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 1.0mm 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 in the upper jaw are considered to be sufficient for treatment with standard-diameter implants without the urgent need of any horizontal bone augmentation.

Distant donor sites like the anterior and posterior iliac crest and introral areas like the retromandibular and the interfemoral 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 introral bone harvesting can be performed ambulatory and under local anaesthesia.1-3

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.1

The aim of the 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 gingival chronic periodontitis, insufficient root treatments and prosthetic suprastructure 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 bone 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. buccal-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 patients 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 (Fig. 2 a & b).

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 1.0–2.0 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 intraradically 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 corticoc cancellous bone-graft for horizontal augmentation in the anterior alveolar ridge. This protocol was employed from 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 mucoperiostal 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 (re-
Pre-prosthetic surgery and prosthetic rehabilitation

After three months of uneventful submucous 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 to show an adequate ratio between attached and free gingiva by performing mucogingival surgery (Figs. 15, 16 & 17). After an additional healing period of one month, the facial bar was screwed onto the four implants (Figs. 18, 19 & 20).

Discussion

In our case presentation, the patient suffered from an extremely horizontal bone resorption, resulting in a 10–15 mm gap in the midline and the alveolar ridge. Since standard diameter 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.

A recently published meta-analysis showed that dental implant survival has probably been seen independently of the biomaterial used in augmentation procedures. Since this evidence is limited and of low evidence level, the defect size, augmented volume, and regenerative capacity are scarcely evaluated. The 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.

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 ad- ditional carving of the bone block. As mean bone gain after healing of the autogenous graft was 6.7mm in our patient, it was slightly smaller compared to the average bone gain of 4.0mm, as reported in a systematic review of Jensen and Thomsen in 2003. It was comparable to the findings of a recent review by Sanz-Sanchez et al., showing a mean bone gain in horizontal defects of 3mm 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 of the osseointegration of the autograft in our patient case. This was crucial advantage of the staged approach comprised in alia the possibility for an implant placement in an ideal position, both for our own and for the patient's 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(Lactic acid) was, supported by the findings of a systematic review of the Cochran Collaboration.

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 already associated with superior outcomes, we decided to use a barrier membrane for the patient, it was less prone to disintegration and was still in function without any biological or technical problems after a three-year follow up.

Special thanks to Dr Pantelis Petrelakis

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, autogenous and xenograft. However, 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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The Full Arch Promise

By Dr Frank R. LaMar Jr., USA

When patients seek dental implant treatments, not only do they bring specific needs, they also bring hope. Health care marketing today has only increased these expectations, and has set up more doctors to fail to meet them. Not because they aren’t capable, but because they haven’t reset their patients’ expectations at the beginning. Many dentists end up struggling to fulfill their own promises, and it can ultimately impact their reputations for years to come.

The Promise of Great Teeth, Right Away

One of the biggest challenges we face as dentists is our patients’ expectations of immediacy. Throughout their lives, consumers have been delivered things fast. Fast food, overnight delivery, two-day gift delivery, from across the globe. People have been trained to believe that fast is best. This has become true in the dental implant / full arch delivery space as well, despite the fact we know that the human body requires time to heal and adjust. Biology just hasn’t kept up with the 24-hour-turnaround promise as simply as they had envisioned. That first denture conversion? It was just step one of what turns out to be a multi-step process. Teeth right away… plus nine months. A little bit longer than the patient had originally thought.

In addition, healing and prosthetic failures are more common in impatient, load cases. The lost time and patient inconvenience often creates a less than ideal sense of a dentist’s satisfaction with this part of the practice. By taking the fast track, patients ultimately spend more time in their chair, reducing your profitability. You end up marrying an unhappy patient, working hard to satisfy them – every extra minute in your chair leading to additional frustration for you both.

The Risk to Our Reputations

Patients rely on us to help them expand their understanding of the full arch process, and especially of what is healthy. When we don’t reset expectations, explain the best way to achieve optimal results, and then deliver to those promises, patients have every right to be unhappy. Unfortunately, practitioners don’t only prey with increased unprofitable chair time – patients hold our reputations in their hands.

Today, dental services and other health care providers are ranked online along with car dealerships and dry cleaners. Negative word of mouth harms our reputations, but bad reviews and horror stories shared online can not only affect perceptions, but also search engine results – for all to see.

What Patients Really Want

When we first meet with patients – regardless of why they say they’ve come to the office – we should ask what their ultimate goals are. Their top answers shouldn’t surprise you: a natural look; the ability to eat all types of foods; and long-lasting implants with a biologically active coating could be used for polymeric and titanium implants, which are employed in implant dentistry, as well as orthopaedic and oral surgery. Therefore, the Russian scientists hope that their development will be universally applicable in implantology. Currently, they are at the stage of synthesizing the compound and are conducting experiments to determine its optimal composition. The research project has received the support of the Russian Foundation for Basic Research and was a gold medal at the RusBioTech international exhibition in 2016, according to the university.

