Masterclass in Clinical Practice

Implant Dentistry
with
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Contour augmentation with simultaneous implant placement in the aesthetic zone

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Introduction

Dental implants have become the standard of care for replacing lost or hopeless teeth. Nowhere is this more important than in the anterior maxilla where aesthetic demands are high and the risks for failure manifold. The most important challenge must be the thin or absent buccal alveolar bone. In more than 90% of patients the buccal bone wall of the anterior maxillary teeth is less than 0.5mm thick, which means it is bundle bone only. Bundle bone (also known as alveolar bone proper) is a tooth related structure, varies from 0.2-0.4mm[1] and will resorb once the tooth is removed. This implies that more than 90% of patients will have a horizontal and vertical defect on the buccal of any proposed implant site in the anterior maxilla.

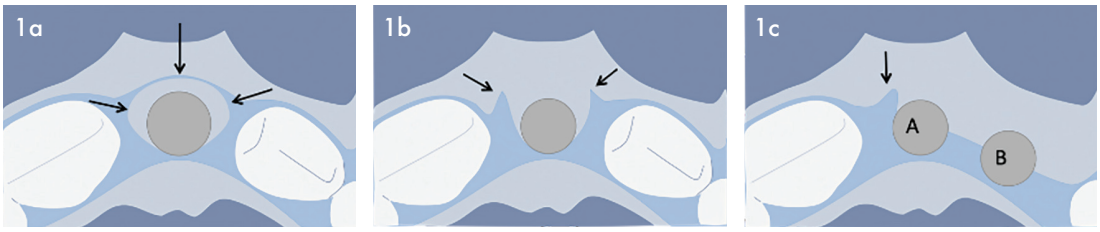
In order to achieve a successful aesthetic outcome with dental implants in the aesthetic zone, one has to augment the lost buccal bone wall and a minimum wall thickness of 1.5mm is recommended for stability.[2,3] This may be done in a variety of ways, with contour augmentation one of the best documented techniques for simultaneous implant placement and horizontal augmentation.[4,5] A requirement for simultaneous placement of a dental implant with horizontal augmentation is primary stability of the implant.[2]

It should however be kept in mind that successful contour augmentation relies on more than just clinical skill and of paramount importance is; non-smoking status, excellent plaque control, absence of periodontitis, more than 7mm horizontal space, level of the bone crest on adjacent teeth and having a 2- or 3-walled defect once the implant has been placed (Figure 1).[2]

The International Team for Implantology (ITI) has developed an online tool to help assess the difficulty of such procedures with the SAC classification. Most if not all contour augmentations in the anterior maxilla are classified as Complex in the SAC. It is therefore of value to be familiar with the classification.

SAC Classification

The SAC classification was designed as a guide for clinicians to identify the level of difficulty or risk of complications in individual cases, thus helping with the decision-making process of case selection and treatment planning. Classification of Straightforward (low difficulty and risk), Advanced (moderate difficulty and risk) and Complex (high difficulty and risk) applies to both restorative and surgical procedures. The ITI offers free SAC assessment via www.iti.org/tools/sac-assessment-tool. One has to create a free account first (content is not exclusively for ITI members) and afterwards start with the assessment process by uploading relevant information. The process itself is explained in detail, with an easy to use interface and should not last more than a few minutes. Finally, the software will gather all data and summarize it with an appropriate assessment score. This can be printed out and kept on file.



A 3-walled defect is illustrated as seen in immediate implant placement (Fig 1a); a 2-walled defect (Fig1b); a one- (A) and no-walled (B) defect (Fig 1c). (With permission from the ITI, www.iti.org)

Bone anatomy and changes after extraction in the anterior maxilla (Use SAC)

Immediate implant placement in the anterior maxilla remains a challenging procedure, requiring a thorough understanding of biological processes of hard and soft tissue healing that will take place after tooth extraction. Achieving successful osseointegration alone does not satisfy aesthetic demands of today's patients and clinicians. It is well known that post-extraction ridge alterations are unavoidable and occur due to resorption of the bundle bone. We also know that the buccal bone wall is less than 0.5 mm thick in most patients in the anterior maxilla, consisting of bundle bone only, which is a tooth-dependent structure. Main reasons for bone resorption are the lack of functional stimulus, lack of blood supply due to a periodontal ligament absence and genetic information.[6] The extent of dimensional changes depends on several factors such as buccal bone thickness, angulation of the tooth and other differences in anatomy at the specific tooth sites. One study revealed a progressive resorption pattern in sites with buccal wall thickness of 1mm and less, with median vertical bone loss of 7.5 mm or 62% of the former facial bone height after 8 weeks of healing.[7] Even though several augmentation techniques have been suggested to compensate the lost hard and soft tissues, an aesthetic treatment outcome remains a major challenge in clinical practice.

