Indications for Simultaneous Implantation and Bone Augmentation Using the Allograft Bone Ring Technique

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Dental implant therapy often requires bone augmentation to facilitate stable implantation with a predictable outcome. Traditionally, this is accomplished through guided bone regeneration (GBR), which is a series of surgical procedures that use barrier membrane technology to direct the growth of new hard and soft tissues in sites with insufficient volumes for the purpose of placing dental implants. GBR and implant placement can be performed in either one or two surgeries. This article will focus on a novel simultaneous approach that utilizes a custom milled cancellous allograft bone ring that is stabilized through the graft preparation and apical threads of the dental implant. Indications include simultaneous implant placement in a deficient sinus as well as horizontal and vertical four-, three-, two-, and one-wall defects. Int J Periodontics Restorative Dent 2020;40:345–352. doi: 10.11607/prd.4526

It has been estimated that greater than 40% of all placed implants require some form of guided bone regeneration (GBR) to support a restoratively driven implant placement and a long-term predictable and esthetic outcome.¹ After tooth extraction, the alveolar bone resorbs due to the loss of the blood supply to the bundle bone derived from the periodontal ligament.²,³ Inevitably, remodeling and a lack of physical load to the alveolus will result in a deficient ridge.⁴

GBR, defined as the use of barrier membranes to direct the growth of new bone with the goal of placing dental implants, has become a predictable therapeutic modality used routinely in clinical practice.⁵ In recent years, the advancing development of allografts, xenografts, and bone substitutes have made them more attractive alternatives to intra- and extraoral bone harvesting as comparable outcomes have been observed.⁶

GBR can be performed as either a one-stage (combined approach) or two-stage (staged approach) procedure.⁷ A two-stage procedure involves the use of a bone graft with the goal of regenerating a ridge defect for the ultimate placement of a dental implant in a second procedure. However, this approach has its drawbacks, as the patient must consent to two surgeries and there is

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the potential of bone resorption due to reentry, necessitating additional augmentation. Total treatment time is also increased, reducing patient acceptance, as implant loading may occur 6 months to 1 year after the initial procedure. A predictable single-stage procedure, with insertion of a dental implant and a simultaneous GBR procedure, has been the goal of many surgeons, as patient acceptance is often gratifying.8

This paper focuses on a less invasive, single-stage approach to GBR borrowing concepts of a FDBA block graft. The depicted technique offers a predictable alternative to traditional autologous and allografts used to regenerate horizontal and vertical ridge deficiencies in a staged approach.

Materials and Methods

The Allograft Ring Technique utilizes a prefabricated ring of allogenic bone (AlloGraft Ring by Straumann was used in this study) that is fixated in a one-step procedure by means of an osteotomy created to stabilize the ring and apical threads of a dental implant. The osteotomy is prepared with either a 6- or 7-mm trephine and planator, which corresponds to the outer diameters of the allogenic rings. These drills reshape and flatten the apical aspect of the defect with minimal bone sacrifice and ensure precise contact between the allograft ring and native bone. The elimination of graft mobility is a key to success for GBR.9 It is also well documented that initial stability of the implant is crucial to successful osseointegration; any micromovement typically contributes to implant failure.10,11 The internal diameter of the allograft ring corresponds to either a 3.3- or 4.1-mm–diameter implant, which is secured in the apical native bone, providing additional stability to the complex. This technique satisfies many surgeon and patient demands, as it avoids the need for a second-stage implant surgery. Therefore, the overall number of procedures are reduced which also reduces costs and treatment time for the patient.12

Quantity of apical native bone, distance from adjacent teeth, and proximity of relevant anatomy are factors that contribute to the decision of whether to use an allograft bone ring. It is important to note that vital native bone is imperative, as successful osseointegration requires adequate nutrition and vascularization of the graft.13

This technique should only be considered if the implant can be placed with good primary stability, within the bony envelope, and in a restoratively driven position. Implant positioning is paramount to success, as a biologically acceptable and prosthetically driven site is necessary to achieve osseointegration and optimal esthetics.14

The allograft ring can be used successfully in most defects, including many large four-, three-, two-, and one-wall defects, as well as certain vertical augmentation procedures, including sinus grafting. This technique should only be considered when a single-stage approach using a particulate graft is unpredictable. Indications include large dehiscence and gap lesions that require a significant bone yield for success (Figs 1a and 1b).

