

Single-Stage Vertical Augmentation with Circular Bone Grafts

Author:

Bernhard Giesenhagen, DDS

Medical Director, Pro- Implant Institute

Institute for Implantology and Cosmetic Dentistry and International Continuing Education Center
Obere Mauergasse 2 / Am Bitzen 6 34212 Melsungen

Tel: (49) 05661 923270

Fax: (49) 05661 923271

E-Mail: info@pro-implantnet

Key Words

Bone grafting Vertical augmentation Single-stage procedure Dental implantology Trepine drill

Abstract

The pre-implant augmentation of bony defects is usually performed with the use of autogenous bone grafts, followed by implant insertion during a second intervention (three to five months later, depending on graft site).

The technique we describe here demonstrates that when using close-fitting circular bone grafts, both the vertical three-dimensional augmentation of bony defects and implantation should be performed in a single procedure. The prerequisite for treatment success is recognition of certain physiological factors. We use a trephine drill, with a diameter 1 mm less than that of the trephine drill used to harvest the graft from the chin area, to prepare the implant site to receive the graft. This ensures a very close fit so that a large number of vital cancellous cells are brought into contact with the graft. Absolutely rigid fixation of the graft is aided by an implant. The results indicate that if these factors are taken into account, this technique can be recommended for the augmentation of three-dimensional bony defects.

Introduction

Tooth loss almost inevitably involves a degree of alveolar bone and soft tissue loss. The esthetic and functional expectations of our patients often require therefore that such defects first be remedied prior to initiating prosthetic or implant-supported treatment.

In the case of larger three-dimensional bony defects, the grafting of free cancellous or corticocancellous block grafts has become a routine procedure in dental implantology for the reconstruction of the alveolar ridge. Autogenous grafts are used for the most part, harvested either >from various intraoral donor sites or extraorally from the iliac crest. The autogenous graft derives differentiation and growth factors from its many vital cells and osteoinductive and osteoconductive properties >from its native trabecular structure. Since grafting of autogenous bone usually involves relatively severe stress for the patient, bone replacement materials or bone augmentation materials are often used to fill larger defects and develop a satisfactory implant bed.

Autogenous bone is the gold standard today and appears superior to the exclusive use of bone replacement materials for augmentation.

In the case of three-dimensional bony defects augmented with autogenous bone blocks, the two-stage method has been the more common approach. The single-stage procedure involves grafting of autogenous bone (block, corticocancellous chips). Depending on the size of the defect, the implants may be inserted in a second stage procedure after 3-5 months of healing. To prevent volume loss during the healing stage, some physiological principles must be observed. A critical factor is the absolute rigid

fixation of the graft (using any of several different fixation systems) and the closest possible fit of the graft to promote vital bone cell contact with the transplanted tissue. In addition, the autogenous bone transfer carries autogenous inductive cells and growth factors with it and therefore ideally supports bone regeneration. Filling any cavities present is facilitated with cancellous chips (harvested from the donor site) or bone replacement material. If the augmentation site is also covered with a barrier membrane, this will provide additional protection against resorptive forces. Since bone grafts usually undergo a loss of volume through adaptation atrophy in the initial stage, we have found it helpful to line the bone grafts with slow resorbable bone replacement material, which acts against volume loss.

The objective of the method described here is to combine a bone block graft and implantation in a single intervention. Care must be taken therefore that the multiplicity of factors involved will receive due attention and thereby increase the likelihood of successful graft revascularization and secure osseointegration of the implants:

1. Adequate residual bone supply to provide primary stability
2. Maximum number of vital cells coming into close contact with the cancellous portion of the graft at the implantation site
3. Rigid, immobile placement of the graft
4. Correct placement of the implant for the prosthetic restoration
5. Secure, tension-free wound closure

Case Report

The following case report provides details of a concurrent vertical augmentation with circular bone grafts. The patient is an 18-year old man who had a sports accident and suffered a root fracture of tooth 11 which was initially treated endodontically and with resection of the root tip, as well as a luxation of tooth 12. Neither tooth was worth saving. We decided to extract the root fragments and treat with immediate augmentation and implantation. Figure 1 shows the root fragments for extraction.