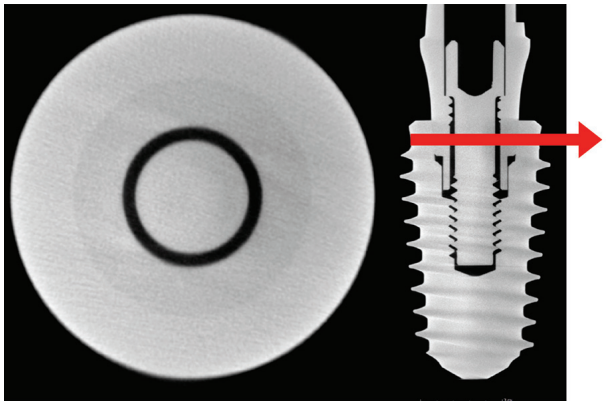


Figure 2: Micro-focus CT of a cone connection with the axial slice shown where indicated in red. No micro-gap can be measured

Implant engineering and effect on bone stability

There can be no doubt about the importance of the abutment-implant connection. Many studies have demonstrated the long-term stability of bone and soft tissue seen with Morse-taper connections.[8,9] The Morse-taper connection shows less peri-implant bone loss which in turn supports the peri-implant soft tissue. This is essential for an aesthetic outcome. Cone connections imply a cone-in-cone joint which is so tight that it leads to a cold weld between abutment and implant, providing a tight seal against bacterial ingrowth. Micro-focus CT scanning reveals no visible space in such connections (Figure 2).

Contour augmentation has been well documented by the Berne University group.[10] The importance is that they used specific materials with a well-controlled clinical protocol. One cannot extrapolate their success to all materials and this is an important tip in achieving success with this procedure. It does not mean that similar results cannot be achieved with other materials, but understanding the properties of the membrane and bone-filler is of great importance in choosing the right materials.

Materials for contour augmentation:

- *Membrane.*

Utilizing barrier membranes to prevent penetration of undesired cells and allow entry of cells that will take part in forming preferred tissue is the basis of the long-established guided tissue regeneration concept. Over time, many types of barrier membranes have been proposed for guided bone regeneration (GBR). They can be classified as resorbable or non-resorbable, moreover resorbable can be classified as natural or synthetic, depending on their origin. Characteristics of the proper barrier membrane involve biocompatibility, integration by the host tissue, cell occlusiveness, space-making ability and adequate clinical manageability.[11] Contour augmentation through GBR is usually done simultaneously with implant placement. Resorbable membranes are the best option for this, as there is no need for additional surgery and membrane removal. The most documented type of resorbable membrane used for contour augmentation is non-crosslinked porcine-derived collagen membrane (Bio-Gide; Geistlich Pharma).[10]

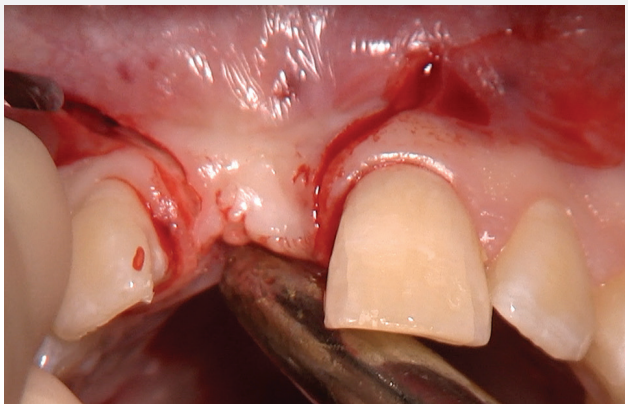


Figure 3: Curvilinear flap design leaving the papillae on adjacent teeth and having a broad base for improved blood supply

