maxgraft® bonering
Bone augmentation and immediate implantation
Surgical guide

innovative
efficient
atraumatic

hard tissue

botiss biomaterials
bone & tissue regeneration
This surgical guide was created with the support of renowned clinical experts to assist you in achieving the best possible results with maxgraft® bonering.

On the following pages, you will find detailed information on the application of maxgraft® bonering in different clinical situations. Each indication is described by a clinical case from an expert, demonstrating a recommended surgical procedure.

The Bone Ring Technique is an innovative solution for single-stage three-dimensional bone augmentation and implant placement. The simultaneous augmentation and implantation reduces treatment time compared to conventional bone block augmentation.1,2

In clinical practice, the application of allogeneic blocks has been established as a reliable alternative to autogenous bone harvesting and alveolar ridge augmentation, thus avoiding donor-site morbidity and limitations in quantity.3,4,5

maxgraft® bonering is a sterilized graft cut into the shape of a ring that originates from living human donor bone by explantation of femoral heads (hip endoprosthesis). Characteristically, it is rapidly incorporated and subsequently remodeled into patients’ own bone.

1. Introduction
**Indications** for maxgraft® bonering

- Single-tooth gap  |  Cases page 8-11
- Edentulous space  |  Case page 12
- Vertical augmentation (three-dimensional defects)  |  Case page 13
- Treatment of periimplantitis with severe bone loss  |  Case page 14
- Sinus floor elevation  |  Cases page 18-19

**Contraindication**

- Thin parallel-walled crest (< 6 mm width)
- 1 mm or less bone height in the sinus

**Product properties and specifications**

- Processed human allotransplant from living donors
- Osteoconductive properties supporting natural and controlled tissue remodeling
- Stable trabecular structure of the cancellous bone enables rapid revascularization
- Mineralized human collagen for excellent biocompatibility and flexibility
- 5 years shelf life at room temperature
- Standard sizes:

<table>
<thead>
<tr>
<th>maxgraft® bonering 3.3</th>
<th>maxgraft® bonering 4.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Art.-No.</td>
<td>Dimension</td>
</tr>
<tr>
<td>33160</td>
<td>cancellous ring, ø 6 mm, height 10 mm</td>
</tr>
<tr>
<td>33170</td>
<td>cancellous ring, ø 7 mm, height 10 mm</td>
</tr>
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</table>

Recommended for implant diameters from 3.3 - 3.5 mm
Recommended for implant diameters from 4.1 - 4.5 mm

The implant directly fixes the bone graft. The technique does not require osteosynthesis screws.

Sub-gingival healing of the implants is recommended. Therefore, maxgraft® bonering should be used only with bone level implants and is not compatible with tissue level and one-piece ceramic implants.

**Pre-operative** assessment and precautions

- Patient selection is critical to the outcome of the surgical procedure.
- Special attention should be paid to patient-related risk factors that may affect bone healing; patients with uncontrolled diabetes and heavy smokers (> 10 cigarettes a day) should be excluded from this procedure.
- The soft tissue situation should be carefully evaluated; in some cases, it might be beneficial to perform soft tissue augmentation prior to bone ring surgery.
- All inflammation and infection should be treated prior to surgery.
- Antibiotic treatment should be started one-day pre-op.
- Professional dental cleaning and chlorhexidine rinses prior to surgery are recommended for optimal operating conditions.
Single-tooth gap & edentulous space
Surgical procedure and guidelines

Step 1 Determine the diameter of maxgraft® bonering
Once the flap is lifted, the diameter of the defect can be determined by using the trephine drill with an outer diameter of 6 or 7 mm. This measurement helps to determine which diameter of maxgraft® bonering should be used, 6 or 7 mm.

Note: When determining the diameter of maxgraft® bonering, the required mesiodistal distance of the implant to the adjacent teeth/implants must be strictly observed. At least 1 mm distance between the ring and adjacent teeth must be kept. For instance, to place a 6 mm ring, at least 8 mm distance between the two adjacent teeth is needed; to place a 7 mm ring, at least 9 mm distance is necessary. An implant of 4.1 – 4.5 mm always requires a 7 mm maxgraft® bonering. 3D diagnostics are recommended.