Fig 1 (a) An implant was placed simultaneously with an allograft ring into the maxillary left second-premolar position, which had a large dehiscence lesion. (b) Preoperative computed tomography scan (left) and postoperative scan (right), showing the osseointegrated implant with a completely regenerated buccal plate.
Large extraction sockets are traditionally treated in a staged approach due to gap-type lesions and an inability to achieve adequate initial stability. The Allograft Ring Technique can be a treatment alternative in these situations.

Removal of a conically shaped mandibular first molar often results in a socket that would not typically lend itself to simultaneous GBR and implant placement (Fig 2a). This presents as a four-wall defect with an intact buccal plate, requiring minimal reshaping with a 7-mm trephine and planator to receive an allograft ring (Figs 2b and 2c). These sites are ideally suited for a 4.1-mm–diameter implant and allograft ring, which can be placed with good initial stability (Fig 2d). Autogenous bone chips that...
are harvested from the osteotomy mixed with particulate allograft are placed in the residual gap lesions and covered with a resorbable collagen membrane. Horizontal mattress and interrupted suturing are necessary, as tension-free primary closure is essential for success. Stage-two implant recovery is performed at 6 months, and the osseointegrated implants can be used in the prosthetic phase (Figs 2e and 2f).

A predictable application for the Allograft Ring Technique is a threewall defect, which is often a large extraction socket missing the buccal plate. Immediate placement will result in a dehiscence lesion, exposing the buccal threads of the dental implant. The Allograft Ring Technique will enable successful implant placement in a single-stage approach. It is essential that the extraction socket is thoroughly debrided, removing the residual soft tissue remnant, and irrigated with 0.12% chlorhexidine gluconate. Full-thickness flap elevation is necessary on both the buccal and lingual aspects to visualize the three-wall defect (Figs 3a and 3b). A 3.3-mm-diameter titanium-zirconium alloy implant with a 6-mm allograft ring works well with many mandibular first premolars (Fig 3c). Vertical releasing incisions are often necessary to attain tension-free primary closure.

The sites are typically reopened after 6 months of hard and soft tissue maturation, quite often revealing complete regeneration with bone growth burying the cover screw (Fig 3d). The final restoration can be completed shortly after soft tissue maturation (Fig 3e).

An innovative approach to the replacement of failing dental implants includes the use of allograft rings. After the implants are removed, sites can be evaluated to determine if they are candidates for simultaneous implant placement with or without an allograft ring (Fig 4a).

A conventional particulate allograft with a collagen membrane can be used to regenerate small gap-type lesions; however, an allograft ring will predictably correct larger multi-wall horizontal and vertical defects. A 7-mm trephine and planator will create the osteotomy for the ring while the apical threads of the 4.1-mm-diameter implant further stabilize the graft and implant complex (Fig 4b). The residual bone chips from the trephine are combined with particulate allograft or xenograft and placed on the buccal aspect of the ridge with a resorbable collagen membrane. The sites are reentered after 6 months of hard and soft tissue healing, revealing horizontal and vertical bone growth (Fig 4c).

The allograft ring, which has proven successful in ridge defects, has also been effective in sinus floor elevation (Figs 5a and 5b). Full-thickness buccal flap elevation is necessary to expose the lateral wall of the maxillary sinus for creation of a window. The sinus membrane is reflected with hand instruments to the superior aspect of the medial wall. Osteotomies are created in the appropriate implant sites using twist drills. A 7-mm-diameter allograft ring used for a 4.1-mm-diameter implant is cut to a vertical dimension of 6 mm for ease of placement within the sinus (Fig 5c). The implant is secured internally with the allograft ring and externally with a fixation cap, creating excellent initial stability (Fig 5d).

A combination of particulate allograft and xenograft is used to eliminate voids, completing the scaffold of the membrane and increasing the overall yield of bone. The resorbable collagen membrane is placed over the window to eliminate soft tissue ingrowth prior to closing. Stage-two implant recovery and restoration is performed after 6 months of hard and soft tissue maturation (Figs 5e and 5f). Since this is a one-stage procedure, overall treatment time is reduced by as much as 3 months.