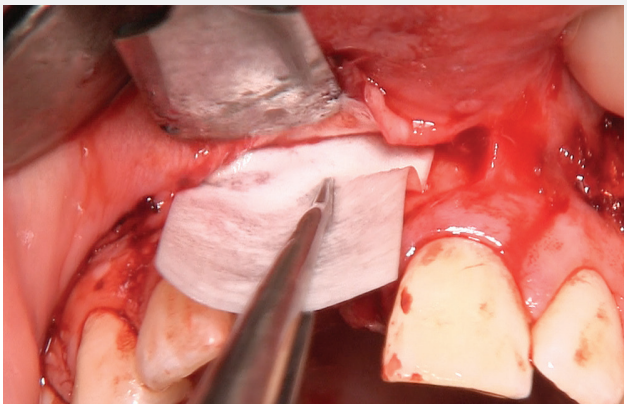


Figure 4: Membrane is placed and measured for shaping

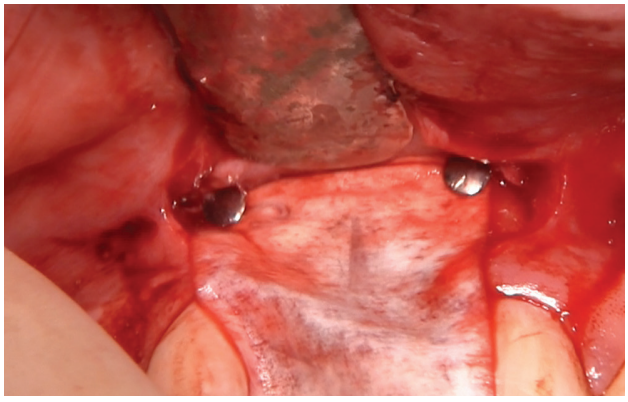


Figure 5: Membrane secured with Titanium tacks

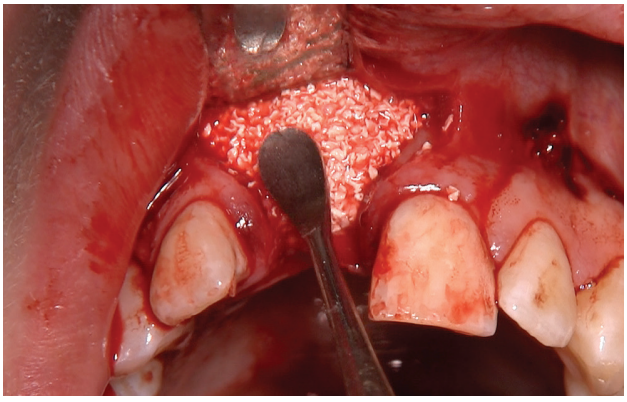


Figure 6: Particulate material packed to over contour the buccal defect

- *Particulate bone filler*

Contour augmentation aims to compensate for the thin buccal bone plate resorption, thus preventing aesthetic complications such as defects of the alveolar ridge and gingival recession. Contour augmentation via GBR as described by Buser et al [4] is performed with a two-layer composite graft. The first layer consists of locally harvested bone chips to cover the potentially exposed implant surface on the facial aspect, while for the superficial layer of the graft a deproteinized bovine bone mineral is utilized (DBBM; Bio-Oss, Geistlich Pharma).

The choice of bone particulate graft is very important and DBBM not only provides an osteoconductive scaffold, but improves the volume and secures the long-term stability of the reconstructed bone wall due to its low substitution rate. It was demonstrated that when embedded in bone DBBM is almost not resorbed.[5]

- *Sticky bone.*

Creating sticky bone by combining PRF with bone particulate graft material is an excellent technique for enhancing the graft material. For more information on PRF in GBR we refer you to Master Class in Implant Dentistry, in the Vol 12 No 1, February/March 2022, edition of this journal.

Clinical procedure (Scan QR code for a short demonstration of surgical procedure):

Cone beam computed tomography is an essential tool in assessing the bone volume before the clinical procedure is planned. Primary stability of the implant must be achieved to prevent micro-movement of the implant during healing, so it follows that there must be enough bone to achieve this. Often a longer implant may be required to achieve good primary stability at the apical aspects of the implant.

