

Titanium granules for contour enhancement of the alveolar process

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For augmentation of buccal osseous defects on late implant placements non-resorbable white titanium granules were used and placed between the mucoperiosteal flap and the bone after having been mixed with the patient's blood. No membrane was used. In the 28 month follow-up the results are both stable and aesthetically satisfactory.



Fig. 1: Loss of the buccal alveolar wall.

The collapse of the alveolar process is frequently a problem when trying to achieve optimal aesthetics of implant-supported restorations (Fig. 1). Especially in the case of late implants, a more or less evident soft and hard tissue deficit is observed [2, 10, 11]. In the case of planned extractions, various techniques are attempted in order to counteract bone resorption. This may include changing the timing of the implant placement: In many cases a so-called delayed immediate placement after the recovery of the soft tissue

will be performed. In the appropriate indications, there may be immediate implant placement, possibly with additional augmentation may be employed. The objective is to maintain the correct shape of the alveolar process [3, 7]. This buccal contour of the alveolar process is one of the seven rating criteria using the Pink Esthetic Scores (PES) by Führhauser for assessing the aesthetic success of an implant-supported restoration. Besides the purely aesthetic aspects, the preservation of the masticatory function also makes the maintenance or reconstruction of the alveolar process contour necessary. If a stricture remains in the apex of an integrated crown, food leftovers may become trapped and should be removed by the patient. In daily practice, as generally recommended in earlier times, late implant placement is performed in many cases in which the bone resorption has already taken place. In these cases, there are various techniques for the correct three-dimensional placement of implants, and also for simple contour enhancement: Bone and connective tissue grafts as well as synthetic bone materials may be used possibly in combination with membranes.

Here a simple contour enhancement with titanium granules as the synthetic bone material is described. All implant placements took place in the locally remaining bone.

Material and method

Titanium granules (Tigran™ PTG) were first used in orthopedic surgery for the fixation of cement-free hip joint prosthesis. The titanium granules (pure titanium grade I, 80% porosity) displayed a high initial mechanical stability; and were, due to their porous structure, the guide rails of bone regeneration with complete particle inclusion and had very good

long-term results at high mechanical loads for this indication [1, 6, 19]. These good results were obtained also in experimental animal studies (hemi-arthroplasties), in which it could be shown that the newly-formed bone grew through the porous particles surrounding the prosthesis and direct contact

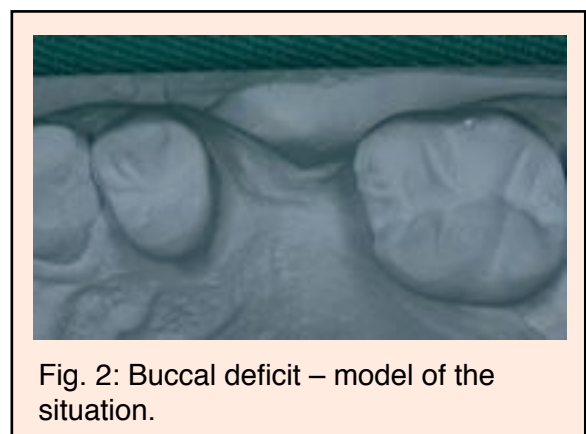




Fig. 3: Buccal deficit – clinical appearance in the mirror.

(osseointegration) between bone and prosthesis was evident [20]. The great advantage of the titanium granules is its long-term dimensional stability. The long-term dimensional stability of the granulate is being verified currently in a randomized study of lateral tibial plateau fractures. Preliminary results from this study indicate excellent radiological results [15]. The good biocompatibility of the material is also evident in more

recent experimental investigations, for example on human mesenchymal stem cells [13, 17, 25].

In the field of dental surgery, the granulate was first implanted in 1995 for filling the atrophic upper maxilla following a bone splitting technique, and its successful use was documented over a period of approximately 12 years [14].

Since then, the material has been used in various dental and oral surgery indications, for which either resorbable or non-resorbable synthetic bone materials were previously used: Filling of cyst cavities and extraction sockets, one- or two-step sinus lift operations, filling of peri-implant defects following decontamination of the implant surface, etc. [4, 5, 8, 9, 12, 16, 18, 21, 22, 23, 24, 26].

Given the wide range of applications, the

titanium granules are fortunately not only available in its original grey color, but also in an oxidized white form. As discolourations of the mucous are thus avoided, the material can also be used in visible areas. Structure and the particle size are the same for both the grey and the white material.