**Discussion**

The concept of the allograft ring has grown out of several techniques that make use of autogenous bone with and without simultaneous implant placement. A procedure that proved successful utilized preosseointegrated implants from the mental area of the mandible, which were transplanted to a deficient sinus. Dental implants were placed horizontally, apical to the mandibular incisors, and allowed to osseointegrate. Ultimately the fixtures were harvested with a trephine and secured in maxillary posterior sextants. The author contention was that this would cut down on total treatment time and provide a more predictable result.15 However, patient acceptance was not overwhelming due to the need to enter the chin area on multiple
occasions. Eventually, sinus floor augmentation procedures were perfected and rapidly became the treatment of choice as a two-stage procedure.

The use of autogenous bone for both horizontal and vertical augmentation procedures was a paradigm shift for GBR due to its predictability, and for many years it was known as the gold standard due to the abundance of pluripotential cells and growth factors. The concept of simultaneous implant placement utilizing autogenous bone between

Fig 3  (a) Preoperative radiograph of hopeless mandibular left first premolar. (b) Buccal and lingual full-thickness flap reflection revealing the morphology of the defect. (c) Implant and allograft ring complex secured in the osteotomy. Good initial stability was attained with the ring osteotomy and apical threads of the implant. (d) Implant uncovering after 6 months of hard and soft tissue maturation. (e) Periapical radiograph of the final restoration.
the mental foramen in the form of bone rings was met with success as well. The one-stage procedure made use of a trephine to harvest the donor bone and twist drills to prepare the implant osteotomy. The apical threads of the implant and snug-fitting autogenous bone ring provided adequate initial stability for a successful outcome, similar to the allograft bone ring. However, the increased morbidity due to the need for a second surgical site to harvest autogenous donor bone, together with the predictability of GBR using allogenic bone, has made the allograft ring a viable option in many situations.

Advantages of the Allograft Ring Technique include the fact that there is no need for a donor surgical site compared to an autogenous graft. However, the decision to consider the allograft ring requires a minimum of 3 to 4 mm of apical native bone to stabilize the implant and ring. Tension-free primary closure is also essential, as one must avoid the potential for graft exposure, which may result in an adverse event and the potential for failure. Recommendations include strategic extraction of the hopeless tooth or teeth with ring and implant placement after 6 weeks of soft tissue maturation. This ensures a larger zone of keratinized tissue, making it easier to attain tension-free closure without reducing the vestibular dimension.

Distance from adjacent teeth and implants must be taken into consideration prior to using the Allograft Ring Technique. Recommendations include between 1 to 1.5 mm of bone between the ring and existing tooth or implant. Violating this dimension could result in bone loss or a deficient papilla, compromising the existing tooth or implant. If there is any question that bone or papillae will be damaged, a two-stage approach is indicated. This must also be considered...
if the distance to relevant anatomy is questionable. Encroachment of the mandibular or mental nerve can lead to an untoward result as well.

Conclusions

The Allograft Ring Technique can be used successfully to regenerate both horizontal and vertical ridge defects with simultaneous implant placement. There are many clinical situations that would benefit from

Fig 5  (a) Preoperative presentation. The maxillary right second premolar and second molar share a hopeless prognosis. (b) Preoperative periapical radiograph depicting sinus proximity in the area of the first molar. (c) Cutting the allograft ring to 6 mm. (d) Implant secured internally with the allograft ring and externally with a fixation cap. (e) Final restoration completed after 6 months of hard and soft tissue maturation. (f) Periapical radiograph of the final restoration.
this treatment; however, case assessment is paramount. Optimal three-dimensional placement is key to restorative success and must be considered prior to surgery. The bone defect must be analyzed, as placement within the bony envelope also increases the likelihood for success. A two-stage procedure is an alternative and should be considered whenever a restoratively driven placement cannot be achieved. The traditional factors that influence clinical success, including patient selection and the surgical judgment of the clinician, cannot be underestimated.

Acknowledgments

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