Step 2 Determine the implant position with the pilot drill
Check the mesiodistal and orofacial implant position/implant axis for optimal aesthetic positioning of the implant. The use of a surgical drill template is recommended.

Step 3 Prepare the ring bed with the trephine
Use a 6 or 7 mm trephine depending on the ring size chosen for the circular osteotomy. The preparation depth can be determined by the markings (2–10 mm, in 2 mm increments) on the trephine. The depth of the maxgraft® bonering bed is defined by the size of the defect. Bone chips can be removed using a blunt instrument and reintroduced in other regions of the augmentation site.

Note: The bone level of the neighboring teeth is the reference for the height of maxgraft® bonering.

Step 4 Straighten/decorticate the ring bed
The planator is used on the bottom of the defect to achieve a uniform surface for implanting maxgraft® bonering with a press fit.

Step 5 Prepare maxgraft® bonering
Use the diamond disc from the maxgraft® bonering surgical kit and the bonering fix to trim the bone ring to the required length.

Note: maxgraft® bonering does not need to be rehydrated. The preparation of the ring bed using the instruments from the maxgraft® bonering surgical kit provides close contact between bone ring and the bone bed, allowing blood to quickly perfuse the maxgraft® bonering.

Step 6 Insert maxgraft® bonering
maxgraft® bonering is ‘press-fit’ in the prepared bone bed.

Note: A precise congruence of the ring base to the bone bed is critical for the primary stability of maxgraft® bonering and implant.

Step 7 Prepare the implant bed
After inserting maxgraft® bonering, the osteotomy for the implant is prepared through the bone ring according to the surgical procedure of the implant system used.

Note: The length of the implant chosen should be sufficiently long so that the implant is situated at least 3 mm deep in the residual alveolar bone. Enlargement of the inner ring diameter to match the size of the implant used can be performed extraorally.

Step 8 Place the implant through maxgraft® bonering
The implant fixes the ring in the jawbone.

Note: The implant should be placed approximately 1 mm below the surface to compensate for possible resorption of the bone ring. If it cannot be stably seated, maxgraft® bonering should be secured with a special screw with a head larger than the diameter of the implant. Ask botiss representatives which implant systems provide these screws: product-management@botiss.com

Step 9 Round off the edges of maxgraft® bonering
After placing the implant, the edges of maxgraft® bonering must be smoothened using a diamond tulip bur to prevent perforation of the soft tissue.

Step 10 Cover defects with a bone substitute material
The defect should be covered with non- or slowly resorbable granules. cerabone® with a particle size of 0.5 – 1.0 mm is recommended.

Step 11 Cover the graft with a barrier membrane and close the wound
The entire augmentation area needs to be covered with a membrane that has a long-barrier function to prevent soft tissue cell invasion and exposure of the augmentation site. The Jason® membrane with its delayed degradation is recommended. Close the wound in a tension-free manner.
CLINICAL CASE BY
Amit Patel, Birmingham, United Kingdom

BONE AUGMENTATION AND IMPLANTATION IN SINGLE-TOOTH GAPS
Restoration of buccal bone lamella with maxgraft® bonering.

Initial situation shows bone loss due to lack of physical load of bridge retained region 11

Clinical situation at time of entry shows loss of buccal bone lamella

Pilot drill to determine later implant position

Trephine drill 7 mm for maxgraft® bonering 7 mm

After preparation with the planator, the necessary length of maxgraft® bonering 7 mm is estimated

Cutting maxgraft® bonering to the required size with bonering fix

Implant bed preparation through maxgraft® bonering

Placing the implant in order to fixate maxgraft® bonering

Smoothing the edges of maxgraft® bonering

maxgraft® bonering and implant in place

PrefGel applied as root surface conditioner prior Straumann® Emdogain®

Application of Straumann® Emdogain® for regeneration of bone around the roots of adjacent teeth

cerabone® granules for contouring the defect and to help slow down resorption of the bone

Jason® membrane to protect the bone graft from soft tissue ingrowth

Flap is sutured with mattress sutures to prevent micromovements of the grafted area