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Bioactive implant coating stimulates healing process

By DFI

TOMSK, Russia: One of the reasons for dental implant failure is rejection of the implant owing to the body’s immune response. Immune cells identify the implant as a foreign body and cause inflammation and finally rejection. A new bioactive coating for medical implants, developed by Russian scientists, may be able to invert this immune mechanism and encourage healing around the implant.

Scientists at Tomsk Polytechnic University have proposed solving the issue of implant rejection by coating implants with a biologically active compound that is an analogue to the cytokine interleukin-4. This substance stimulates the behaviour of the innate immune cells, the macrophages, forcing them to stimulate the healing process instead of rejecting the implant.

“A feature of macrophages is their enormous plasticity: under different conditions the same immune cells can either fight the implant or, conversely, stimulate the healing process. We are trying to synthesize these compounds, which could force macrophages to differentiate into a positive phenotype,” said project manager Ksenia Stankovich, a PhD student at the Department of Biotechnology and Organic Chemistry at the university’s Institute of High Technology Physics.

According to the researchers, the coating could be used for polymeric and titanium implants, which are employed in implant dentistry, as well as orthopaedic and oral surgery. Therefore, the Russian scientists hope that their development will be universally applicable in implantology. Currently, they are at the stage of synthesizing the compound and are conducting experiments to determine its optimal composition.

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Novel implant coating could facilitate bone integration

By DTI

LEIOA, Spain: Oral infections are regarded as the main reason that dental implants fail. Spanish researchers are currently developing antibacterial implant coatings that are capable of preventing and eliminating potential bacterial infections while providing the implants with osteointegration properties.

The quest for surfaces that are capable of preventing bacterial colonisation and adhesion in the areas surrounding the implant “is a subject of undoubted interest, borne out of the huge number of studies that have been undertaken in this field.” according to Beatriz Palla, researcher at the Biomedical Group of the Department of Polymer Science and Technology at UPV/EHU-University of the Basque Country. “About 10 per cent of implants have to be removed due to osteointegration problems or because of the onset of infection,” she explained.

When designing strategies to combat these problems, the challenge is to give the surface of the titanium implant antibacterial properties, while simultaneously overcoming the tremendous resistance that bacterial strains are capable of developing against conventional antibiotics. “We have already created coatings that facilitate bone generation around the implant, thereby facilitating anchoring to the bone. In a bid to go a step further, we looked at how we could turn these coatings into bactericides,” said the Palla.

The Spanish researchers used sol-gel synthesis to tackle the problem. This process, when combined with the preparation of a precursor solution (sol), which, if it is left on its own for a while, turns into a gel that can be used to coat the surface of the titanium screw. After heat treatment at a high temperature in the kiln, it adheres to the screw that will be implanted. “We used titanium as the precursor, because in many studies this compound has shown to be osteoinductive, so it meets one of the objectives that we wanted to achieve. What's more, in order to provide the materials with antibacterial characteristics, we added various antibacterial agents”.

In a related study, Palla developed three types of coatings using various antibacterial agents. Each of the coatings are able to tackle bacterial infections, either prophylactically by preventing the bacteria from adhering initially or against subsequent infection by eliminating it as soon as it develops.

One of the requirements of the prophylactic coating was to create “a material with a very long degradation time so that it would adhere to the screw and work for as long as possible, while preventing bacteria from adhering,” said Palla. In the coatings that were designed to eradicate an infection that has already taken hold, however, “a rapidly degrading material is needed so that it can release the antibacterial agent as quickly as possible to attack the infection”. Furthermore, one of the coatings that were developed for this purpose “is designed to be used in situ, at the dentist’s surgery itself, on the infected screw without any need to extract the implant from the patient”. This new material is in the process of being patented and remains a trade secret, the researcher stated.

In view of the results, Palla believes that “it is possible to confirm that coatings with antibacterial capabilities, which do not affect the proper integration of the implant into the jawbone, have been developed”. However, she also admits that there is still a long way to go until these can be applied and used at dental surgeries. She explains that “apart from all the trials that remain to be carried out, it would also be advisable to further pursue the research a little in order to optimise the results”.

The study, titled “Control of the degradation of silica sol-gel hybrid coatings for metal implants prepared by the triple combination of alkoxysilanes”, was published in the December 2016 issue of the Journal of Non-Crystalline Solids.