

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.^{2,3} 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.³

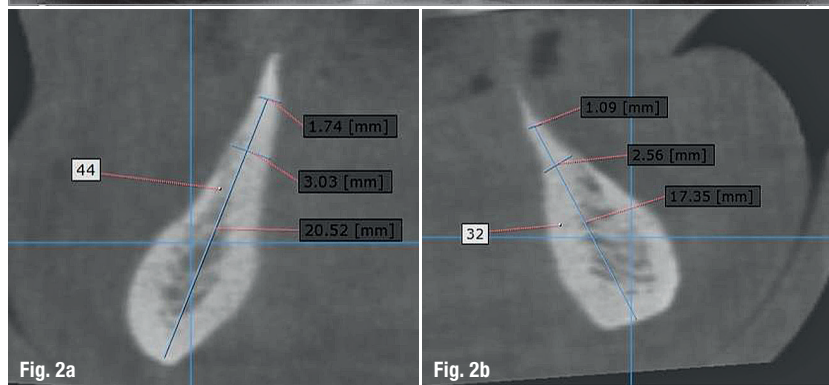
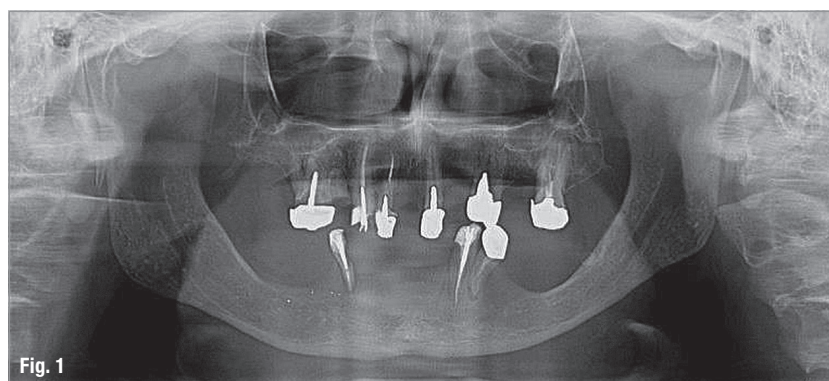
The aim of this case presentation is to demonstrate a predictable, two-stage operating protocol for the horizontal augmentation of the severely resorbed, edentulous anterior mandible with an autogenous bone graft, harvested from the crestal alveolar ridge at implant site, in order to create a sufficient 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.

Fig. 1: Pre-operative panoramic X-ray: poor periodontal and prosthetic conditions.

Figs. 2a and b: Pre-operative CBCT: aspect of the extremely horizontally resorbed alveolar ridges of the anterior part of the mandible.



