Bone Ring Technique for the Treatment of Vertical and Horizontal Bone Defects with Immediate Implants: A Report of Two Cases

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In dental implant surgery, bone grafts are used for the reconstruction and reestablishment of alveolar bone volume and to improve bone architecture for better positioning of an implant. The present report describes the use of the bone ring technique for vertical and horizontal bone augmentation with simultaneous implant placement. This is a simple technique for acquiring donor bone in a ring shape and performing 3D reconstruction of bone defects, with an increase in the alveolar crest, using autogenous bone in a surgical procedure together with implant placement. Block bone grafts taken from the mentum can be used for predictable bone augmentation of up to 6 mm in the horizontal and vertical dimensions. The thickness of the bone ring collected from the mentum is very important. It cannot be too thin due to the risk of fracture, nor can it be too thick, as its contour could become deformed when placed in the receptor site. For stabilization and synthesis, a horizontal mattress suture is performed at the receptor site without promoting tension, and simple sutures are used for the complete co-optation of the flap and consequent stabilization of the clot. In the present type of bone defect, single-stage implant placement may be useful to shorten the overall treatment period. Int J Periodontics Restorative Dent 2021;41:413–421. doi: 10.11607/prd.4401

The clinical replacement of lost natural teeth using osseointegrated implants is one of the most significant advances in restorative dentistry.1 The efficacy of this technique is well consolidated in the literature, but excellent esthetic results in the anterior region of the maxilla remain a challenge to dentists.2,3 Although a period of 6 to 8 months was initially established between tooth extraction and implant placement,4 this is currently considered a long time for this practice, and placing implants immediately after tooth extraction is a current trend.5 This method has numerous advantages, such as reductions in treatment time6,7 and the number of surgeries,8,9 a better esthetic outcome due to the lower risk of bone resorption, and the maintenance of the architecture of the gingival tissue and bone crest.7 However, additional measures are often necessary to increase bone dimensions due to the physiologic processes of remodeling and resorption following tooth loss.10

The morphology of the remaining bone is vital to the placement of implants in the esthetic region.11 Preexisting endodontic and periodontal diseases and tooth extraction can result in significant horizontal and vertical bone loss, requiring intervention for bone augmentation.12 Bone grafts are used for the 3D reconstruction of alveolar bone

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volume. Block corticomedullary autogenous bone grafts were originally proposed for the lateral and vertical augmentation of bone defects and were considered the material of choice in a majority of vertical bone loss cases.

However, it is still possible to improve the bone graft results with a predictable esthetic outcome: The surgeon augments the remaining bone structure and places the implant in a single session using the bone ring transplant procedure developed by Bernhard Giesen-hagen in 2004. This is a simple technique for acquiring donor bone in a ring shape and performing 3D reconstruction of bone defects with an increase in the alveolar crest using autogenous bone in a surgical procedure combined with simultaneous implant placement. Block bone grafts taken from the mentum can be used for predictable bone augmentation of up to 6 mm in the horizontal and vertical dimensions. The thickness of the bone ring collected from the mentum is very important. It cannot be too thin due to the risk of fracture, nor can it be too thick, as its contour could become deformed when placed in the receptor site. For stabilization and synthesis, horizontal mattress sutures are performed at the receptor site without promoting tension, and simple sutures are used for the complete co-optation of the flap and consequent clot stabilization. These steps are important to minimizing the risk of suture dehiscence, enabling the incorporation of the graft, and complete osseointegration of the implants within a period of 8 months.

The aim of the present study was to describe the bone ring technique for vertical and horizontal bone augmentation with simultaneous implant placement through a report of two clinical cases.

Clinical Cases

Case 1

An 8-year-old girl suffered an automobile accident that resulted in the avulsion of both maxillary central incisors (teeth 11 and 21, FDI numbering system) and the right lateral incisor (tooth 12). The patient was instructed to wait until reaching 18 years of age before performing implant placement. At 19 years old, she was submitted to implant surgery, but the outcome was considered unsatisfactory, as it did not meet her expectations in terms of esthetics, function, and speech. Four years later, the patient sought further treatment to solve these problems.

Besides dissatisfaction with the previous results (Fig 1a), the diagnosis was complete insufficiency of the peri-implant tissues in an attempt to create an adequate emergence profile. The gingival margins and interproximal tissues did not enable the correct contour of the prosthetic crowns to establish good esthetics and function (Figs 1b and 1c). Significant bone loss was found after removing the esthetic crowns, with horizontal and vertical atrophy of the alveolar ridge and poor 3D positioning of the implants. This situation required reconstruction with bone grafts prior to the placement of new implants. Therefore, the decision was made to submit the patient to surgery for the removal of the implants at sites 11 and 12, which were positioned below the bone peaks of the adjacent teeth, with the simultaneous placement of a subepithelial connective tissue graft taken from the palate to establish a better soft tissue condition for subsequent surgical steps.

