Augmentation and implant treatment

Two-stage surgery in the severely resorbed edentulous mandible

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Introduction

An adequate bone volume at the future implant site is a prerequisite for ideal implant placement and implant success. A residual bone with a vertical dimension less than 5.0 mm indicates a cut-off point and implies the need of additional augmentation procedures in connection with implant insertion, whereas higher values of the alveolar crest ≥ 5.0 mm are considered to be sufficient for treatment with standard-diameter implants without the urgent need of any horizontal bone augmentation.1

Distant donor sites like the anterior and posterior iliac crest and intraoral areas like the retromandibular and the interforaminal region of the chin are common sources for harvesting autogenous bone-grafts. Depending from the donor site, patient and surgeon should be aware of the possible confrontation with various advantages but also disadvantages when harvesting the bone. Harvesting bone from the iliac crest requires patient hospitalisation, and surgery under general anaesthesia, whereas intraoral bone harvesting can be performed ambulatory and under local anaesthesia.1,3

The main problem with autogenous bone-grafts is represented by the high risk of patient morbidity, causing pain, swelling, and healing problems at the donor site: The aim of this case presentation is to demonstrate a predictable, two-stage operating protocol for the horizontal augmentation of the severely resorbed, edentulous anterior mandible with an autogenous bone graft, harvested from the crestal alveolar ridge at implant site, in order to create a sufficient bone volume for the later implant therapy, without donor morbidity for the patient.

Patient data

The 47-year-old male patient visited our dental office in order to renew his old and poor fitting prostheses in the lower and in the upper jaw. The remaining five teeth 32–43 in the front of the lower jaw had been removed three months previously due to a chronic periodontitis in our dental practice. Nearly all remaining teeth in the upper and the lower jaw showed significant signs of progredient chronic periodontitis, insufficient root treatments and prosthetic suprastructures as well (Fig. 1). The medical history of the patient was without any significant pathological findings.

Diagnostic procedures

In cases of long-term edentulism, the dental surgeon is almost always confronted with a reduced bone volume, representing both a major challenge and a significant demand for the use of diagnostic imaging methods prior to augmentation and implant treatment. Conventional X-ray images contain only a two-dimensional information concerning the vertical height of the alveolar bone. Therefore, they represent an insufficient method for the appreciation of the horizontal bony dimensions. In comparison, three-dimensional (3-D) diagnostic tools like cone beam computed tomography (CBCT) offer the advantage of the visualisation of the so-called 2-axis, representing the bone volume in the horizontal, i.e. bucco-lingual dimension of the alveolar crest respectively. A proper treatment planning and the use of 3-D diagnosis are therefore crucial parameters for a predictable and sustainable final treatment outcome in implant therapy, especially in patient cases with severe resorption of the jawbone, like in our presented patient case.

The oral examination and the CBCT-Scan (SCANORA, Soredex, Schutterwald, Germany) revealed a distinct bone resorption in the lower jaw, showing a more pronounced horizontal atrophy in the anterior part of the mandible (Figs. 2 & 4). According to the clinical measurements and the values of the 3-D CBCT scan, the interforaminal vertical bone height was between 22.0–25.0 mm. The horizontal bone volume amounted to between 12.0–15.0 mm in the implantation zone. The CBCT-Scan revealed a horizontal crestal bone thickness of 1.09 mm in region 32 and 1.73 mm in region 44.

Treatment planning and augmentation procedure

After patient-consultation, we opted for a twostage surgery with an intracrevally harvested autogenous bone-graft and a delayed implant treatment after a healing period of at least four months. As the vertical dimension of the implant region appeared to be sufficient enough for placement of implants with a standard length, we decided to cut off 5.0 mm of the thin and sharp-edged alveolar bone ridge by osteotomy, in order to create an autogenous lateral onlay bone-graft for horizontal augmentation in the anterior alveolar ridge. This protocol comprised in our view the advantage of the avoidance of donor morbidity, because the donor site was the receptor site as well. After creation and mobilisation of the mucoperiosteal flap, the very thin and sharp edge of the atrophied alveolar crest became visible (Fig. 4). The osteotomy of the bone was performed with a saw (Bone splitting system, Helmuth Zepf Medizintechnik GmbH, Seetingen Oberflacht, Germany). Subsequently, the graft was detached from the anterior mandible...
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Fig. 7: Aspect of the bone harvest.