After the extraction there remained a three-dimensional bony defect at tooth 12 and a fenestration at tooth 11 (Fig. 2). The diameter of the required graft was measured with a 6 mm diameter trephine drill (Fig. 3). It should be noted that in any augmentation the level of the bone of the adjacent teeth must serve as the maximum grafting height.

Following exposure of the bone of the chin area, the graft site was mapped out by gently marking it with the trephine, using the next larger drill diameter than that selected for the previous measurement (Fig. 4). This method is advisable since the graft size is defined by the inner radius of the trephine drill. In contrast, the outer diameter of the trephine drill is decisive for the preparation of the implant site. This exchange of diameters makes an almost gap-free fit of the graft possible.

While the graft to be harvested is still anchored in the bone, it should be spot-drilled in the center using a pilot drill, depth drill, and in the case of the ANKYLOS implant system (used here) also a reamer and thread cutter (for the Ankylos implant) . It is very important during this procedure to make certain that the cancellous bone of the donor area is clearly penetrated.(Fig.5)

The trephine drill is used to set the final depth of the graft when removing the bone ring. The procedure above should be performed only upon completion of the implant bed preparation since in the presence of very thin cortical bone the ring may loosen before completion of the implant bed preparation and make the rest of the procedure more difficult. It is also advisable to widen the implant bed diameter on the graft a little (Fig. 6) since a ring fracture may occur in the presence of very thin cortical bone during the subsequent attachment of the circular graft to the implant at the implant site. Likewise, the insertion of the implant into its final position may be made more difficult with dense cortical bone. Now I use the ringknife (Fig.7) to cut the cancellous boning from the lingual cortical bone. All instruments used for this technique are in a special ring kit. Use of a rasp or chisel facilitates easy removal of the bone ring (Fig. 9). An extra piece of bone was harvested to cover the fenestration at tooth (Fig. 10) and the defect was filled with liquid collagen (Fig. 11) and sutured over. The harvested bone ring (Fig. 12) was positioned with its cancellous portion at the implant site and the cortical portion was wrapped around the implant

neck. To do this, the implant site was first prepared with the same trephine drill (Fig. 13). The excess bone segments were removed with a chisel and saved for a later augmentation build-up (Fig. 14). Once the graft had been fitted (Fig. 15), the local bone was marked through the graft to indicate the implant position. The implant bed preparation through the graft followed the conventional procedure (Fig. 16). Likewise, the implant was inserted through the graft (Fig. 17) and it obtained its primary stability in the local bone. The graft was attached via the crestal threaded portion. Ring markings on the placement head (adapter) provided orientation to the subcrestal implant position (Fig. 12). Next, the implant was inserted at tooth 11 (Fig. 19) and parts of the second bone segment from the chin region were used to fill the fenestration and the residual apical defect around the implant at tooth 12. The graft edges were smoothed off and the graft was shaped all around to match the anatomical conditions. The cancellous chips harvested from the donor site were used for further augmentation build-up (Fig. 20). Then the entire site was covered with a membrane (Biogide, Geistlich). In this procedure, the membrane is first attached apically with membrane tacks (Friadent). Prior to final closure, the augmented bone was covered with granular bone replacement material (BioOss, Geistlich) to protect it against resorption during healing (Fig. 21).

Finally, the soft tissue was closed tension-free (Fig. 20)

The x-ray control shows six month post OP a revascularization of the bone-grafts and a stable bone volume.⁽²³⁾ Picture 24 shows the healing of the soft tissue six month post OP and the opening procedure to create a natural soft-tissue design. Picture 25;26 shows the healing of the soft-tissue and the prosthetic restoration.

Since 2003, 311 patients have been treated with this technique; 409 ringgrafts and implants were inserted. . Complications were observed in the form of hematomas, and 9 dehiscences of the suture. 6 rings and 3 implants get lost. In case of respecting all key-points of the surgery procedure, the bonering-technique can be used for nearly all augmentation indications for two or three-dimensional bone defects. The advantage is a one-step surgery bone augmentation and implantation. A perfect fit of the bone transplant to the recipient side is a key requirement for revascularisation of the bonering. Thanks to the special thread geometry of the Ankylos implants with its excellent primary stability. A depth of two or three threads in the local bone is sufficient of this technique.

