ridges, it is difficult to carry it out in more subtle ridges, such as those belonging to the divisions B and C of the classification of bone.[14]

MATERIALS AND METHODS

During 2015, five patients were enrolled in the study: Four women and one man (aged 44–59 years, mean age 51.5 years). Patients with edentulous areas in the jaw area were treated with horizontal GBR and implant insertion (Premium and Martina®, Sweden, Italy). A simultaneous approach with immediate fixture insertion was adopted when primary stability was sufficient. Patients reported no systemic or local contraindications to surgery.[15] Smokers were not included in the study. Informed consent, regarding procedures and risks of intervention, was obtained from each patient before the procedure. The morphology of the alveolar ridge was preoperatively investigated by X-ray and cone-beam scans. Each patient was administered 2 gm of amoxicillin + clavulanic acid 1 hour before surgery as prophylaxis and subsequently 1 gm every 12 hours for a week, to reduce the risk of infection. Each patient performed a presurgical rinsing with chlorhexidine gluconate 0.2% (1 minute), and perioral skin was disinfected with iodine solution at 10% (Betadine Pharma® Meda, Italy). The surgery was performed with local anesthesia (mepivacaine hydrochloride with epinephrine 1:100,000, Optocain Molteni®, Italy). The first incision, in total thickness, was conducted horizontally at the level of the vestibule, and then, vertical releasing incisions were performed in the coronal direction, extended to the palatal side of the alveolar ridge and through the gingival sulcus of the neighboring teeth (if present). The incision of the flap has been extended several millimeters beyond the limits of the GBR site so as to expose a large surgical field, increase the visibility on the site, and easily manage the tissue tensions reducing the risk of bacterial contamination during the healing phase.[16] The flap was of full thickness and overturned on the side palatal with the aim of a retractor, thus exposing the bone crest. The mucous membrane at the base of the alveolar ridge has been released apically 5 to 10 mm. To cover the future increase in crestal volume without tension, the flap, previously low cut, was sectioned vertically, over its entire height. Then, the mucosal layer, more rich in elastic fibers, was gently detached from the underlying periosteal layer (Fig. 1). When a sufficient bone volume was achieved for adequate primary stability, implants were placed (Premium and Martina®, Sweden, Italy); otherwise, the implant placement differed. The bone atrophy was treated through a horizontal regenerative procedure using a particulate bone allograft (Apatos OsteoBiol®, Italy) on four patients and an autologous bone graft for one patient (SmartBone On Demand®, Switzerland). Any autologous bone fragments, resulting from the surgical milling, were mixed to the heterologous origin material, due to their osteogenic properties. The graft material was then covered and protected with a resorbable collagen membrane (Geistlich

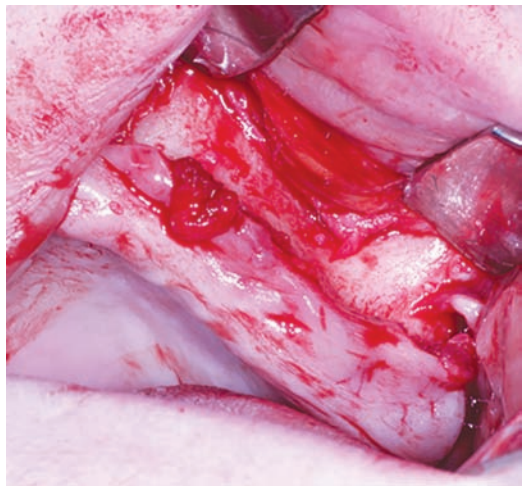

Fig. 1: Surgical incision on the vestibular side of the alveolar crest

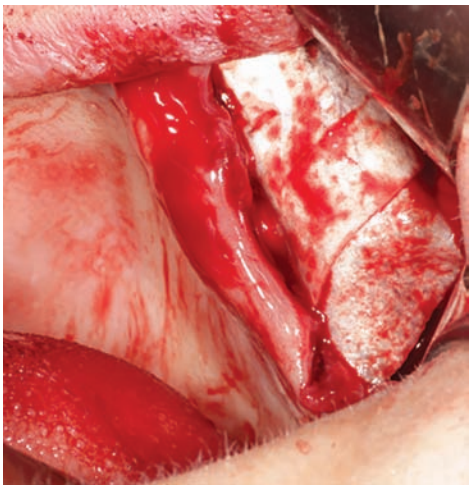

Fig. 2: After periosteal separation, graft and resorbable membrane (Geistlich Bio-Gide®, Switzerland) were positioned

