

# Augmentation— one important basis in implant treatment concept

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**\_In recent years** new issues have arisen in the field of implant dentistry. The 1980s was the decade of osseointegration; the 1990s, the era of guided bone regeneration. Recently, the focus has mainly been on the improvement of dental aesthetics and methods of improving the aesthetic and functional results, the load-carrying capacity and the simplification of surgical techniques. These aspects should not be considered separately from each other, as they overlap.

In 1980, Philip Boyne first described procedures for sinus floor augmentation. Since then more than 1,000 scientific articles on sinus floor augmentation have been published.

Today, the use of osseointegrated dental implants is an effective and reliable method for long-term treatment of patients with partial and total tooth loss. The success rate and predictability of implant treatment depends on several factors but are generally high. The goal is to make this rehabilitative process accessible to as many patients as possible, even those with poor bone quality and/or low bone mass. Until now, an insufficient amount of bone and poor bone quality have been unfavourable or even a contra-indication for implant treatment. Because of poor bone quality and often-progressive bone re-

sorption after tooth loss, the posterior maxilla especially is a high-risk area for the placement of dental implant restorations. If atrophic maxillary bone or a large maxillary sinus is present, the implant treatment is more difficult. A solution in such cases is the use of shorter implants. However, certain clinical conditions must be met so that an unfavourable relationship between the implant and the restoration length (implant-crown ratio) does not lead to biomechanical problems, improper loading or premature implant loss. In such cases, the implant treatment must be planned carefully and additional surgical procedures before dental prosthetics, such as a bone graft in the maxillary sinus, are often required to compensate for inadequate bone. In this way, optimal conditions for the insertion of implants in the posterior portions of the alveolar process of the maxilla are created.

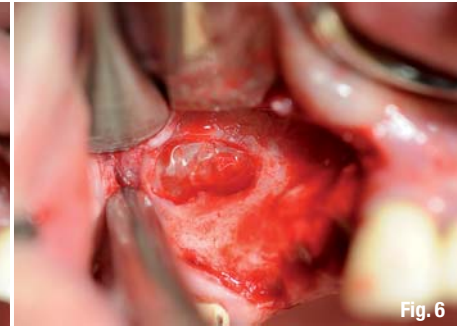
In the past, dentists and maxillofacial surgeons avoided complex procedures that required access to the maxillary sinus through the oral cavity, provided such were not necessary. As early as 1984, Brånemark demonstrated with clinical and experimental data that the apical end of an osseointegrated implant can be placed in the maxillary sinus without adversely affecting the health of the sinus area if the Schneiderian membrane remains intact.

**Fig. 1**\_Situation before operation, vestibule area is relatively broad, flat ridge regions # 14 to 16, 6 weeks after extraction of tooth #14.

**Fig. 2**\_Surgical site after surgical flap preparation shows fully ossified alveolus of tooth #14, 6 weeks after extraction.

**Fig. 3**\_Pre-preparation of the bone window in region #16 with large Rosecutter to mark the finish line under continuous cooling.





Today, it is common knowledge that the long-term success of dental implants depends on the degree of osseointegration. This, in turn, is dependent on the primary stability, on the one hand, which is determined by the density of cortical bone and the bone quality, and on the secondary stability, on the other hand. The latter results from the progressive deposition of bone along the implant surface. Although an implant that is inserted into bone with reduced height and width and that extends from one end into the sinus cavity shows a good primary stability with a sufficient solid cortex, its anchor remains limited. Thus, osseointegration of the entire implant surface, which is critical to the long-term success, cannot be achieved. If a progressive loss of crestal bone takes place over time, the implant stability is further affected.

Therefore, in the posterolateral maxillary it is often necessary to perform a sinus floor augmentation if there is poor bone quality and insufficient alveolar process height. A sinus floor augmentation and significant pneumatization of the maxillary sinus are indicated in order to be able to use sufficiently long implants to guarantee the anchor in a region of high functional load.