In the preoperative period, the patient was medicated with a single dose of midazolam (15 mg), a single dose of fexofenadine (60 mg), and 500 mg of amoxicillin every 8 hours beginning 24 hours prior to the procedure, then maintained for 7 days. For intraoral antisepsis, the patient rinsed with 0.12% chlorhexidine for 1 minute prior to surgery. Local infiltrative anesthesia was performed with 4% articaine and epinephrine 1:100,000. A portion of the maxillary palate between the left first premolar and first molar was selected as the donor region for the soft tissue graft. The same local infiltrative anesthesia was used at the receptor site. The implants at sites 11 and 12 were removed, keeping the implant at site 21, which, along with tooth 13, would serve as support for the temporary partial restoration. After implant removal, a surgical envelope was created in the same area to enable the placement of the subepithelial connective tissue graft, which was sutured and stabilized with horizontal mattress and simple sutures. The synthesis was performed with Vicryl 6-0 thread (Ethicon, Johnson & Johnson) and the stabilization of the temporary bridge, which was
screwed on implant 21 and supported on the cingulum of tooth 13. The donor site area was protected with a surgical tray in acrylic resin that had been constructed on a plaster model obtained from previous molding.

Postoperative rest and diet control were recommended, along with the chemical control of bacterial plaque using 0.12% chlorhexidine twice a day beginning 48 hours after the procedure, as well as local hygiene with a surgical brush for the first 15 days. An analgesic (500 mg dipyridamole every 6 hours over 48 hours) and antibiotic (500 mg amoxicillin every 8 hours for 7 days) were prescribed. The sutures were removed after 10 days. Orthodontic treatment was initiated after another 45 days (and lasted 10 months), at which time the second step of the surgery was performed for the placement of two implants and bone reconstruction using the bone ring technique. For such, the mentum was selected as the donor region.

The patient received the same preoperative medication described above and was anesthetized at the donor and receptor sites with 4% articaine using the blocking technique complemented with infiltrative anesthesia. The surgery began with the incision above the crest in the receptor area (enabling the creation of a pedunculated flap) combined with bilateral vertical releasing incisions involving the papilla of the adjacent teeth (enabling complete flap movement). This incision technique is specific to this approach and enables the coronary movement of the flap so as not to cover the teeth adjacent to the defect when closing the wound. It is of the utmost importance for this flap to exhibit complete passivity in its coronal movement. This is achieved with superficial incisions under the flap to release the muscle insertions, consequently releasing tension at the time of suturing and thereby minimizing the risk of postoperative dehiscence. Once the defect was exposed, the trephine bur (Bone Ring, Helmut Zepf Medizintechnik) was selected to correct the defect.

The initial drilling at the receptor site was performed with a spherical bur to perforate the cortical bone, followed by a pilot bur for the preparation of the receptor bed, which was done using the initial perforation to select and fit the trephine guide pin used for decorticalization and preparation of the receptor bed (5-mm trephine) of the bone ring. Next, the entire drilling sequence was performed for the indicated implant (Ankylos Morse taper, Dentsply Sirona; 3.5 × 14 mm). Once the trephine for the rectification of the receptor bed was selected (6.0-mm inner-diameter Bone Ring trephine, Helmut Zepf Medizintechnik), the donor area of the mentum was accessed.
In the donor area, the blocks were marked only to the cortical level with a no. 6 trephine bur (6-mm inner diameter, a size immediately above that used at the receptor site). It should be stressed that the donor area should be determined with respect to the space 3 mm apical to the root apices and 3 mm coronal to the base of the mandible. With this first marking, the diameter of the ring was established, and the center was selected for the drilling sequences. The perforations in the ring were compatible with the implant to be inserted at the receptor site (3.5 × 14 mm Ankylos Morse taper). The entire drilling sequence for the implant must be performed with a thread-promoting bur.

With the drilling complete, the trephine was deepened within the anatomical limits evaluated on the tomographic scan. Using a specific instrument (3-mm Adenoid Curette, Helmut Zepf Medizintechnik), the surgical alveolus of the ring was accessed for apical release from the bone. Cleaving to release the ring was performed with small leveraging movements on the ring walls (Fig 2a).

The graft was stabilized with the implant itself (Fig 2b). At the donor site, collagen sponges (Hemospon, Maquira) were placed in the orifices created by the 6-mm (inner diameter) trephine bur, and the incision was sutured. At the receptor site, the rings were fixed, freeze-dried particulate bone graft (Bio-Oss small, Geistlich; Fig 2c) combined with particulate autogenous graft was placed, and the entire new volume was protected by a resorbable collagen membrane (Bio-Gide, Geistlich), followed by stabilization with fixation pins (Fig 2d). The tension-free flap was sutured with 5-0 polypropylene thread using horizontal mattress and simple sutures. The donor area was sutured with resorbable Vicryl 5-0 thread (Ethicon) using simple sutures, and the temporary partial restoration was placed.

