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The Use of Autogenous Bone Grafting With Platelet-Rich Plasma for Alveolar Ridge Reconstruction: A Clinical Report

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Abstract

Implant dentistry has become an effective and predictable treatment modality in modern dentistry. Patients with missing teeth can benefit from partial or complete tooth replacement. Implants can also be used to improve denture retention, stability and support, and enable improved function and esthetics for patients. Several implant systems are commercially available, and their use is predictable with excellent success rates.

Many indications for implant therapy are encountered in daily practice, ranging from a single tooth replacement to complete rehabilitation of edentulous alveolar ridges. Implants can also be used as orthodontic anchorage or temporarily to support a temporary restoration until the final implants heal.^{1,2} Clinicians are able to offer patients a wide variety of different treatment options to achieve the desired outcome in a particular clinical scenario while providing a predictable treatment with long-term performance of the dental implant. In many situations, the optimal implant sites from a prosthodontic perspective are compromised due to inadequate



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quantity and quality of bone. This deficiency may be due to bone resorption in response to periodontal disease, trauma, acute infection, neoplastic processes, and disuse atrophy following premature tooth loss. Various bone augmentation procedures have been developed to address the problem of compromised bone quantity.^{3,4}

The objective of these augmentation procedures is to reconstruct the deficient ridge three dimensionally and obtain an optimal implant site with proper esthetics for the prosthesis. When required, the bone graft of choice for most augmentation procedures is autogenous, as it provides a great degree of predictable success. Several donor sites are available and include intraoral sites (chin, mandibular ramus, and maxillary tuberosity and bone harvested from implant site drillings) and extraoral sites (e.g., iliac crest, and tibia). Extraoral sites are used when significant amounts of bone are required to reconstruct large deficiencies. Intraoral sites have the distinct advantage of decreased patient morbidity and, at times, remain accessible through the implant field.

The chin, as a donor site, has the advantage of being easily accessible to the surgeon and can provide significant bone volume for a localized moderate ridge augmentation. The mandibular symphysis can provide cortical as well as cancellous bone to be used as a block graft or as a particulate graft. Grafts that are primarily cortical bone can be molded to fit the recipient site and usually show less volume loss after implantation. The chin is considered relatively safe site for harvesting bone, yet complications can occur due to proximity to adjacent anatomical structures. The surgeon must maintain an adequate distance from the apices of the lower anterior dentition, the mental foramen



Figure 1. Preoperative buccal view.



Figure 2. Preoperative occlusal view.

and lower border of the mandible.⁵ Bicortical grafts should be avoided to prevent injury to structures within the floor of mouth. Recognized postoperative sequelae may include swelling, bruising, and pain. Infrequent and more serious complications include devitalization of teeth, altered facial contour, sensory disturbances, prolapsed mentalis muscle (known as a “chin drop”), and fracture of the mandible.

Several grafting materials are commercially available for the use in ridge augmentation procedures, e.g., bovine bone mineral, demineralized human bone matrix. As effective as these materials may be, they lack a predictable osteoinductive potential, i.e., the ability to induce differentiation of bone forming cells. Most graft materials are able to serve as a scaffold for bone forming cells, thus making them osteoconductive. An ideal bone graft for use in ridge reconstruction should have osteogenic, osteoconductive, as well osteoinductive properties.⁶

Autogenous bone provides these essential properties through its mineralized structures, as well as pluripotent undifferentiated mesenchymal cells with osteogenic potential. The release of growth factors that stimulate bone formation and revascularization of the graft are a direct benefit of autogenous grafting procedures.

Abundant ongoing research is aimed at exploring the use of biologically active substances for bone regeneration. It is believed that through the addition of factors that induce differentiation of cells, such as endothelial and osteoblastic cells, enhanced osteogenesis will occur. Some of the suggested factors include bone morphogenetic proteins, which have been shown to act on undifferentiated mesenchymal cells, inducing them to differentiate into chondroblasts and osteoblasts.⁷ Platelet-rich plasma, PRP, has also been suggested as an effective way to enhance osteogenesis.^{8,9} PRP has been advocated in conjunction with bone grafting with the expectation that faster and better graft consolidation will occur together with improved bone quality.¹⁰

These qualities are attributed to the vast variety of growth factors that are released from the platelets as they degranulate. Among the factors that can be found in PRP are platelet-derived growth factor, PDGF; transforming growth factor β , TGF- β ; vascular endothelial growth factors, VEGF; epidermal growth factors, EGF; and insulin growth factor, IGF. These factors introduce a combined effect that includes the formation of new blood vessels, known as angiogenesis, stimulation of bone growth and maturation and enhance-



Figure 3. Horizontal deficiency of the alveolar ridge.