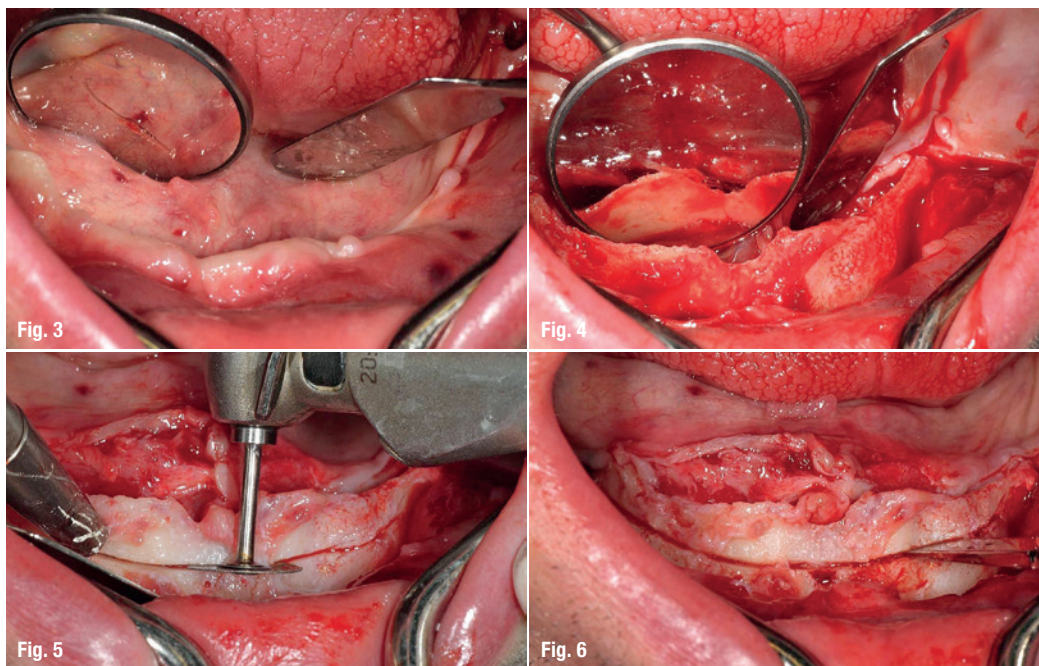


Fig. 3: Pre-operative clinical aspect of the anterior alveolar ridge.

Fig. 4: After elevation of the mucoperiosteal flap, the sharp-edged alveolar ridge becomes visible.

Fig. 5: Preparation of the osseous graft with the microsaw.

Fig. 6: Detachment of the graft with a chisel.

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.⁴ In comparison, three-dimensional (3-D) diagnostic tools like cone beam computed tomography (CBCT) offer the advantage of the visualisation of the so called 'z-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 & 3). 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 1.0–3.0 mm in the implantation zone. The CBCT-Scan revealed a horizontal crestal bone thickness of 1.09 mm in region 32, and 1.74 mm in region 44.

Treatment planning and augmentation procedure

After patient-consultation, we opted for a two-stage surgery with an intraorally 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 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, Helmut Zepf Medizintechnik GmbH, Seitingen-Oberflacht, Germany; Fig. 5). Subsequently, the graft was detached from the anterior mandible with chisel (Bone splitting system, Helmut Zepf, Medizintechnik GmbH, Seitingen-Oberflacht, 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 (Storz am Mark GmbH, Emmingen-Liptingen, 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 process, as well as around and on the bone graft. The augmented site was covered with a platelet rich in

Fig. 7: Aspect of the bone harvest.

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

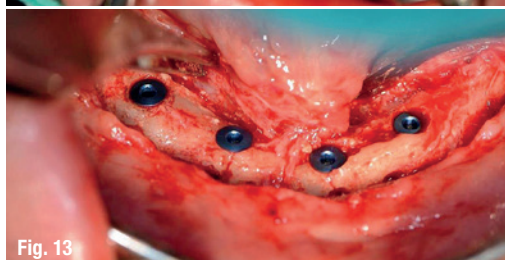
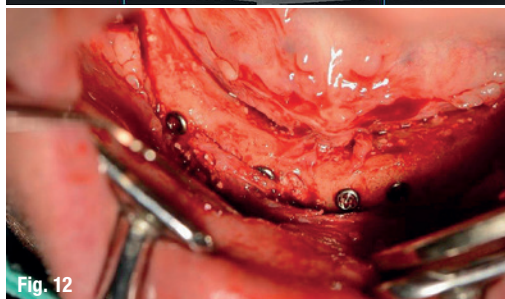
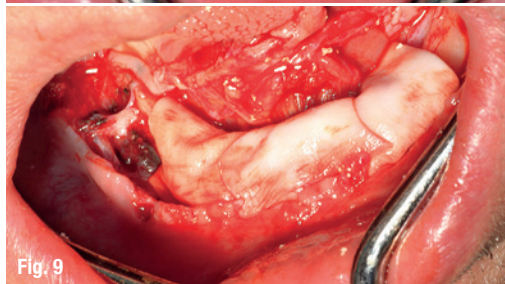
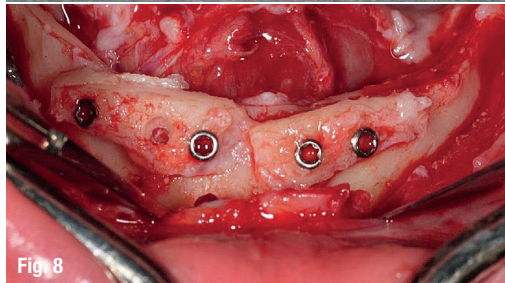
Fig. 9: The osseous graft was covered with a PRGF membrane and a barrier membrane for GBR.