Bio-Gide®, Switzerland), which has been stabilized on the palatal side and at the base of the crest (Fig. 2). The periosteal layer of the flap was then positioned above the resorbable membrane without traction, while the flap mucous (more rich in elastic fibers that allow its advancement) was repositioned to close the surgical wound. The sutures as vertical mattress were then positioned (silk Convidien Sofsilk®, Ireland) or 4/0 absorbable polyglycolic acid (Ethicon Vicryl®, USA). Each patient received an intramuscular betamethasone dose (4 mg/50 kg) to limit postoperative edema. Patients were instructed about the postoperative behavior, to continue antibiotic therapy for 7 days (amoxicillin + clavulanic acid 1 g, every 12 hours), to maintain oral hygiene, and for appropriate wound cleaning. The patients were recalled for a control on 7, 14, and 21 days for the removal of the sutures and subsequently every 30 days to monitor the healing.

RESULTS

No severe systemic or local complications were reported by patients in the study. For four patients, a GBR intervention with simultaneous implant placement was adopted, and for one residual patient, a delayed approach due to insufficient primary stability was made. No cases of tissue dehiscence were observed during the period of wound healing. The patient in whom the delayed technique with customized bone graft (SmartBone On Demand®, Switzerland) was done reported an exposure of the bone graft 4 months after surgery, showing the failure of the integration of the biomaterial on a small area. There were no signs of infection or purulent exudate; therefore, the nonintegrated material was immediately removed through a small incision. The site has been thoroughly disinfected with chlorhexidine 0.2% and is an absorbable suture (4/0 Ethicon Vicryl® been applied, USA).

DISCUSSION

The maxillary arch usually requires more attention to esthetic results than the mandibular one in oral rehabilitation. Often, surgeons are forced to extract severely compromised teeth for extensive caries, periapical infectious processes, fractures, root resorption, or periodontal diseases. After the loss of teeth, inevitably alveolar bone undergoes resorption; it decreases by approximately 25% during the 1st year and 40% is lost by the 3rd year.[6] To solve this issue during a prosthetic rehabilitation supported by implants, an increase of hard and soft tissues is often required. The technical proposals for bone reconstruction include the use of block grafts, GBR with the use of bone particulates, the expansion of the ridge, the distraction osteogenesis, and the sinus lift.[8,17,18] However, careful soft tissue management is an important step for the success of any regenerative procedure.[8] The volumetric augmentation makes soft tissue closure by primary intention difficult, so we need to release the flap with periosteal incisions, remove tension forces, and translate it coronally to cover the graft. Some authors, in addition, suggest the use of the scalpel to dissect the residual periosteal fibers.[8,16] Sometimes, this can be very difficult and cause a dislocation of the joint gingival mucus, a height loss of the vestibular sulcus, and a reduction of the KM band, interfering with hygiene maintainability and the esthetic result of fixtures-supported prosthesis.[6] Furthermore, when the muscular layer is involved, the postoperative morbidity increases, in terms of swelling, bleeding, and discomfort.[19] The incidence of early exposure of the graft is a quite common complication. A recent systematic review reports a percentage of wound dehiscence of 11.9% for horizontal GBR interventions that can go up to 24% when combined with contemporary fixtures positioning.[18] Four important factors have been identified to achieve and maintain the integrity of flaps: (a) Width of keratinized gingiva (KM), (b) flap thickness, (c) the flap tension, and (d) vestibular depth. The KM on the edentulous ridge is important to withstand the tension exerted by the suture on the limb and obtain a greater mechanical strength. This technique also provides for a better vascularization and incorporation of the graft into the recipient site. Some authors have shown that when the width of KM is <3 mm, the incidence of reopening of the incision line increases exponentially compared with sites in layers with more than 3 mm.[4] Burkhardt and Lang[20] suggested that a flap thickness of ≥1 mm has an incidence of dehiscence significantly lower compared with more subtle ones. A reduced vestibular depth makes the release of tissues difficult, and more tension in sutures is required to close the mucous flaps.[7] Obviously, other factors are involved in the risk of dehiscence of the wound: A higher incidence

