Augmentation and implant treatment

Two-stage surgery in the severely resorbed edentulous mandible

By Dr Marko Nikolic, Croatia

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 intracranial areas like the retrosphenoidal 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 complications 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 intracranial bone harvesting can be performed ambulatory and under local anaesthesia.1,2

The main problem with autogenous bone grafting 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 jaw and in the upper jaw. The remaining five teeth 32–35 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 progressive chronic periodontitis; insufficient root treatments and prosthetic superstructures 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, Schutzwald, 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 12.0–14.0 mm in the implantation zone. The CBCT-Scan revealed a horizontal cortical bone thickness of 1.09 mm in region 32 and 1.39 mm in region 44.

Treatment planning and augmentation procedure
After patient-consultation, we opted for a twostage surgery with an intracranially 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 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 maxilofrontal 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, Helmut Zepf Medizintechnik GmbH, Seetens-Oberricht, Germany, Fig. 5). Subsequently, the graft was detached from the anterior mandible.
ble with chisel (Bone splitting system, Helmut Zepf, Medizintechnik GmbH, Settingen-Oberlacht, Germany). Fig. 6) and a cortico-cancellous 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, Emmingen-Lippingen, Germany). Fig. 8). A combination of autogenous bone chips and particulated xenograft (Bego Oss, Bego Implant Systems, Bremen, Germany) was placed in the small remaining 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 planatex in growth factors (PiFOS) membrane (BTI Biotechnology Institute, Blue Bell, USA) and additionally with a barrier membrane for guided bone regeneration (GBR, Bio-Gide, Geistlich Biomaterials Vertriebsgesellschaft mbH, Baden-Baden, Germany; Fig. 9). The healing of the graft was uneventful and without any complications, like membrane exposure, being classified as a frequent post-operative complication. The patient was provided with a removable provisional prosthesis.

Re-entry and implant surgery

The re-entry for the delayed implant placement protocol was planned after 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 significant gain of bone volume in the interforaminal region of the mandible after augmentation. The horizontal thickness of the crestal alveolar bone was 5.53 mm in region 44 and 4.43 mm 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 regions 32 respectively, representing a mean bone gain of 3.6 mm (Fig. 11). After elevating the flap, an apparently good osseointegration 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 were inserted epicrestally without a surgical guide.

Discussion

In our case presentation, the patient suffered from an extremely horizontal bone resorption, resulting in a 10–15 mm thin, and knife-edged alveolar crest. Since standard-sized dental implants need a certain bone volume for an adequate stabilisation and a good predictability in osseointegration, augmentation procedures had to be performed prior to implant treatment.

A recently published meta-analysis showed that dental implant survival has probably to be seen independently of the biomaterial used in augmentation procedures. Since this evidence is limited by the fact, that defect size, augmented volume, and regenerative capacity are scarcely well described in literature, autogenous bone is still recommended as the ‘gold standard’ for augmentation in the deficient alveolar crest. Subsequent simultaneous grafting and augmentation is the standard procedure in ridge augmentation, resulting in an extended operating time.

Fortunately, as the vertical dimension of the anterior mandible was high enough in our clinical case, we were able to harvest an adequate autogenous bone block from the thin alveolar crest, in order to use it as an onlay graft for the horizontal augmentation of the anterior mandible. This procedure avoided donor site morbidity, and resulted in less operating time and a reduced patient discomfort. The dimensions of the graft were ideal for lateral augmentation, so that there was no need for any additional 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 compared to the average bone gain of 4.3 mm, as reported in a systematic review by Jensen and Terheyden in 2009, 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 mm in a staged approach. Nonetheless, we gained enough bone volume for insertion of four standard diameter implants. Considering the fact that the fixation screws had to be removed, and with regard to a number of benefits of a delayed implant placement in augmented deficient alveolar ridges, we opted for a two-stage protocol. Even though delayed implant placement with flap elevation required a second surgical 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 a ideal position for the later prosthetic restoration under visual control. Another reason for open access for implant placement was the use of non-resorbable microscrews for the stabilisation of the bone graft. The decision to utilise...
non-resorbable titanium screws in favour to resorbable screws out of poly (D,L-lactide) acid, was supported by the findings of a systematic review of the Cochrane Collaboration. Thus, resorbable screws seem to have a high susceptibility for fracture during fixation of osseous grafts.

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 PRCF 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 vestibuloplasty 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 Lim 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.

Conclusions

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- tograf 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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By Dentsply Sirona Implants

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 dentition 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 sys- tem is to further improve system log- ic, robustness and user friendliness, and simplicity without compromise has permeated the evolution of the Astra Tech Implant System IV. The new system is also the result of collaborative input 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 Bjørn Delin, DDS, and Vice President Global Platform Implant Systems at Dentsply Sirona Implants.

The foundation of this evolution- ary step is the unique Astra Tech Implant System BioManagement Complex®, well documented for its long-term marginal bone mainte- nance and aesthetic results provided by the combination of four key fea- tures: the OsseoSpeed surface, Mi- croThread, Conical Seal Design and Connective Contour.

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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 Osseo- Speed Profile implants show bone preservation, increased soft tissue volume and regain of keratinized mucosa in patients with compre- hensive soft tissue conditions. P1 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—a investigative OsseoSpeed Profile EV implant survival, soft and hard tissue maintenance following placement in healed sites of the posterior max- illible. Twenty-four centers, 184 pa- tients and 218 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 immediate fixed, full-arch prosthesis, supported by only four implants. The SmartFix® concept includes an angulated 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 aesth- etics 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® IV, including OsseoSpeed Profile EV.

References


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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 muco-gingival surgery, the bar was inserted.

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

Fig. 23: Final prosthetic restoration of the upper and lower jaw.

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