3.75 mm and a length of 11.5 mm were inserted epicrestally without a surgical guide. A combination of autogenous bone chips and particu- lated xenograft (BEGO Otto, BEGO Implant Systems, Bremen, Germany) was placed in the small remain- ing space between the bone block and the alveolar processus, as well as around and on the bone graft. The augmented site was covered with a planed rich in growth factors (PRGF) membrane (B1T Biotechnology Insti- tute, Blue Bell, USA) and additionally with a barrier membrane for guided bone regeneration (GBR, Bio-Gide, Geistlich Biomaterials Vertriebse- sellchaft mbH, Baden-Baden, Ger- many; Fig. 9). The healing of the graft was uneventful and without any complications, like membrane ex- posure, being classified as a frequent post-operative complication. The patient was provided with a remov- able provisional prosthesis.

Re-entry and implant surgery

The re-entry for the delayed implant placement protocol was planned af- ter a healing period of four months. With regard to the soft aspect of the augmented area of the anterior mandible, the dimensions of the alveolar ridge appeared sufficient enough for implant placement (Fig. 10). The CBCT data confirmed the assumption, demonstrating a sig- nificant gain of bone volume in the interforaminal area of the mandible after augmentation. The horizon- tal thickness of the crestal alveolar bone was 5.53 mm in region 44 and 4.43 in region 32. The augmentation procedure resulted in a horizontal bone gain of about 3.9 mm in region 44 and 3.3 mm in region 32 respec- tively, representing a mean bone gain of 3.6 mm (Fig. 11). After elevat- ing the flap, an apparently good os- seointegration and stabilisation of the autograft with the underlying pristine bone could be noticed (Fig. 12). Prior to implant placement, the fixation screws were removed. The four implants with a diameter of 3.75 mm and a length of 11.5 mm (BEGO Semados®, BEX, BEGO Implant Sys- tems) were inserted epicrestally in regions 31, 32, 41 and 43 using the freehand method without a surgical guide (Fig. 13). The insertion torque of the implants was 35 Ncm with good primary stability. The bone graft was fixed at the buc- cal with chisel bone splitting sys- tem, Helmut Zepf, Medizintechnik GmbH, Siegenthal-Oberlacht, Ger- many; Fig. 6) and a cortico-cancel- lous bone block was obtained (Fig. 7). The bone graft was fixed at the buccal side of the anterior mandible (region 34–44) with four 8.0 mm long titanium microscrews (Storns am Mark GmbH, Emmerings-Liptingen, Germany; Fig. 8). After three months of uneventful submerged healing, the panoramic X-ray showed a successful implant osseointegration without any signs of bone resorption (Fig. 14). Due to a lack of keratinised gingiva, we de- cided for an enlargement of the ratio between attached and free gingiva by performing mucogingival sur- gery with the Edlen-Mejchar method (Figs. 15, 16 & 17). After an additional healing period of one month, the fi- nal bar retained, a removable interim- overdenture was incorporated. The bar was constructed with bar abut- ments (PS Tiba, BEGO Implant Systems) and a non-precious alloy (Wirobond®, BEGO Dental, Bremen) and was screw- retained on the four implants (Figs. 18, 19 & 20).

Discussion

In our case presentation, the patient suffered from an extremely hori- zontal bone resorption, resulting in a 10–15 mm thin, and knifed edge alveolar crest. Since standard stan- dard diameter implants need a certain cortical bone volume for an adequate stabilization and a good predict- able osseointegration, augmenta- ting procedures were performed prior to implant treatment.