In 1980, Boyne and James wrote the first publication on the treatment of patients with endosseous implants in combination with sinus floor elevation. Access to the maxillary sinus was by means of the intra-oral antrostomy and the preparation of a "bone window". This was then carefully advanced into the cavity and drawn. Therefore,

a partial detachment of the Schneiderian membrane from the sinus floor was needed. Subsequently, a bone graft was placed under the membrane and the opening was obturated again. Generally, the bone from the patients themselves was used as the graft. In a second step, several months after the sinus floor elevation, blade implants were successfully implanted. The prosthetic reconstructions existed in fixed or removable dentures, which were placed in the edentulous sections of the posterior maxilla.

Soon thereafter, Tatum *et al.* worked on this surgical technique intensively, seeking to improve the results by means of modified procedures. Tatum Sun took on a key role in the development of the procedure for sinus floor elevation using an autogenous bone graft from the iliac crest for the preparation of the implant insertion (Tatum 1977, 1986). Progress in the field of biomaterials and refined techniques and protocols for the rehabilitation of tooth loss by osseointegrated implants have increased the success rate and the predictability of implant treatment.

### Xenogeneic grafts

To spare patients an additional removal of autologous bone in other areas of the spine or of the iliac crest, bone substitute materials (xenogeneic grafts) are used increasingly today. Xenogeneic grafts are now mostly deproteinized (inorganic) bovine bone specimens. These grafts are used either alone or are mixed and used as part of a mixed transplant with

**Fig. 4** Extraction of the patient's own (autologous) bone chips by Safescraper.

**Fig. 5** Careful dissection of the Schneiderian membrane by the use of a diamond bur.

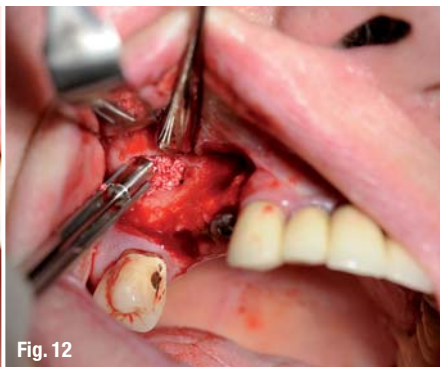
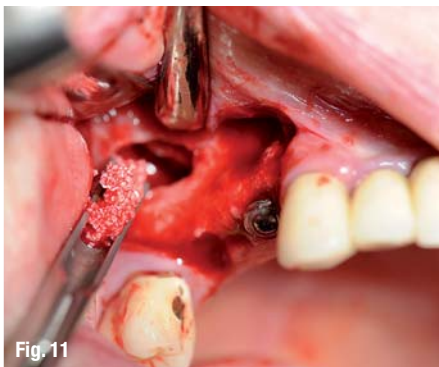
**Fig. 6** Illustration of the intact Schneiderian membrane in region #16.

**Fig. 7** Carefully solution of the Schneiderian membrane from lateral to caudal.

**Fig. 8** Lifting and moving of the Schneiderian membrane.

**Fig. 9** Preparation of the implant cavity after pilot hole with bone-condensing instruments.





**Fig. 10** Insertion of the implant in region #14.

**Fig. 11** After stabilisation of the Schneiderian membrane, the Bio-Gide membrane is raised by the introduction of Bio-Oss granules (Geistlich), blood from the operation area and mixed with autologous bone chips of the patient.

**Fig. 12** Another gentle introduction of the augmentation in the Bio-Gide membrane before insertion of the dental implant in region #16.

autologous transplant patients and bone defect of the patient's blood.

The implant survival rate with the use of xenogeneic grafts is statistically equivalent to the use of particulated autogenous bone grafts. Del Fabbro *et al.* conducted studies on various bone replacement materials in 2004. Aghaloo and Moy 2007 found a survival rate of 88% in pure autologous transplants, 92% in mixed grafts with autologous bone, 81% in pure alloplastic grafts, 93.3% in pure allogeneic grafts and 95.6% in pure xenogeneic grafts was found. These figures are encouraging for dentists and indicate a positive long-term prognosis for implant treatment in the distal maxilla. However, in aesthetically challenging zones, an implant insertion without augmentation procedures is almost impossible to achieve, for only connective soft tissue aided by bone or graft material can contribute to aesthetically satisfying results.