Sutured free of tension

Rest of Straumann® Emdogain® applied to support wound healing

Four weeks after surgery eventless healing and healthy soft tissue

Prosthetic restoration six months after surgery with aesthetical outcome

maxgraft® bonering in conjunction with Straumann® Emdogain®:

Straumann® Emdogain® can be used to support soft tissue wound healing in oral surgical procedures comprising implantations and peri-implant procedures. Straumann® Emdogain® is a gel containing enamel matrix proteins which stimulate various cell types that are important for the wound healing process. It can be pre-mixed with bone grafting materials and additionally applied on top of the graft before final wound closure. To promote the regeneration of the periodontium of adjacent natural teeth Straumann® Emdogain® can also be applied on the exposed root surfaces.6
CLINICAL CASE BY
Dr. Bernhard Giesenhagen, Kassel, Germany

BONE AUGMENTATION AND IMPLANTATION IN SINGLE-TOOTH GAPS
Restoration of buccal and lingual bone lamella with maxgraft® bonering

Initial situation: X-ray shows a two-wall bony defect with loss of buccal and lingual lamella

Clinical situation of the ring bed after preparation according to protocol (pilot drill, trephine, and planator)

Placement of maxgraft® bonering after adjusting to desired length

Fixation of maxgraft® bonering with an implant after implant bed preparation through the ring

Fixed implant placed in the aesthetic window

X-ray after surgery

X-ray six months after surgery shows osseointegrated implant and bone ring with the same radiopacity as the native bone

Clinical situation six months after surgery; vital bleeding bone on the shoulder of the implant

Crestal view after removing the cover screw

Clinical situation after placing a healing cap for several weeks

Healthy soft tissue situation after removal of the healing abutment

Abutment for final restoration

Final restoration

X-ray seven months after surgery shows bone with the same radiopacity as the native bone

Initial situation: Bone loss due to a lack of physical load and inflammation in region 21 retained with a bridge

Guided pilot drill to determine the aesthetic implant position

Trephine drilling; the guiding pin in the trephine follows the pilot drilling path. Depth of drilling in this case: 4–5 mm

Ring bed preparation with a 7 mm planator; same size as the trephine

Implant bed preparation through the guide according to drilling protocol

CBCT and clinical situation showed vertical and horizontal bone loss. Surgery planning with a digital implant planning software

Drill guide

Situation three months after tooth 21 extraction and template in place

Initial situation: X-ray shows a two-wall bony defect with loss of buccal and lingual lamella

Clinical situation: Bone loss due to a lack of physical load and inflammation in region 21 retained with a bridge

Guided bone ring surgery and implantation in aesthetic zone with maxgraft® bonering.

Initial situation: Bone loss due to a lack of physical load and inflammation in region 21 retained with a bridge

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Ring bed preparation with a 7 mm planator; same size as the trephine

Implant bed preparation through the guide according to drilling protocol

Implantation of maxgraft® bonering

Enlargement of maxgraft® bonering, if a bigger implant diameter is used with a profile drill

Implantation through the drill guide

After smoothening sharp edges, the defect is covered with cerabone® and Jason® membrane

It is advisable to save the geometrical shapes of bone rings in your planning software to visualize the optimal position and size of maxgraft® bonering.

- Ø 7 mm and 10 mm length
- Ø 6 mm and 10 mm length

In areas where facial muscles, the tongue or oral cavity might exert tensile stress to the augmentation site, it is recommended to place apical mattress sutures deep into the vestibulum. This prevents micromovements of the graft and reduces mechanical irritation of the incision line.

Single sutures close the flap and apical mattress sutures remove tension from the facial muscles

Abutment for final restoration

Adhesive temporary restoration in place

It is advisable to save the geometrical shapes of bone rings in your planning software to visualize the optimal position and size of maxgraft® bonering.

- Ø 7 mm and 10 mm length
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CLINICAL CASE BY
Dr. Orcan Yüksel and Dr. Kris Chmielewski, Frankfurt, Germany

BONE AUGMENTATION AND IMPLANTATION IN SINGLE-TOOTH GAPS
Guided bone ring surgery and implantation in aesthetic zone with maxgraft® bonering.