Figure 4. Chin donor site.



Figure 5. Block graft harvested.

ment of the wound-healing cascade. Although some evidence may exist to support the use of PRP, it has not been studied in randomized control trials and should be further investigated.

PRP is derived from the patient's own blood and is processed in a centrifuge to isolate a high concentration of platelets. Blood is collected from the patient (approximately 50 cc, but variable) and is stored in commercially available test tubes with an anticoagulant. The latter prevents coagulation and premature degranulation of the platelets. The blood is then separated into cells and plasma. The cellular component contains the PRP, which is manipulated to create an autogenous tissue adhesive. In the following case report, PRP was utilized together with an autogenous corticocancellous chin graft to facilitate ideal rehabilitation of a partially edentulous patient.

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The patient was a 43-year-old healthy man with a noncontributory medical history. His objective was to have tooth No. 7 restored with a fixed restoration (Figure 1). Tooth No. 7 had been lost 10 years earlier. Examination of the edentulous site revealed a large horizontal labial osseous defect (Figure 2). Tomographic evaluation confirmed

the existence of a labial concavity. The absence of sufficient soft and hard tissues posed a challenge for ideal placement of a dental implant. Had an implant been placed in the site, it would have resulted in an esthetic compromise as well as nonaxial loading of the future restoration. After presenting all treatment options to the patient, including restoration with a fixed partial denture, consent was obtained to perform a ridge augmentation procedure utilizing a block graft harvested from the chin in conjunction with platelet-rich plasma.

Employing a proper aseptic technique, the procedure was accomplished under intravenous sedation using midazolam hydrochloride (Versed). The phlebotomy was accomplished at the time of initiating intravenous access. A total of 50 cc of blood was collected. The patient also received 8 mg of dexamethasone. The patient's blood was processed in the method described previously, and PRP was obtained and set aside to be used later. The patient was anesthetized at the donor and recipient sites by means of local infiltration and bilateral mandibular blocks. The recipient site was exposed using two vertical releasing incisions beyond the mucogingival junction with full thickness labial and palatal flaps.

The site proved to be significantly deficient in the horizontal dimension (Figure 3). The vertical component of the site was optimal (1.5-2 mm apical to the CEJ of the planned crown). The dimensions of the required graft size were determined. A vestibular incision between the mandibular canines, apical to the mucogingival junction was then utilized to facilitate elevation of a full thickness mucoperiosteal flap and exposure of the donor site. The outline of graft was drawn with a sterile pencil based on the measurements taken at the recipient site. The most superior aspect of the graft was determined to be more than 5 mm from the apices of the lower incisors. Using a high speed with irrigation diamond disk, cuts were made according to the outline, into the cancellous portion of the mandible (Figure 4). The graft harvest was then completed by the use of osteotomes (Figure 5).

Additional cancellous bone was harvested and placed into chilled saline together with the block graft. The intrabony defect in the donor site was obliterated with an absorbable gelatin (Gelfoam, Kalamazoo, MI) to aid in hemostasis, and then closed in a layered fashion ensuring proper reapproximation of the mentalis muscle.



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Figure 6. Block graft fixated to recipient site.



Figure 7. Implant placement with surgical guide.



Figure 8. Implant integrated with healing abutment.

The graft was trimmed to fit the recipient site. The recipient site was intentionally perforated several times, and the graft was fixated in place using two fixation screws. The cancellous bone was then hand mixed with the PRP and activated using thrombin. The mixture created a moldable mass and was used as filler around the block graft. Additional PRP was then placed over the reconstruction (**Figure 6**). The flaps were repositioned to achieve primary closure in a tension-free manner, and closed with Gortex 4/0 sutures (Gore, Flagstaff, AZ). Perioperatively, the patient was placed on an antibiotic regimen (amoxicillin 500 mg TID for one week), a nonsteroidal anti-inflammatory (ibuprofen 600 mg TID for two days) as well as chlorhexidine rinse (BID commencing three days prior to the surgical procedure for one week).