### Placement of grafts and implants

The graft material should be inserted starting from the areas that are the most difficult to reach and contact with the bone walls must be ensured to improve the healing of bone. If the sinus membrane (Schneiderian membrane) is very thin, it should be protected and stabilised with a collagen membrane. The recesses are first filled anteriorly and posteriorly, and thereafter the area of the medial sinus wall was filled too. The graft should not raise the membrane further and must not be compressed too much, as then vascularisation particularly with biomaterial will be hampered. The implants are then successively inserted into the prepared implant cavities. This achieves compaction of the loose cancellous tissue of the maxillary bone after the actual pilot hole with poor bone quality is achieved by means of bone-condensing instruments. This is also a useful and effective way to improve primary stability. After the insertion of the implants from the lateral side, the graft material is placed on the implants, all intermediate space and cavities are filled and the bone window is covered with a small collagen mem-

brane. The size of the collagen membrane should correspond to the existing bone window. The attachment can take place without the use of pins or absorbable sutures under the mucoperiosteal flap.

New studies have shown that there are no differences between the results with the use of collagen-membranes and those with membranes made of expanded polytetrafluoroethylene (ePTFE, GORE-TEX; Wallace *et al.* 2005). Since collagen-membranes stick, they can be installed without screws or pins and, because of their absorbability, they do not have to be removed in a later procedure.

### Suturing and wound care

For the final wound care, the defect is covered passively with the lobes. For this purpose, releasing incisions in the periosteal area are necessary. This method, however, is usually only necessary with simultaneous maxillary bone augmentation (for widening) because pure sinus floor augmentation does not change the ridge contour. The thread thickness can be specified from 4.0 to 6.0 mm with non-absorbable monofilament.

### Summary

It is generally in the interest of the patient to weigh the benefits of pure autologous grafts or some combination of autologous bone and the incorporation of synthetic bone materials and/or xenogeneic bone substitute materials. The use of foreign material leads to conservation of the patient's own bone and avoids a second opening at a donor site, which creates an additional wound.

In principle, in treatment planning and advising patients must respect the patient's desire that all surgical procedures proceed as smoothly, efficiently and, ultimately, as successfully as possible. It is through the combination of autologous bone grafts and foreign material, depending on the case and necessary use of membranes, that the long-term success of implant treatments is predictable. Oper-





Fig. 13



Fig. 14

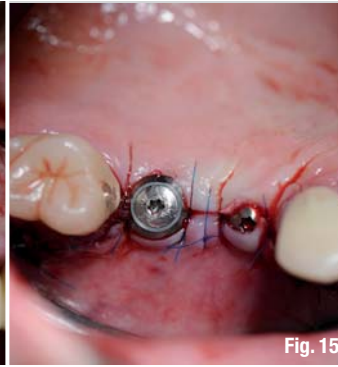


Fig. 15

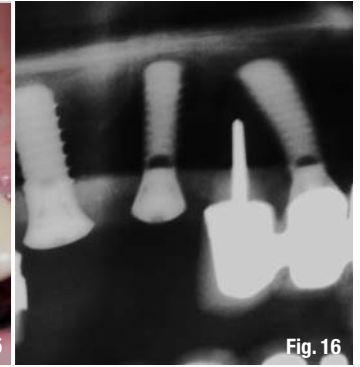


Fig. 16

ators should always be open to learning new methods, but must do so with their responsibility to their patients in mind.

The demands of today's patients are constantly growing and so the management of hard and soft tissues is of crucial importance for dental implantology. The current augmentation procedure provides a well-supported and physiologically shaped gingiva in the adjacent implant shoulder and super-structure area and thus provides an indispensable basis for aesthetic long-term success. Knowledge and mastery of augmentation is essential for ensuring long-term success and makes the

use of endosseous implants possible in the first place.

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**Fig. 13** After the insertion of the dental implant, loose filling with augmentation of the lateral side takes place.

**Fig. 14** Coverage of the facial bone defects with residual Bio-Gide membrane.

**Fig. 15** State after wound closure and preparation of trans-mucosal healing of ITI-implants (Straumann Dental Implants).

**Fig. 16** X-ray after external sinus lift shows no displacement of the augmentation material in the maxillary sinus.

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