38 patients with late implant placement (Fig. 2 and 3) had their buccal alveolar processes re-contoured with Natix® white (Tigran Technologies AB, Malmö, Sweden) directly after implant placement. After opening a

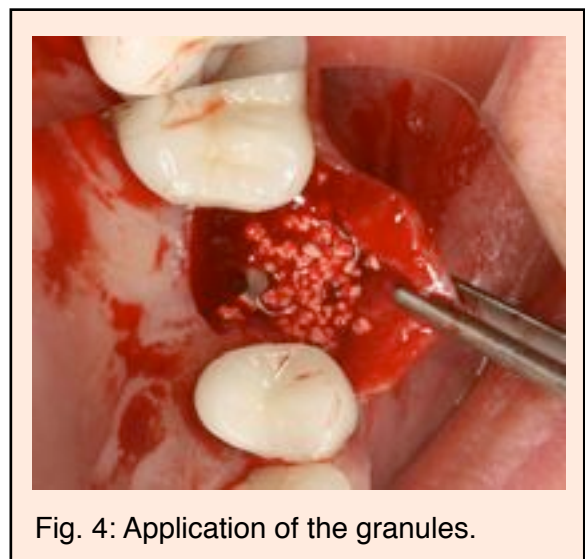


Fig. 4: Application of the granules.



Fig. 5: The situation before molding.

mucoperiosteal flap across the entire resorbed area without vertical releasing incisions, a periosteal slitting was performed apically at the base of the flap in the area to be augmented. The slitting was therefore not located over the augmentation placed later on. The slitting is necessary for a stressless closure of the wound and should always be verified

prior to introducing the granules. The granulate are mixed with blood from the defect, or, if necessary, with the patient's venous blood at the ratio of 1:1. After waiting around 1 minute, the granules will stick together and can be placed with an appropriate instrument in portions between bone and the mucoperiosteal flap (Fig. 4) and corresponding of the planned contour of the alveolar process. Perforation of the compact bone underneath was avoided. The stressless closure of the wound was done with simple interrupted sutures. In the absence of complications, the sutures were removed 7 days after surgery. For all patients, the implants were exposed after a healing time of 3 months. The Astra Tech implants with conic fit of the gingiva former were used in all cases; hence an incision was executed above the implant in order to expose it, so that the locking screw could be replaced via the self-centering gingiva-former without any additional mobilization of the soft tissue. After the soft tissue had healed (Fig. 5) within 2 to 4 weeks, an impression was taken at the level of the implant. The mould was created according to the current generally accepted rules with flexible gingival mask without saw incisions (Fig. 6). The compensation of the buccal bone deficit is already evident on the mould. Only individually shaped Atlantis abutments were used for



Fig. 6: Master model with soft tissue.



Fig. 7: Control image for the abutment design.



Fig. 8: Crown inserted (mirror).

prosthetic maintenance (Fig. 7). The "preparation borders" were all located isogingival or 0,5 mm subgingival, so that surpluses from cementation could be safely removed (Fig. 8). Intra-oral x-rays (Fig. 9) were taken of all implants following the integration of the dental prosthesis (baseline).

Results

The buccal defects of all patients were sufficiently corrected: There was no indentation apically from the restoration. No discoloration of the covering soft tissue was observed with the use of the white titanium granules. Over an observation period of 28 months, no visible size changes occurred, which was to be expected when using a non-resorbable augmentation material. No inflammatory changes around the implants with buccal augmentation with titanium granules have occurred so far.



Fig. 9: Intraoral radiograph.

Discussion

Synthetic bone materials used so far are subject to different resorption rates. The result is a change in the size of the augmented area. The titanium granules used is a material that displays good bone consolidation as well as long-term dimensional stability both in animal and in clinical studies. The good bone integration takes place due to the structure of the granulate (80% porosity and 20% commercially pure titanium). Due to the high porosity, the actual amount of titanium is relatively low. As the results from orthopedic surgery show, the material has shape stability in areas with high mechanical loads as well. Due to no resorption, the titanium granules remain radiologically visible, so that its behavior can be documented long term.

Conclusion

Easier handling, good aesthetic and functional results can be achieved with the non-resorbable titanium granules within the observation period. It would be desirable to obtain this material also in smaller sizes in order to save costs for single implants.

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