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Induction of bone formation by titanium implants coated with immobilized recombinant human bone morphogenetic protein-2 in the rabbits petrous bone

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Purpose: Bone morphogenetic proteins (BMPs) belong to the group of transforming growth factor (TGF- β) proteins and were shown to have numerous biological effects of which the osteoinductive ability is the most outstanding. By means of surface modification it has recently become possible to immobilize recombinant human (rh)BMP-2 on implant surfaces. As only few publications deal with rhBMP-2 effects in otology, the present study aims to evaluate both BMP effects and BMP-“coating” of titanium implants in the woven petrous bone.

Materials and methods: A total of 20 titanium cylindrical dumb-bell shaped implants were manufactured containing equivalent composites as used for ossicular replacement prosthesis. Subsequent to creating ultrahydrophilic, bioadhesive surfaces, one half of the implants was used for immobilization of rhBMP-2. In 10 rabbits one titanium sample each was implanted in both tympanic bullae comparing the groups of immobilized rhBMP-2 vs. rhBMP-2-free and immobilized vs. soluble rhBMP-2. The formation of new bone in the gap healing model was observed by microradiographic and histomorphometric analysis. **Results:** A significant amount of new bone was detected in the gap given by the shape of the implants. Bone formation was exaggerated in the immobilized compared to the control group. No substantial difference in bone formation was observed between the group immobilized vs. soluble rhBMP-2.

Conclusion: It was shown for the first time that immobilized rhBMP-2 induces new bone formation in the woven petrous bone. Due to the immobilization this effect can be localized to the implant surface, thus preventing ectopic bone formation. Clinical goals for the application of rhBMP-2 in otology differ from those in other skeletal parts: Depending on the carrier material possible indications include obliteration/augmentation of large mastoid cavities, reconstruction of the posterior canal wall, improvement of osseointegration of various implants. If BMP-induced bone formation was possible in the ossicles, rhBMP-2-coated implants could serve as a guideline for bony restoring of necrosis of the long process of the incus or even for creating a missing stapes-superstructure. Many further aspects have to be examined prior to such goals.