Bone Splitting As A Transversal Augmentation Method For Optimizing The Implant Bed

Bone splitting is a method of transversal augmentation for preparing an implant bed. The method, which is presented in this article, allows simultaneous procedures. Dr. Dr. Andres Stricker explains the classic steps of the method, including a variant that allows better assessment of the bone width in cases of severe atrophy.

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1989-2001: Studying Dentistry and Medicine at the Albert-Ludwigs Universität, Freiburg, Germany.
Since 1997: Research Assistant at the Clinic and Polyclinic Department for Oral and Maxillofacial Surgery at the university hospital in Freiburg.
1998-2001: Various stints as visiting scientist at University of Michigan, Harvard University, University of Louisville, university of Miami, and other institutions.
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Modern implantology endeavors to restore structures destroyed by tooth loss. The implant insertion is no longer dictated by the existing bone support, but depends on the most favorable position in terms of prosthetics. Therefore many implantations must be accompanied by augmentation. The latter should ensure the long-term stability of the implant bed, however without overstretching the patience and pain tolerance of the patient over the period beginning with the healing phase and ending with the eventual result.

Primary and secondary augmentation

The indication for transversal augmentation is given by narrow alveolar processes of the maxilla and the mandible, with a residual bone width of less than five millimeters. Following the implantation, the bone foundation must still be at least one millimeter vestibular and lingual around the inserted implants.
Various surgical techniques for transversal extension have been described in literature,[15] where a distinction is made between primary-simultaneous and secondary, that is delayed augmentation procedures. On the one hand we have block augmentation and horizontal distraction osteogenesis, as secondary techniques, on the other there are primary augmentations such as Guided Bone Regeneration (GBR) or bone splitting with or without interposition. The secondary techniques involve an initial block augmentation or distraction in the mandible before, in the secondary, later step the actual implantation is carried out.

The bone splitting method

The simultaneous technique of bone splitting involves the following procedure (fig. 1): The bone is longitudinally split, electrically or manually, using rotating or ultrasound-powered instruments, and then distracted with osteotomes. The implant is inserted in the cavity thus created. The hollows between the implants can be padded out with autologous bone or bone replacement material. The vestibular lamella should be well perfused, which can only be ensured if it remains pedicled.

Fig. 1: Preoperative OPG with sufficient vertical, but poor transversal bone support

In the presence of borderline atrophies, however, this procedure is difficult to accomplish since, with the periostea still in place, the bone width can not be reliably determined. Any rushed and uncontrolled fracturing increases the risk of failure of the procedure (fig. 2), which is why we argue for a different method of bone splitting for such indications.

Special procedure for borderline atrophies

This procedure starts with the preparation of the mucoperiosteal flap with two- or threefold periosteal slits. This is done right at the beginning of the procedure because periosteal slitting at a later stage would cause stronger hemorrhage into the wound area. Also, it allows carrying out a tension-free flap adaptation during wound closure. After this initial step the vestibular lamella is completely displayed and the transversal situation is examined. The residual transversal bone is split by Piezosurgery as shown in fig. 3. The buccal lamella should be thinner than the lingual lamella. Ideally, the ratio between lingual lamella and the buccal lamella should be two thirds to one third because, in case of spontaneous fractures of the split bone segment, it is much easier to fixate the buccal segment against the lingual or palatinal segment by means of an osteosynthesis screw.
Piezosurgery allows carrying out bone incisions in a bone-preserving manner. The operating method is perceived as more gentle by the patient as forceful hitting movements against the patients jaw can be avoided. In terms of anamnesis, it must be clarified before the operation if the patient carries a

cardiac pacemaker because, in that case, the ultrasound vibrations would cause systemic complications.
With the longitudinal ultrasound incision completed, the defined relief incision in the mesial and distal region at a distance of at least one millimeter to the adjacent tooth, so that this tooth is not damaged approximally and basaly in the root region. Initial transversal widening of the opening is carried out with the osteotomes (supplied by Aesculap, Tuttlingen, Germany) before the step osteotome is inserted in the defined implantation site (fig. 4).
The step osteotome has to be applied in such a way that the shorter peg with the larger planar surface sits on the vestibular side so that the notch is initially created on the lingual side. Peg movement into the vestibular lamella follows four millimeters deeper. This results in a depth preparation with a starting point for a pilot drill of 2 mm diameter. Alternatively, in a maxilla of D3 bone quality, the implant bed can be prepared successively with a bone condenser (fig. 11 and 12).
This procedure involves a risk of bone trauma possibly caused by movement and luxation of the buccal bone segment leading to long-term absorption, which in turn could result in an increased rate of implant loss (fig. 5). To compensate for this, we recommend strengthening the lamella with bone replacement material and membrane technique on the vestibular side, since a thicker buccal lamella can prevent absorption (fig. 6).
After that, the implants are inserted in the existing bone, with good primary stability, followed by basal pin fixation of the collagen membrane from the cortical lamella as shown in fig. 7. The membrane is prepared and flipped towards buccal. Then the replacement material, based on tricalcium sulfate and hydroxylapatite is implanted as shown in fig. 8. The membrane is readapted towards lingual via the augmented buccal lamella (fig. 9).