Postoperatively, the patient was instructed to rest and control their diet (only soft foods and liquids) for 72 hours, use ice packs in the first 6 hours, and control bacterial plaque with 0.12% chlorhexidine beginning 48 hours after the procedure. An analgesic (500 mg dipyrene every 6 hours for 48 hours) and antibiotic (500 mg amoxicillin every 8 hours for 7 days) were prescribed. Periapical radiographic follow-ups were performed after surgery and 8 months.
later. Follow-up tomography was also performed (Fig 3). With the new tomographic scans and finalization of orthodontic treatment, the abutments for the dentures were placed, and the implant at site 21 was removed. The new implant was immediately placed with concomitant temporization, then evaluated via periapical radiograph (Fig 4).

The temporization step for the establishment of the correct peri-implant profile lasted 120 days, followed by transfer molds using transfer dies compatible with the installed prosthetic abutments. Once the models were obtained, ceramic crowns were made in lithium disilicate, concluding the rehabilitation (Fig 5). Radiographic follow-up was performed after 6 years and showed continued success of the bone ring treatment (Fig 6).

Case 2

A 27-year-old man suffered a bicycle crash and experienced trauma to the face, losing several mandibular teeth. He underwent facial surgery, as well as extraction of the remaining roots and avulsed teeth, beneath the tongue and nasal cavities.

After several months of postoperative recovery from the trauma (Fig 7), the patient sought dental care specialized in oral rehabilitation to begin treatment. Because there was severe bone loss that prevented satisfactory prosthetic rehabilitation, it was decided to perform a bone graft with the bone ring technique (Figs 7 and 8). The patient received a definitive prosthetic rehabilitation, and results remained successful at the 5-year follow-up (Fig 9).

Discussion

Osseointegrated implants are the clinical solution for replacing missing
teeth. However, returning function and esthetics to the region of the missing teeth is challenging. This is especially true for the maxillary anterior region, where adaptation of the prosthetic crowns depends on sufficient gingival tissue and bone so that the peri-implant tissues can establish an adequate emergence profile for future prosthetic crowns.

The success of implant therapy is based not only on esthetic and functional aspects, but also on subjective aspects, such as patient well-being, an appearance in harmony with the natural dentition, and the reestablishment of self-confidence in one’s smile. A positive esthetic outcome requires the adequate health, volume, color, and shape of the peri-implant tissue.
Fig 7  Case 2. (a) Details of the vertical and horizontal bone loss visible after the initial incision. (b) A corticomedullary bone ring was collected from the mentum, then (c) placed and stabilized with the implant itself.

Fig 8  Case 2. (a) Removal of the screw covering the bone ring, which was placed to cover the implant screw. (b) Panoramic radiographic view at 8 months.

Fig 9  Case 2 at the 5-year follow-up. (a) Clinical and (b) radiographic views of the final partial restorations.
quantity and quality of the soft tissue around the implant-supported crowns is crucial to long-term stability and optimal esthetic results.24

One difficulty found in the rehabilitation of critical defects is that the loss of bone dimension results in surgical interventions that are repeated until a sufficient quantity of bone is achieved to place an implant. The maxillary anterior region poses a considerable challenge with regard to obtaining an excellent aesthetic outcome.2,3 Therefore, knowledge of block onlay bone reconstruction techniques for dimensional gains enables better surgical and esthetic outcomes by ensuring better gingival architecture.7

The two-step method is generally employed in implant surgery in cases of 3D bone defects using autogenous bone blocks. To avoid the loss of bone volume during the healing phase of transplants, it is imperative for the bone block to be rigidly fixed to the receptor bed so that adequate incorporation of the graft can occur. Any remaining space should be filled with autogenous bone particles obtained from the donor region combined with a slow-resorption biomaterial, such as a deproteinized inorganic bovine matrix, as performed in the present case. Moreover, a natural collagen membrane of a swine origin (BioGide) was used to cover the augmented area.

Reconstruction using an autogenous block onlay bone graft enables gains in bone dimensions,13,14 but the conventional technique requires two surgical steps between placement of the graft and insertion of the implant. To reduce the treatment time and number of surgical steps, the bone ring block onlay graft method was developed,10,22 which enables the placement of both the graft and implant in a single surgical step,23 thereby minimizing patient morbidity and treatment time.

Conclusions

The use of the bone ring technique promotes bone augmentation and reduces the number of surgeries, leading to less morbidity, fewer surgical expenses, and rehabilitation of the area in a shorter period of time.

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References


