

## Hard tissue regeneration in the maxillary sinus using methods of tissue engineering

J. Kuschnierz, E. Rütger, C. Kister, S. Sauerbier, R. Schön, R. Schmelzeisen, R. Gutwald  
*University of Freiburg, Department of Oral and Maxillofacial Surgery, Freiburg, Germany*

### Introduction

Hard tissue defects of the alveolar process after trauma, tumor or the atrophy after the loss of teeth are a common problem. For the dental rehabilitation of the patient dental implants is often the method of choice. Sinus floor elevation is a standard procedure prior to implant insertion in the atrophic maxilla when vertical bone height is limited. Augmentation by autologous cancellous bone from the iliac crest is considered as today's gold standard. Harvesting of pelvic cancellous bone has its own morbidity. Most biomaterials used in sinus grafting are considered to be bioinert fillers with only osteoconductive properties. Using tissue engineering methods we combine the the advantages of autologous cancellous bone with limited donor site morbidity.

### Material and methods

In animal experiments and human studies we have investigated different methods of tissue engineering. In 9 adult sheep we performed a bilateral sinus floor elevation using the growth and differentiation factor rhBMP-2. In the augmented sinus dental implants were inserted. In another similar sheep study we augmented the sinus using BioOss in combination with stem cells from bone marrow aspirate. Autologous cancellous bone was used as a control standard in both animal experiments. After the successful use of stem cells in the

animal study we treated human patient in a pilot study with autologous stem cells in combination with a biomaterial. The augmented sinus was examined radiologically and histologically.

### Results

In the maxillary sinus augmented with BMP the volume, the bone to implant contact and the bone density was investigated. In the experiments using stem cells and BioOss the cell number, the volume and the new bone formation was measured using radiography and histomorphometry.

BMP showed a similar bone volume but a higher bone to implant contact and a higher bone density than the gold standard. The combination of stem cells with the biomaterial resulted in a high new bone formation rate with no complications in the maxillary sinus. The density of the biomaterial and the new bone was higher than the cancellous bone control. In the patient study biopsies harvested during implant insertion showed new bone formation and no signs of infection or inflammation. Stabil implant insertion was possible in all patients.

### Conclusion

Methods of tissue engineering might a promising alternative to augmentation methods in sinus floor elevation.