Guided pilot drill to determine the aesthetic implant position

Trephine drilling; the guiding pin in the trephine follows the pilot drilling path. Depth of drilling in this case: 4–5 mm

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Clinical situation: Bone loss due to a lack of physical load and inflammation in region 21 retained with a bridge

Guided bone ring surgery and implantation in aesthetic zone with maxgraft® bonering.
CLINICAL CASE BY
Dr. Orcan Yüksel and Andrea Seyfer, Frankfurt, Germany

BONE AUGMENTATION AND IMPLANTATION IN EDENTULOUS SPACES
Restoration of incisors in aesthetic zone with two maxgraft® bonerings

Initial situation: Young patient with loss of teeth in region 21 and 22 after trauma
Clinical situation after lifting flap
Prepared ring bed according to protocol
Implantation of maxgraft® bonering
Two maxgraft® bonerings fixed with implants
Defect covered with cerabone®
Jason® membrane tacked on the buccal aspect
L-PRF matrix support wound healing
Single sutures free of tension
Abutments for prosthodontics
Final restoration
Aesthetic outcome one year after loading

Platelet-rich fibrin (PRF) may be beneficial for soft tissue healing, maturation of bone grafts and aesthetic results of soft tissue. Its application can be considered in bone augmentation procedures.

CLINICAL CASE BY
Dr. Anke Isser, Frankfurt, Germany

VERTICAL BONE AUGMENTATION AND IMPLANTATION IN FREE-END SITUATION.
Advanced vertical augmentation in posterior maxilla with maxgraft® bonering

Initial situation: X-ray shows severe bone loss due to inflammation in region 13
Treatment plan: Extraction of teeth 13 and 14 and augmentation of site after healing
Situation after extraction and healing phase shows insufficient bone in posterior maxilla
Defect covered with cerabone® and Jason® membrane
7 mm vertical augmentation with maxgraft® bonering and immediate implantation
Implant and ring bed preparation
X-ray seven months post-op shows newly formed bone with almost the same radiopacity as the native bone
Clinical situation at re-entry shows healthy bleeding bone

Every vertical bone augmentation procedure has its limit. The bone height of adjacent teeth is the maximum level for augmentation. Mobilization of the periosteum is particularly important for achieving an optimal outcome. In the mandible, soft tissue should be mobilized lingually; primarily, the periosteum should be detached up to the mylohyoid muscle with a dull elevator and the superficial fibrils mobilized in direction of the base of the mouth, as this can gain up to 10 mm of soft tissue. In free-end cases, apical mattress sutures are always recommended to avoid dehiscence.
**Clinical Case by**
Dr. Bernhard Giesenhagen, Kassel, Germany

**Treatment of Severe Periimplantitis**
Single implant removal and immediate bone augmentation and implantation with maxgraft® bonering

- **Initial situation:** X-ray shows severe periimplantitis at tooth 15 with bone loss of up to 1/3 of the implant.
- **Crestal incision shows exposed implant shoulder.**
- **Infected and exposed implant.**
- **Defect is measured with either a 6 or 7mm trephine.**

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**Guidelines for the application of maxgraft® bonering in the sinus:**
- This technique requires a special screw to secure the implant in maxgraft® bonering. The screw head diameter needs to be larger than the shoulder of the implant. The screw must ensure close contact with the crestal bone to provide stability during the healing phase, as well as prevent the ring and the implant from moving into the sinus cavity.
- The bone ring can be kept in place in the sinus cavity with special tweezers: 'bonering tweezers sinus', available from Ustomed Instrumente (www.usted.de / Art. No. 10-824-165).
- Pre-op planning is mandatory for thoroughly reviewing the patient’s anatomy of the maxillary sinus, its adjacent structures, and residual bone height/quality.
- Placement of the implant and maxgraft® bonering must be correctly planned and performed to achieve a successful prosthetic rehabilitation.
- Care must be taken to keep the Schneiderian membrane intact.
- The sinus should be sufficiently wide, i.e. not too narrow at the base otherwise the ring cannot be placed flush with the bone.
- If the implant lacks primary stability, the residual bone height is too thin or the bone is of poor quality, it is recommended to switch to a two-staged standard lateral window SFE procedure.
- Healing time is approximately eight to nine months until final restoration.