The immediate postoperative period was uncomplicated. The patient did identify “numbness” of his lower anterior teeth, which subsided after three weeks. The patient reported an intermittent “wooden” sensation in one of his lower anterior teeth. This sensation subsided several months later. The donor and recipient sites healed uneventfully.

Following a healing period of

seven months the patient returned for implant placement. Under local anesthesia, the No. 7 site was exposed preserving the adjacent papillae. At the time of exposure, the graft was noticed to be completely incorporated within the surrounding bone and minimal resorption on the labial aspect had occurred. This anticipated resorption is the reason overgrafting is advised in ridge augmentation procedures. The site presented with an increase in the ridge width that was now optimal for implant placement. The fixation screws were removed and a 10 mm length by 3.75 mm diameter 3I Osseotite implant was placed using a surgical template (**Figure 7**). The site was sutured using Gortex 4/0 sutures. The postoperative healing period was uneventful and the site was left to heal for four months.

After the second healing period, the implant was exposed using the same flap elevation technique as employed at the time of the osteotomy. The implant was clinically integrated and a healing abutment was placed. Radiographically, the implant presented with proper bone level on its mesial and distal aspects (**Figure 9**). Following an uneventful healing period of three weeks the implant was restored with a screw-retained crown (**Figure 10**).

Discussion

Implant surgeons are often faced with clinical scenarios that require site preparation procedures prior to implant placement. The ability to predictably augment the alveolar ridge with deficient bone volume has greatly benefited patients with such challenging situations. Block grafts offer the advantage of slow resorption and easy fixation in the site of compromised bone quantity. The use of autogenous bone has been advocated as the preferred bone graft, with its osteogenic, osteoinductive and osteoconductive properties. Clinicians with an advanced level of surgical training (oral surgeons and periodontists) can harvest bone from donor sites and use it for ridge augmentation procedures. Intraoral donor sites are ideal, since they can be easily done in an office setting with minimally invasive techniques. In an attempt to enhance the bone grafting procedures, clinicians have used different kinds of growth factors as part of the innovative tissue-engineering concept. Platelet-rich plasma has been proposed as potential stimulant of bone and soft tissue healing. Reports have shown enhanced osteogenesis and faster healing periods. These observations are most probably attributed to the abundance of growth factors that can be found in



Figure 9.
Radiograph of integrated No. 7 implant



Figure 10. No. 7 implant-supported crown.

PRP. Although, no randomized control studies have been done examining the benefit of PRP, the preliminary results obtained to date suggest that these techniques hold promise.

The described implant treatment modality is lengthier compared to other treatment options, e.g. removable or a fixed partial denture. This is due to several healing periods required for graft incorporation with the surrounding bone and the appropriate implant healing period. Potential morbidity can also be encountered while using this technique. Therefore, the sequence of procedures, healing periods and possible risk and complications should be clearly explained to patients prior to treatment.

In conclusion, this clinical report demonstrated that block grafts with PRP may be successfully used in healthy patients with deficient alveolar ridges, restoring the original bony architecture to accommodate a dental implant.

Summary

In the case reported here, a patient who required a dental implant had a deficient alveolar ridge that was unsuitable for a dental implant placement. The patient underwent a ridge augmentation

procedure using a block graft taken from his chin in conjunction with platelet-rich plasma that was used in the recipient site in an attempt to enhance the hard and soft tissue healing. The graft has healed uneventfully and enabled implant placement in an ideal position from a restorative perspective. The implant was restored and is now in function for more than four years. The use of autogenous block grafting is a predictable treatment modality in ridge augmentation procedures. It was well documented in the literature using different donor sites (i.e. mandibular symphysis, ramus, iliac crest), and provides sufficient bone quality and quantity for implant stabilization by itself without using PRP. Adding platelet-rich plasma may enhance the soft tissue healing and the maturation of the graft. At present, the previous statement has not been proven and whether growth factors can significantly improve the treatment outcome of these procedure remains to be investigated. ■■■■

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