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 volume after augmentation.

Fig. 12: After flap elevation, a good osseointegration and stabilisation 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.



growth factors (PRGF) 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.⁵ 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 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 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 (BEGO Semados® RSX, BEGO ImplantSystems) were inserted epicrestally in regions 33, 31, 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.

Pre-prosthetic surgery and prosthetic rehabilitation

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 decided for an enlargement of the ratio between attached and free gingiva by performing muco-gingival surgery with the Edlan-Mejchar method (Figs. 15, 16 & 17). After an additional healing period of one month, the final bar retained, a removable acrylic overdenture was incorporated. The bar was constructed with bar abutments (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 horizontal bone resorption, resulting in

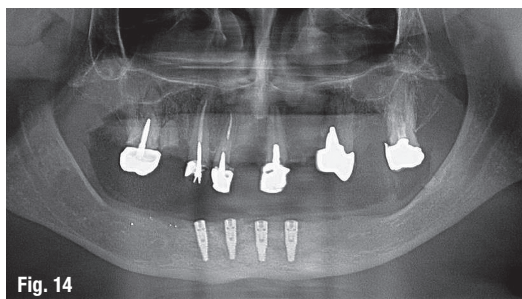


Fig. 14

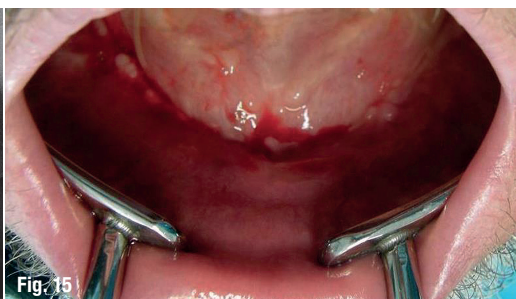


Fig. 15



Fig. 16

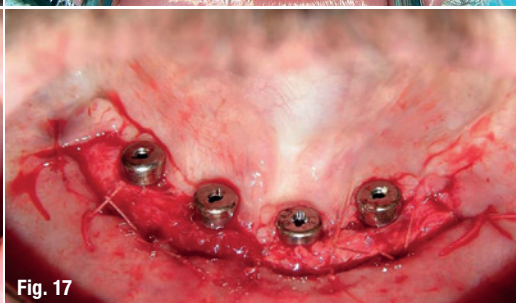


Fig. 17

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

Fig. 15: Soft-tissue condition of the anterior alveolar crest at the time of implant-uncovering: lack of keratinised gingiva.

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

Fig. 17: Aspect after plastic surgery.

a 1.0–3.0 mm thin, and knife-edged alveolar crest. Since standard diameter dental implants need a certain crestal bone volume for an adequate stabilisation and a good and predictable osseointegration, augmentation procedures had to be performed prior to implant treatment.⁶

A recently published meta-analysis showed that dental implant survival has probably to be seen independently of the biomaterial used in augmentation procedures.^{7,8} 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 ridge. Simultaneous grafting and augmentation is the standard procedure in ridge augmentation, resulting in an extended operating time.³

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 2009,⁵ but was comparable to the findings of a recent review by Sanz-Sanchez et al., showing a mean bone gain in horizontal defects of 3.9 mm in a staged approach.⁹ Nonetheless, we

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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. 18



Fig. 19



Fig. 20



Fig. 21

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 an ideal position for the later prosthetic restoration under visual control.⁵ 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.⁶ Thus, resorbable screws seem to have a high susceptibility for fracture during fixation of onlay 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.⁹ 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.¹⁰ 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 Lin et al., a lack of keratinised mucosa around implants fosters plaque accumulation, inflammation, and soft-tissue recession.¹¹ 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, autograft and implants. Obviously, the described grafting procedure has not been previously reported in literature. Despite the lack of any experience reports, our method revealed nonetheless a successful rehabilitation with an implant-supported, screw-retained prosthetic rehabilitation, and is still in function without any biological or technical problems after a three-year follow up.

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Editorial note: A list of references is available from the publisher.

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