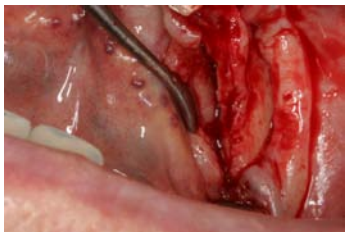

Fig. 2: Intraoperative situation with borderline transversal bone support

Fig 3: Initial bone splitting with Piezosurgery

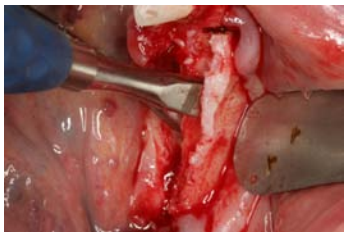

Fig 4: Application of the Aesculap osteotome

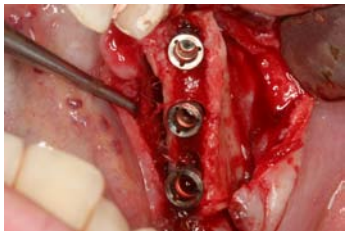

Fig. 5: Situation after implant insertion

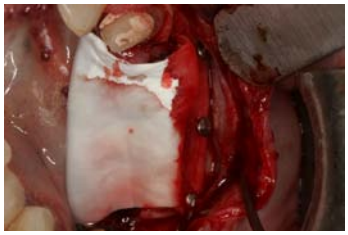

Fig. 6: Securing the membrane with nails

Fig. 7: Secured membrane prior to implantation of the replacement material

The procedure is concluded by the provision of a tension-free suture with 5.0 stitches (fig. 10).
After a healing phase of four to a maximum of six months, depending on the existing support bone of the implant bed, the healed-in implant is exposed. The prosthetic provision can follow two weeks later.

Discussion

The aim of the splitting technique is to create a new implant bed on the alveolar process. Alternatively a lateral augmentation or distraction osteogenesis could be considered.
The lateral augmentation is an augmentation process requiring a long healing phase prior to implant insertion.

This means that the secondary implant insertion is carried out three to six months after the initial bone transplantation. Simultaneous implantations in conjunction with bone transplantations were unsuccessful. For the lateral augmentation one can use either particulate materials or bone blockers. Particulate material in turn requires mechanical retention by GBR membranes.
Lateral block augmentation suffers the disadvantage of absorption, which can reach 20% to 30% after 12 months.
Bone splitting is carried simultaneously in normal cases. The indication is a soft bone that allows osteocompression or Grünholz fracture. Implants in the maxillary bone after interpositional augmentation have shown a success rate between 86% and 99%.
For this procedure the buccal lamella is osteotomized longitudinally and carefully mobilized towards vestibular, analog to a Grünholz fracture. The step between the buccal and lingual cortical lamellas is filled with either autologous, or allogenous, or alloplastic materials.

In the mandible there is a very high risk of fracture of the osteotomized buccal segment since, due to the strong corticalization and mineralization of the buccal lamella, the bone is less flexible and therefore more prone to fracture. Therefore the splitting technique along the longitudinal axis has to be combined with relief incisions or relief cuts in vertical direction.
In surgical terms bone splitting, which is opened up after a slightly lingual crest incision of the mucoperiosteal flap, is carried out to display the width of the alveolar process. The true width can be clinically determined only by the vestibular denudation of the bone. It is important that the adaptation of the lingual periosteum is left in place. In some cases it is only just displayed to find a pouch for the subsequent membrane insertion.
The step osteotome is applied immediately before the implantation to create the conditions for an implant bed preparation with as little ablative effect as possible. After that the standardized drills or, especially in the maxilla, osteotomes can be used to prepare the bone bed to the definitive implant diameter.
To adapt the vestibular alloplastic material the membrane should be basally fixated with a pin to secure it against muscular movements on the buccal side and prevent the material from migrating under the membrane. In this combination – a primarily stable implant over a stabilized augmentate at the fixated vestibular lamella – first results show good stability of the implant bed and a shorter therapy period to achieve the definitive result.

Fig. 8: Insertion of the replacement material buccal

Fig. 9: Fixation of the membrane in the labial periosteal pouch

Fig. 10: Postoperative OPG

Fig. 11: Aesculap Step-Osteotome

Fig. 12: Detail of the Aesculap step osteotome

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