A recently published meta analysis showed that dental implant survival has probably to be seen indepen- dently of the biomaterial used in augmentation procedures.3 Since this evidence is limited by the fact, that defect size, augmented volume, and regenerative capacity are scarce- ly well described in literature, autog- enous bone is still recommended as the ‘gold standard’ for augmentation in the deficient alveolar bone.3 Nonetheless, it is the standard procedure in ridge augmentation, resulting in an ex- tended operating time.4 Fortunately, as the vertical dimen- sion of the anterior mandible was high enough in our clinical case, we were able to harvest an adequate au- togeneous bone block from the thin alveolar crest, in order to use it as an onlay graft for the horizontal aug- mentation of the anterior mandible. This procedure avoided donor site morbidty, and resulted in less oper- ational discomfort. The dimensions of the graft were ideal for lateral augmentation, so that there was no need for any addi- tional carving of the bone block. As mean bone gain after healing of the autogenous graft was 3.6 mm in our patient, it was slightly smaller com- pared to the average bone gain of 4.3 mm, as reported in a systematic review by Jensen and Thilander in 2005.5-6 But was comparable to the findings of a recent review by Sanz- Sanchez et al., showing a mean bone gain in horizontal defects of 1.9–3.7 mm in a staged approach.7 Nonetheless, we gained enough bone volume for insertion of four standard di- ameter implants. Considering the fact that the fixation screws had to be removed, and with regard to a number of benefits of a delayed im- plant placement in augmented de- ficient alveolar ridges, we opted for a two-stage protocol. Even though delayed implant placement with flap elevation required a second sur- gical intervention and therefore an additional burden for the patient, it comprised the additional advantage of a visual and tactile assessment with respect to the osseointegration of the autograft in our patient case. Another crucial advantage of the staged approach comprised inter alia the possibility for an implant placement in an ideal position for the later prosthetic restoration un- der visual control.8 Another reason for open access for implant place- ment was the use of non-removable microscrews for the stabilisation of the bone graft. The decision to utilize

Fig. 8: The graft was fixed with four miniscrews.

Fig. 9: The osseous graft was covered with a PRGF membrane and a barrier membrane for GBR.

Fig. 10: Sufficient horizontal ridge dimensions after a healing period of four months.

Fig. 11: The CBCT shortly before re-entry demonstrated a significant gain of bone vol-

Fig. 12: The flap elevation, a good osseointegration and stablisation of the autograft was noticed.

Fig. 13: After the fixation screws were removed, the four implants with a diameter of 3.75 mm and a length of 11.5 mm were inserted epicrestally without a surgical guide.

Fig. 14: After three months of submerged healing, a successful implant osseointegration without bone resorption was visible on the panoramic X-ray.

Fig. 15: After uncovering the implants, an Edlen-Mejchar plastic surgery was performed to deepen the vestibulum.

Fig. 16: After uncovering the implants, an Edlen-Mejchar plastic surgery was performed to deepen the vestibulum.

Fig. 17: Aspect after plastic surgery.

Fig. 18: The graft was fixed with four miniscrews.

Fig. 19: Aspect after plastic surgery.
Dentsply Sirona Implants presents the next step in the continuous evolution of the Astra Tech Implant System®. The Astra Tech Implant System EV® is designed with a site-specific, crown-down approach based on the natural denition for increased surgical simplicity and flexibility and restorative ease — without compromising the unique Astra Tech Implant System BioManagement Complex®.

The main objective of the new system is to further improve system logic, robustness and user friendliness, and simplicity without compromise has permeated the evolution of the Astra Tech Implant System EV®. The new system is also the result of collaborative work and insights from dental professionals throughout the global dental industry.

“When we develop new implant therapy solutions, it is important that they meet actual clinical needs. With our solutions, clinicians are able to solve these various challenges and, as a result, they can deliver long-term function and aesthetics to their patients. Our focus is to deliver safe, well-documented solutions and the best service to our customers,” says Björn Delin, DDS, and Vice President Global Platform Implant Systems at Dentsply Sirona Implants.

The foundation of this evolutionary step is the unique Astra Tech Implant System BioManagement Complex®, well documented for its long-term marginal bone maintenance and aesthetic results provided by the combination of four key features: the OsseoSpeed surface, MicroHed, Conical Seal Design and Connective Contour.