**Indication**
Maxillary bone height of 1-3 mm, or if no primary stability can be obtained with direct implantation.

A residual bone height of less than 1 mm is contraindicated. Furthermore, the quality of the residual bone must always be evaluated when using this technique.

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**Surgical Guide Maxgraft® Bonering**

Conventional periimplantitis treatment prescribes surface decontamination of the implant using different means. However, as shown in most case studies, subgingival bacteria is not completely eradicated and surgical intervention is most effective in cases of progressed periimplantitis. Nevertheless, for long-term clinical success, proper decontamination is essential. Antibiotics or photodynamic therapy are applicable in combination with the Bone Ring Technique.

Please note that the technique above requires trephines without guiding pins to remove the infected implant. These are not included in the maxgraft® bonering surgical kit.
Sinus floor elevation

Surgical procedure and guidelines

**Step 1** Prepare the lateral window
After flap elevation, carefully prepare a lateral window with a burr or piezoelectric instrument.

**Step 2** Elevate the Schneiderian membrane
Gently detach the Schneiderian membrane from the inner aspect of the sinus cavity. The bony lid of the lateral wall of the sinus should be carefully reflected to allow visualization of the bony floor of the sinus and the area for bone ring implantation.

**Step 3** Prepare the implant position
Mark the planned implantation site from the crestal side with a diamond tulip.
Use a pilot drill to access and prepare the planned implant bed and axis.
Take care to keep the Schneiderian membrane intact.

**Step 4** Place maxgraft® bonering
maxgraft® bonering is placed through the lateral window of the osteotomy. The height of maxgraft® bonering depends on the thickness and anatomy of the sinus floor and the length of the planned implant. Usually half of maxgraft® bonering (5 mm) is sufficient to stabilize the implant in the sinus cavity.

*Note:* It may be necessary to adjust the shape of the bone ring further to fit onto the floor of the sinus.

**Step 5** Place the implant
During the placement of the implant, hold maxgraft® bonering inside the sinus cavity through the lateral window using forceps to prevent rotation. The special tweezers from Ustomed can help to apply gentle pressure while screwing in the implant.

*Note:* The implant should be placed 1 mm subcrestally. See case 2 from Dr. Chmielewski for an alternative treatment procedure in case of very thin sinus floors.

**Step 6** Place a fixation screw
A special screw secures the implant within maxgraft® bonering. The screw head needs to be larger than the shoulder of the implant.
Ask botiss representatives which implant systems provide these screws: product-management@botiss.com

**Step 7** Fill sinus with bone substitute material
The remaining space in the sinus cavity should be filled with particulate bone substitute material thanks to its volume stability, cerabone® is recommended.

**Step 8** Cover the lateral window and close the wound
The lateral window should be covered with a resorbable collagen membrane (such as collprotect® or Jason® membrane). Closure of the flap for submerged healing should be carried out in a tension-free manner to facilitate healing.

*Note:* botiss offers a 3D printed model based on CT/CBCT sinus scans of the patient. This helps to visualize the sinus cavity, the necessary positioning of the ring and the lateral window and enables to train the hard-tissue procedure on the actual anatomical situation. maxgraft® bonebuilder dummy Art. No. 32100 maxgraft® bonering sample Art. No. BOC-33SAM

Please contact botiss for further information.
CLINICAL CASE BY
Dr. Bernhard Giesenhagen, Kassel, Germany

SINUS FLOOR ELEVATION AND IMPLANT PLACEMENT.
Single-tooth restoration of maxillary bone height of 1.5 mm with maxgraft® bonering

Initial situation: X-ray shows maxillary bone height of 1.5 mm in region 15

Preparation of a lateral window for external sinus floor elevation

Gentle detachment of the Schneiderian membrane

Insertion of maxgraft® bonering through the lateral window after preparing the implant position crestally

The sinus cavity filled up with cerabone® and implant in place

Cover screw with threads to fit the fixation cap

Fixation cap secures the implant in place and prevents the ring and implant from moving into the sinus cavity

Closure and fixation cap to provide stability during the healing phase

X-ray eight months after surgery shows a stable bone situation and sufficient maxillary bone height

bonering tweezers sinus secure the ring in the sinus cavity; they apply gentle pressure from the top while drilling the implant through maxgraft® bonering