As most of these cases will be done in a two-stage surgical

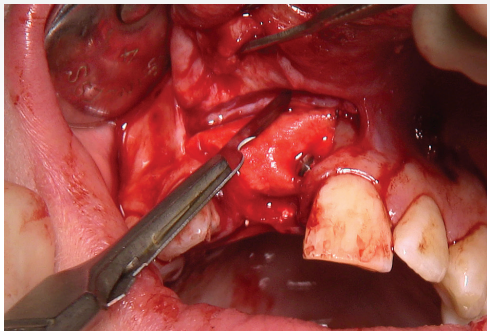


Figure 7: Once the bone has been packed and membrane shaped, the periosteum is released at an angle as shown. Periosteal release may cause increased bleeding which is why it is best done just before closing the flap.

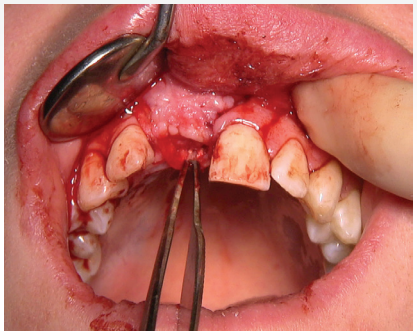


Figure 8: Test the passive closure by pulling flap to its final position ensure it stays there when tissue forceps is removed.

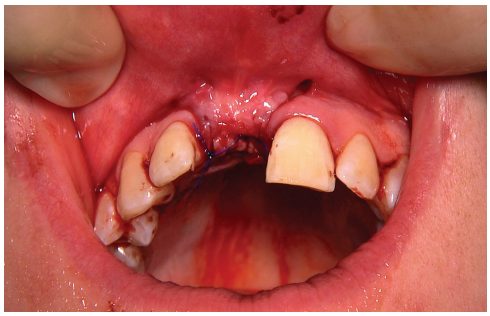


Figure 9: Mattress suture on crest to secure flap in correct position

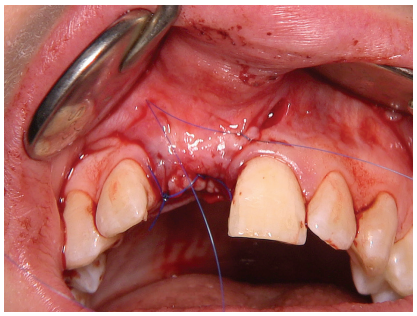


Figure 10: Releasing incisions are sutured last, preferably with a monofilament to minimize risk of bacterial ingrowth

procedure, with exposure after 8-12 weeks, tension free closure of the wound is of great importance. For a detailed description of passive closure and video demonstration, we refer you to the MC in Implant Dentistry of the August/September 2021 edition of this journal.

It is therefore important to design the flap to have a good blood supply (having a broad base to the flap is important). One can use a curvilinear flap design or an intrasulcular approach. With the intra sulcular approach, it is important to make sure the bone material and membrane is not in communication with the sulcus on adjacent teeth as it may introduce bacteria to the augmented site. The curvilinear design enables primary closure of the flap without involving the gingival sulcus (Figure 3)

Once the implant has been placed, a membrane needs to be secured to cover the particulate bone material. Titanium tacks work very well to secure the membrane and two tacks at the apical corners of membrane will suffice to keep membrane stable (Figures 4-5).

The particulate bone may be mixed with PRF to create sticky bone which is much easier to mould to the ridge than loose particles. The bone material is over contoured to ensure a convex shape to the ridge (Figure 6).

One of the trickier aspects of this procedure is to release the periosteum. The blade should be angled to not cut too deep into the supra-periosteal space, as this may sever the supra-periosteal blood vessels to the coronal aspects of the flap (Figure 7).

Necrosis of the coronal flap may occur if the blood supply is damaged too much in the periosteal release.

Passive closure is the most important aspect of the procedure, as any tension in flap/sutures will lead to opening of the wound or worse, necrosis of flap. Before suturing, the flap should be tested for passive closure by pulling it to the final position and make sure it will stay in that position indicating a passive flap (Figure 8).

Suturing is started on the crest with horizontal mattress sutures to keep flap in position (Figure 9) before the releasing incisions are sutured (Figure 10).

Conclusion

Contour augmentation is a reliable, well documented procedure to create a buccal bone wall of more than 1.5mm in the anterior maxilla. This will in turn support the soft tissue to create an aesthetic outcome in the anterior maxilla. This remains a complex procedure and should not be undertaken by inexperienced clinicians or without the necessary training.

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