As the combination of autogenous grafts with guided bone regeneration (GBR) is apparently associated with superior outcomes, we decided to use a barrier membrane. With the additional application of a PRGF membrane, we aimed to utilise the beneficial effects of platelet-derived rich plasma for an advanced wound therapy, and the reduced risk of post-operative infection. The vascularisation with the Edlan-Mejchar method was performed for two purposes: Firstly it was done in order to create a sufficient amount of keratinised mucosa. According to findings of a systematic review, published by Lin et al., a lack of keratinised mucosa around implants fosters plaque accumulation, inflammation, and soft-tissue recession. Secondly we aimed to create enough space for the final overdenture.

Conclusion

The staged approach with the use of an autogenous bone graft, harvested from the surgical site in the anterior mandible, resulted in a significant horizontal bone gain, and took to a good osseointegration of both, aug- toplast and implants. Obviously, the described grafting procedure has not been previously reported in literature. Despite the lack of any experi- ence reports, our method revealed nonetheless a successful rehabilita- tion with an implant-supported, screw-retained prosthetic rehabilita- tion, and is still in function without any biological or technical problems after a three-year follow up.

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1 Schlieguth E, Noekelen R, Moergel M, Berres M, Wagner W. Survival and overall survival rate, soft and hard tissue maintenance following placement in healed sites of the posterior man- dible: Twenty-four centers, 184 pa- tients and 288 implants were includ- ed in the study that showed >99% overall survival rate and an average bone level reduction of 0.3 mm.

The SmartFix® concept

SmartFix® is a treatment concept that can provide edentulous patients with an immediately fixed, full-arch prosthesis, supported by only four implants. The SmartFix® concept includes an augmented abutment that comes together with a short and flexible abutment holder for easier handling. The option of angulating the screw access channel through the prosthesis opens up for ideal aes- thetics and function.

This concept is an easy and cost-effective treatment that offers im- proved treatment satisfaction for the patient and practice growth for the dental professional.

SmartFix® is available for the Astra Tech Implant System® EV, including OsseoSpeed Profile implant. For more information and highlights of the new Astra Tech Implant Sys- tem® EV, please visit www.dentsply-implants.com

**Fig. 18:** Facial view of the bar construction and PS TiBA abutments.

**Fig. 19:** Oral view of the bar.

**Fig. 20:** After an additional healing period of one month after mucogingival surgery, the bar was inserted.

**Fig. 21:** Final prosthetic restoration of the upper and lower jaw.

**Fig. 1:** Astra Tech Implant System BioManagement Complex®.

**Fig. 19:** OsseoSpeed Profile implants. Almost 40% of all implant sites pre- sent with a sloped alveolar ridge after healing. The Os- seoSpeed Profile EV implant (Astra Tech Implant Sys- tem) is a uniquely shaped, patented implant specifi- cally designed for just this clinical situation. It is de- signed to follow the natural shape of the bone, supporting the soft tis- sue by preserving marginal bone loss degrees around the implant. In addition, it can help to eliminate the need for bone augmentation proce- dures. 93% of all implants in sites have a reduced need for augmenta- tion when using the OsseoSpeed Pro- file implant.

OsseoSpeed Profile EV is the second generation of the uniquely shaped, patented implant specifically de- signed for sloped ridge situations that was first introduced in 2011. The implant is now upgraded with the simplicity and design principles of the Astra Tech Implant System® EV. Newly published results on Osse- oSpeed Profile implants show bone preservation, increased soft tissue volume and regain of keratinized mucosa in patients with compro- mised soft tissue conditions. PD Dr. Robert Nolken, co-author of the study, explains: “We have seen a great deal of improvement on the peri- implant soft tissue in our research follow up. This allows us to achieve a good aesthetic outcome for patients with thin biotypes.”

This prospective, 2-year follow-up, multicenter study— investigated OsseoSpeed Profile EV implant survival, soft and hard tissue maintenance following placement in healed sites of the posterior man- dible: Twenty-four centers, 184 pa- tients and 288 implants were includ- ed in the study that showed >99% overall survival rate and an average bone level reduction of 0.3 mm.