Localized bone regeneration with porcine bone graft: clinical and histological evidences

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Summary
Localized bone regeneration with porcine bone graft: clinical and histological evidences. The presence of localized bone defects in the alveolar process can impede the use of implants because of insufficient bone volume for osseointegration. Localized reabsorption of bone can also prevent a good aesthetic result due to the scarce bone support of the gums. Autologous bone grafting is considered the gold standard, but it has disadvantages for the patient, such as the need of a donor site and the risk of morbidity. The use of alloplastic, allogenic or xenogeneic grafts has become an attractive alternative. A recent study in the rabbit maxilla has demonstrated that porcine bone graft has strong osteoconductive properties and is remodeled and replaced with new bone over time. The aim of the study is to describe a technique for reconstruction of localized defects to enable installation of implants and to support the gums in order to obtain a satisfactory aesthetic result. The augmentation of the bone is evaluated also from a histological point of view.

Keywords: dental implant, bone regeneration, xenogenic grafts, porcine bone.
regenerate the defects.

However, most of the membrane are not able by themselves to create an adequate space for the bone regeneration. Though, for the alveolar ridge augmentation, the autologous bone grafting, in blocks or particulate, represents the gold standard, alternative materials as xenografts, alloplastic bone and allografts have been suggested and studied.

The search of alternative materials comes from the need to avoid to the patient the discomfort of a second surgical site, the donor site, so reducing the invasiveness of the procedure and the morbidity of the postoperative period.

A recent study in the rabbit maxilla demonstrated that the porcine bone graft has strong osteoconductive properties and is remodeled and replaced by new bone over the time.

Aim of this study was to describe the clinical, radiographic and histological results obtained with the use of granules of porcine bone (OsteoBiol Gen OS, TecnoSS, Italy) mixed with a collagen gel and covered by a cortical lamina.

Methods and Materials

In order to evaluate the efficacy of the proposed protocol, two patients have been selected with a bone deficit, of horizontal and partially vertical type, at the first upper premolar. As both the bone defects were very large, we preferred to perform the regeneration procedure in two stages: bone regeneration and waiting time of 6 months, insertion of implants with a healing period of at least 4 months before the uncovering and the positioning of the abutment.

The area to be regenerated is filled with a mixture of collagen gel (OsteoBiol Gel, TecnoSS, Italy) together with collagenated bone of porcine derivation (OsteoBiol Gen OS, TecnoSS, Italy).

This particular mixture has allowed a better graft control, thanks to the characteristic of a better malleability of the product obtained and to its particular adhesiveness.

The main objective of the proposed protocol was to preserve ad adequate space for the regeneration of new bone; this was obtained by the use of a supporting screw beneath the bone cortical lamina (OsteoBiol Soft Cortical Lamina, TecnoSS, Italy).

The lamina was stabilized on the vestibular side by two osteosynthesis mini screws (length 5mm, diameter 1,2mm; Graftek fixation screws, Roen); while, on the palatine side, was positioned beneath the mucoperiosteal flap.

After 6 months, at the end of the healing period, we inserted an implant with a bimodal surface, a positive tolerance geometry and taper of about 1° (Neoss Italia). After the insertion of the implant, at the uncovering stage and before the positioning of the final abutment, we measured the ISQ value (Implant Stability Quotient, Osstell Mentor) that is the value of the resonance frequency, which is linked to the stiffness of the titanium bone complex. The preparation of the implant site was performed with a Trephine bur (Maillefer) with an internal diameter of 2mm and external of 3mm.

The bur, together with the bone harvested, was immersed in a buffered solution of 4% of formaldehyde and sent to the Biomaterials Department of the Institute of Surgical Sciences (Sahlgrenska Academy, Göteborg University, Svezia) for the histological evaluations.

The specimens have been dried with following steps in different alcohol gradients and, after this, included in lightcuring resin. With a little saw and a grinder we cut sections of about 10-15 μm and then colored with blue of toluidine and observed under microscope.
First case report

A 56 years old female patient, affected by edentulism in the 1.4 area, presented an inadequate bone volume, both vertically and horizontally, for the insertion of an implant. Consequently, we decided to perform, before the insertion of the implant, a reconstruction of the bone defect through GBR (Figures 1 and 2).

Under local anesthesia (Lidocain 2% with epinephrine 1:80,000) we performed a full thick vestibular flap in order to completely display the bone defect. After cleaning carefully the bone surface from all the periosteum debris, we cut the vestibular cortical of the receiving site with a round bur, in order to cause the bleeding and promote the incorporation and vascularization of the grafting material.

We inserted a supporting screw on the occlusal side of the receiving site in order to establish a tent effect and avoid the collapse of the barrier lamina. Later on, the site was filled with OsteoBiol Gel mixed with a collagen gel in order to make the product more dense and sticky, simplifying in this way its positioning; above the grafting material, we modeled a fine cortical lamina (OsteoBiol Lamina Soft), that is stabilized to the bone with two fixing screws in correspondence of the vestibular side apically to the defect; in the meanwhile, on the palatine side, the lamina is adapted to the bone surface under the mucoperiosteal flap. Before suturing the wound, we performed the fenestration of the periostium, at the base of the vestibular flap, in order to obtain an adaption without tension of the margins of the wound. This is sutured with a mattress horizontal suture and interrupted stitches. The patient has been subjected to a follow up control once a week. At the end of the third week, we noted a partial exposure of the head of the osteosynthesis screw that was maintained advising the patient to apply everyday a chlorexidine gel.