LITERATURE

1. Branemark PI: Osseointegration for rehabilitation in the oral, mandibular, and maxillofacial areas. Phillip J 6 275-281 (1990)
2. Clavero J, Lundgren H: Ramus or chin grafts for maxillary sinus inlay or local onlay augmentation: comparison of donor site morbidity and complications. Clin Implant Dent Relat Res 5 154-160 (2003)
3. Lindorf HH, Müller-Herzog R: The bundled bottoming tap. ZMK17,6-12 (2001)
4. Marx RE: Clinical application of bone biology to mandibular and maxillary reconstruction. Clin Plast Surg 21,377-392 (1994)
5. Misch CM, Misch CE Resnik R, Ismail, Y.H: Reconstruction of maxillary alveolar defects with mandibular symphysis grafts for dental implants: A preliminary report. Int J Oral Maxillofac Implants 7 ,360-366 (1992)
6. Schliephake H: Harvesting techniques for autogenous bone grafts. Part 1: Donor Sites in the Head-Neck Area. Implantology 2,317-327 (1994)
7. Terheyden H., Sader R: Current Bone Augmentation Methods. In: Horch HH (ed.):Dental Surgery. Urban and Fischer, Munich 2003, pp. 346-383
8. Triplett RG, Sihow SR: Osseous Regeneration with Bone Harvested from Anterior Mandible. In: Nevins M, Mellonig JT (eds.): Implant Therapy. Clinical Approaches and Evidence of Success. Quintessence, Chicago 1998, pp. 209-217
9. Maurer P, Schubert J: Intraoral bone donor sites in dental surgery. Clinic and Polyclinic for Oral, Mandibular and Plastic Facial Surgery (Director: Prof. J. Schubert DDS). Quintessence 2005 pp. 7-13

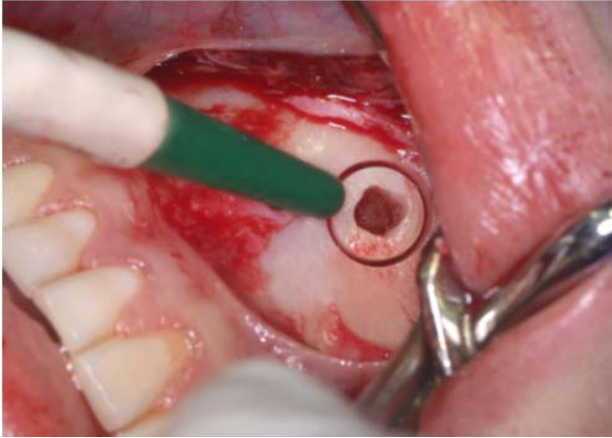
MATERIALS LIST:

| | |
|-------------------------|--|
| Ankylos implant | Dentsply Friadent Steinzeugstr. 50 68229 Mannheim |
| Membrane tacks | same |
| Biooss | Geistlich Biomaterials Schneidweg 5 76534 Baden-Baden |
| Biogide membrane | same |
| Trephine set | Zepf Medizintechnik Obere Hauptstr. 22 78606 Seitingen |

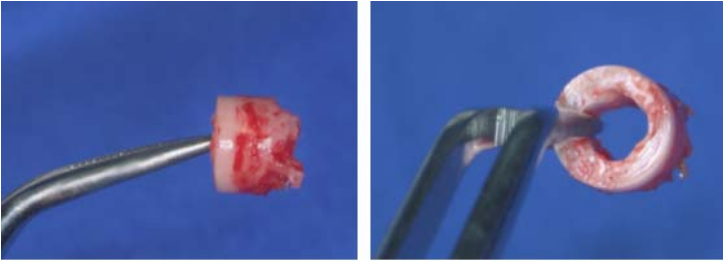
Pictures:

2.





12.



20.