CLINICAL CASE BY
Dr. Kris Chmielewski, Gdansk, Poland

SINUS FLOOR ELEVATION ON BOTH SIDES OF THE MAXILLA
Alternative treatment option to place an implant subcrestally in an eggshell thin sinus floor with maxgraft® bonering

Initial situation: X-ray shows eggshell thin sinus floor (1–3 mm) and planned maxgraft® bonerings on both sides of the maxilla

Lateral window prepared with a piezoelectric instrument

Detaching the Schneiderian membrane

Defect filled with cerabone®

Direct implant placement in the area with sufficient maxillary bone height

Preparing ring and implant extracortically. The implant should be placed a below the margin of maxgraft® bonering

Bone ring and implant placed through the lateral window and secured with a membrane screw

Sinus cavity filled with more cerabone®

Lateral window prepared with a piezoelectric instrument

Detaching the Schneiderian membrane

Initial situation: X-ray shows eggshell thin sinus floor (1–3 mm) and planned maxgraft® bonerings on both sides of the maxilla

Defect filled with cerabone®

Jasen® membrane secured with titanium pins

PRF matrix to support soft tissue healing

Wound closed with single stitches and apical mattress sutures

Second site treated in the same manner

Note: This procedure is only recommended if the sinus floor is very thin or of poor quality because the lateral window requires a larger surgical site than the crestal approach and may therefore be more traumatic for the patient.

Nine months after surgery: Eventless healing and gingiva former in situ
Surgical precautions and post-op care

- Tension-free wound closure is the key to success for every augmentation. Therefore, sufficient mobilization of the flap should be achieved. This is essential for vertical augmentations.
- Mattress sutures are recommended to remove tension from the lip and the facial muscles to avoid micromovements within the augmentation site.
- Sutures:
  - 4-0 Apical mattress sutures/single sutures
  - 5-0 Free gingival grafts
- The sutures are removed after approximately ten days.
- Mattress sutures are removed approximately three weeks after surgery.
- No pressure should be exerted on the healing site from temporary prosthesis. In the first three weeks, it is recommendable to renounce on any temporary provision.
- Advise patients to:
  - Avoid mechanical stress on the augmentation site. No solid food and excessive tooth brushing in the first days post-op.
  - Abstain from physical exercise in the first week after surgery.
  - Be examined immediately if inflammation or dehiscence is detected.

Healing time:

Healing times are approximately six months in standard bone ring procedures and eight months in sinus floor elevation procedures. The exact amount of time must be estimated individually by the surgeon depending on the location, type, and extent of the defect. The age of the patient should also be considered, as significant variations in patients of different age has been reported in terms of new bone formation.14

X-ray or CBCT follow-up is recommended

Representative histological image of the healing and integration behavior of maxgraft® allogenic bone blocks at six months after surgery. The allograft becomes optimally integrated within new build bone (asterisks) (HE-staining, 10x magnification). Biopsy provided by Dr. Bernhard Giesenhagen.

Re-entry

For an optimal aesthetic outcome, it is advisable to perform a special incision technique to produce an ideal emergence profile. The mean-der, or split finger, technique consist of a circular incision line around the implant to relocate attached gingiva to the buccal side around the implant.15

Courtesy of Dr. Bernhard Giesenhagen and Dr. Orcan Yüksel
Complication management

Thorough and regular follow-ups are essential to discover infection and dehiscence as soon as possible (three days, one and two weeks after surgery). In case of dehiscence, the exposed graft needs to be removed to an extent so that bleeding occurs. The wound margins should be trimmed and mobilized again for wound closure. Additionally, a pedicled connected tissue graft (CTG) can help to close the augmentation area. If the flap keeps reopening, removal of the implant should be considered.

In all cases, patients should be treated with antibiotics and rinsed with chlorhexidine.

Pedicled palatal CTG in the upper jaw

Small fenestrations should be immediately covered by connective tissue graft after decontamination of the surface. A diamond round drill can be used to reduce the infected and exposed bone ring.

Rotated CTG from palatinal to cover the soft tissue defect and fixed with single sutures

Six weeks after CTG procedure

References

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