

Sinus Augmentation with Periosteum derived Tissue Engineered Bone

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Background and Introduction:

Tumors in the oral cavity cause loss of bone and soft tissue. More often than the reconstruction of soft tissue the improvement of the hard tissue bearing of dentures and dental implants is required. For the reconstruction of bone defects the gold standard is still the autologous bone harvested from the iliac crest, the mandible or the maxilla. Tissue-engineering procedures for hard tissue augmentations of the maxilla offer significant advantages compared with conventional grafts, as there is minimal or no donor site morbidity, limited availability of bone and the necessity of an additional surgical procedure. Periosteum has been demonstrated to have cell populations, which include chondroprogenitor and osteoprogenitor cells, that can be isolated in tissue culture and form both cartilage and bone. The aim of this prospective study was to evaluate the feasibility of the clinical application of periosteum derived tissue engineered bone.

Methods:

Periosteal cells were isolated from a biopsy of periosteum, resuspended and cultured. The cell suspension was soaked into polymer fleeces and polymerized. The periosteal grafts were transplanted via sinus lift eight weeks after harvesting. The patients were divided into two groups. One underwent a one-stage procedure sinus lift with simultaneous implantation. In the other group the implants were inserted three month after augmentation. A control group was augmented just with autologous bone.

Results:

Periosteal harvesting from the mandibular angle via an intraoral approach under local anaesthesia was tolerated well by the patients, and throughout the complete procedure no complications occurred. The wounds resulting from replantation of the engineered tissue healed without complications. The implants were inserted into the grafted areas. When the implant was inserted primary stability was tested and proven clinically. Radiographs demonstrated a tight implant-bone interface. A total number of 118 (TE) and 183 (control group) ITI implants (Straumann AG, Waldenburg, Switzerland) were inserted into the grafted areas. All patients could be provided with fixed prosthetic rehabilitation like either crowns and bridges or dentures. The biopsies taken during the two-way protocol revealed mineralized trabecular bone with remnants of biomaterial. Osteocytes were apparent within the bone lacunae. In seven patients of the two-stage protocol group and in 17 patients if the one-stage procedure, an excellent clinical, radiological, and histological result could be proved 3 months after augmentation. In comparison to the initial situation, the clinical inspection showed a good formation of new bone without signs of resorption. This was confirmed

by radiological imaging. In 10 patients (16 Sinus) of the two-stage protocol group the biopsies showed that the grafts had turned into a clinically appearing connective tissue-like consistency. In seven of these patients the situation was complicated by infection. The relation of augmentation procedures with BioSeed® - Oral Bone to infections as for example sinusitis and abscess is highly significant ($p=0,000$). All these cases required an additional augmentation procedure with autologous bone and bone substitutes. Only one patient of the control group which had been operated on just with autologous bone required secondary surgery. Also no infection was seen in this group. The loss of augmented material is significantly higher in the group in which the tissue engineered material was applied ($p=0,000$).

Discussion and Conclusion:

Our experiences from this pilot study with tissue engineered bone transplants reveal the necessity to limit the indications for tissue engineered bone. Its application is restricted to the sinus augmentation with simultaneous implant insertion at sites providing a sufficient bone bearing. These techniques are a new approach in hard tissue-impairment therapy and were applied in the region of the jaw and the face for the first time. To improve long term results modifications in the field of cell cultivation and carrier materials and a better understanding of the physiological part of the healing process are necessary.

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