At the moment of the second surgical stage, after 6 months, we didn’t note residuals of lamina nor presence of biomaterial granules, but a formation of new compact and well vascularized bone. The partial exposure of the head of the fixing screw indicated that there was a minimal vertical reabsortion of the grafting material (Figure 3). The crest augmentation was quantifiable in 5mm horizontally and 4mm vertically. Once removed the screw, with a Trephine bur with an external diameter of 3mm, we harvested a little portion of the regenerated bone for the histological examination (Figure 4). Afterwards, we completed the preparation of the implant socket and inserted an implant of 13mm of length and
4mm of diameter (Neoss LTD, Harrogate, UK), reaching a good primary stability (ISQ 71). We immediately inserted a PEEK (polyetheretherketone) transmucosal healing cap with a height of 3mm in order to manage the soft tissues and avoid an other intervention. After a healing period of 5 months, we measured again the implant stability (ISQ 78) and the radiographic examination showed the correct integration of the implant within the basal bone. Later on, the implant was restored with a gold ceramic crown (Figures 5 and 6).

**Second case report**

A 38 years old female patient presented to our observation with a defect as a result of a traumatic extraction of the element 2.4 (Figure 7).

The residual area presented a severe horizontal and vertical defect and, particularly, an attachment loss of about 7mm, mesially to the element 2.5 (Figure 8). Following our protocol, the area was anesthetized and skeletonized and, after performing several holes into the bone to be grafted, we inserted a regeneration screw (Memphix, Strauman) with a smooth side of 5mm out beyond the bone (Figure 9).

The cortical soft lamina (OsteoBiol Lamina, Tecnoss) was modeled and fixed with two mini screws (length 5mm and diameter 1.2 mm, Graftek fixation screws, Roen) vestibularly to the defect and, afterwards, a Memphix pin occlusally.

After adapting la cortical lamina, we filed the defect with a mixture of collagen and bone (OsteoBiol Gen Os e Ge 10, Tecnoss) and, afterwards, we covered it with the cortical lamina (Figure 10). The release of the flap with a periosteal incision and a mattress suture allowed to close the flap and to cover the graft for the whole healing period.

After 7 months, without inflammation or infection symptoms or signs, we proceeded with the reopening of the flap, the elimination of the screws and the preparation of the implant site with a Trepchine bur for the histological examinations, using a surgical guide.

The site was finished with a 3.2mm diameter bur and a counterbore. Then, we inserted a Neoss implant (length 13mm, diameter 4mm) achieving an optimal primary stability (ISQ 77). The bone measurements revealed a vertical increment of 5 mm and an horizontal one of 4mm. Moreover, mesially to the second premolar, we noted a localized attachment gain (Figure 11).

After 5 months, we proceeded with the site reopening, the positioning of a zirconia abutment and of a temporary crown, measuring an increment of the resonance frequency values (ISQ 81).

A de-epithelized flap, vestibularly elevated, helped to re establish an adequate quantity of attached gingiva and to reposition the levels of the muco gingival line. After 4 months, we cemented the final zirconia and porcelain crown (Figure 12).
The intraoral rx confirmed the augmentation and the stability of the bone increment (Figures 13-15).

The histological examination of the bone biopsy revealed that the particles of the bone substitute were well incorporated and the presence of thick bone (Figure 16).

**Conclusions**

The results of this clinical and histological study suggest that the use of a mixture of collagen gel (OsteoBiol 0, Tecnoss) and a collagenated porcine bone (OsteoBiol Gen Os, Tecnoss) as a grafting material in combination with a bone cortical lamina (OsteoBiol Lamina Cortical Soft, Tecnoss) can lead to the augmentation of the alveolar ridge bone in localized defects, before the positioning of dental implants. This particular combination of materials allows a very simple handling thanks to the consequent adhesion and containment properties. In the treated clinical cases, we saw a ridge augmentation, both vertically and horizontally, of about 4-5mm and an increment of the volume of the local soft tissue, allowing the insertion of implants in a correct position, in order to satisfy the functional and aesthetic criteria. There were no complications, except in one of the two cases, when, after about 3 weeks, there was a partial exposure of the head of
the osteosynthesis screw, but without any inflammatory or infective reaction and without affecting the bone healing. These data prove the optimal biocompatibility of the materials used.

The comparison of the ISQ values at the moment of the implant insertion and at the moment of the abutment positioning, after 10 months, revealed in both cases a significant increment (first case: from 71 to 78; second case: from 77 to 81) and this means that an evident bone remodeling process is in progress, leading to a better thickening an maturation of the new bone tissue. The results of the histological examinations, performed 6 months after the GBR, revealed the presence in the two biopsies of mature bone (Figures 4 and 15); the porcine bone particles were well incorporated and hardly distinguishable from the native bone and, in some areas, it was possible to note a remodeling with a partial absorption of the particles and the formation of new bone. Occasionally, it was possible to observe particles without bone contact in the deepest areas of the biopsy. Similar data were reported also by Nannmark and Sennerby in an animal model: the Authors evaluated the response of the bone tissue to PCPB, with or without a collagen gel, covered with a collagen membrane (OsteoBiol Evolution, Tecnoss). The histological examinations, performed after 8 weeks, showed an active reabsorption of the materials, the presence of mature bone and vascularization of the mineralized part and of the soft tissue and, finally, the active degradation of the collagen membrane. Therefore, it is possible to conclude that this study in humans gave an histological and clinical evidence of the regenerative potentiality of the combination of the three materials used (OsteoBiol Gel 0, OsteoBiol Gen Os, OsteoBiol Soft Cortical Lamina, Tecnoss). In any way, in order to support these conclusions, more clinical studies are necessary, especially monitoring the long term results of the implants inserted, after their functional loading.
References