of wound opening was demonstrated for vertical than the horizontal ridge augmentation procedures and for the use of rigid biomaterials or not resorbableones.[7,19,21] Various techniques have been described to overcome these limits, including the free gingival graft, the interposition of connective–periosteal tissue, a scroll palatal flap positioned coronally, a flap of palatal advancement, a palatal flap rotated, and a lingual flap with coronal advancement.[6,8,22] The flap design, according to our prescription, seems to be a viable alternative to reduce tissue tension and hence, the risk of dehiscence during the healing time in the GBR procedures. We made a full-thickness incision at the base of the alveolar ridge similar to that described in the past by Buser et al.[23,24] Hur et al[5] gave the hypotheses that the periosteal and the mucous layer maintain their own vascularization following their separation. This seems to be a favorable condition for healing compared with a method that dissects a periosteal layer to release the flap.[5] It is also true that the adoption of the flap type we proposed may be more difficult in situations with thin gum biotype. An accidental perforation of the flap can reduce the blood supply generating necrosis, but the flaps involving the periosteal incisions are also affected by this risk. A limit encountered during the execution of the intervention is the reduction of the depth of the fornix and a dislocation of KM band similar to that which we get with a traditional flap with incision at the apex of the ridge. A solution for the reduction of the depth of the vestibular sulcus and the dislocation of the KM could be adopted at the time of fixture exposition by performing an incision on the side of the palatal ridge and after fixing the healing screw, repositioning the flap apically (Fig. 3). One patient included in the study (the only one in whom a custom-made bone graft was used) reported late exposure of the graft 4 months after surgery. A lack of integration of a limited part of the material with the absence of signs of infection was reported. Probably, this exposure is not due to the type of flap used considering the time span after surgery. We have also to take into account that we had a higher percentage of exposures when a custom-made bone graft (SmartBone On Demand®, Switzerland) associated with conventional flaps was used. Further studies regarding the use of this type of material are necessary.

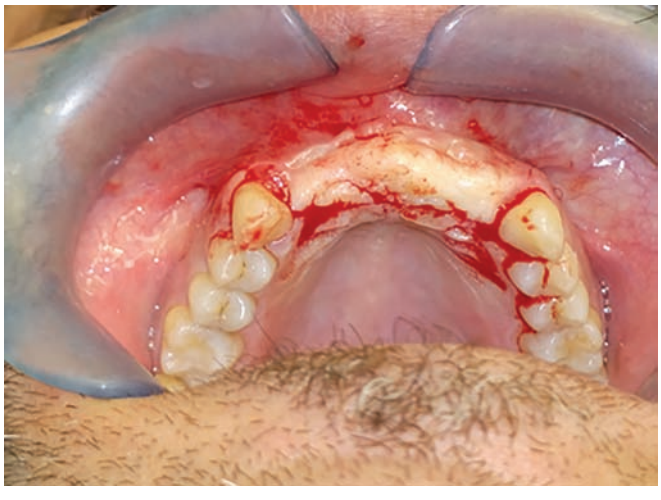

Fig. 3: After GBR 6 months later at the moment of fixtures exposition, a palatal flap was made to vertically expand the fornix

CONCLUSION

The incidence of early exposure of the flap is a frequent complication in the GBR. The design of flap proposed seems to be effective in controlling tissue tension and as a consequence the risk of dehiscence, during the healing time in the GBR. The incision vestibularly performed, compared with a peak of alveolar ridge, favors, in our view, soft tissue healing. When the incision is made in the crest, in fact, the solicitation which acts on tissues during mastication and functional phases is greater. Vestibular incision is easier to run in sites with very thin alveolar ridges, where it is not easy to follow the profile of the ridge with the surgical incision. Moreover, by keeping intact the periosteal layer and mucous one, the vascular supply is rarely compromised. We have not found, in fact, signs of ischemia of the flap during healing. The results we obtained are encouraging even if further studies on this technique are needed.

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