Bone Augmentation Materials

Evaluation of Implant Osteointegration

This dissertation thesis contains a description and results of six constituent studies.
The first study was performed in order to investigate the most common indications for the use of three bone augmentation materials, Biogen, Cerasorb and Bioresorb. The most common indications identified were based on statistical data collected from patients treated at the Maxillofacial Surgery Department, Faculty Hospital in Pilsen, during 2003-2007.

The second experiment was performed in vivo. We evaluated the possible osteoinduction potential and osteogenic activities of two different bone augmentation materials (Cerasorb, Biogen) by examining whether ectopic bone formation could be induced when implanted subcutaneously into the extremities of our test subjects (pigs). The results obtained, highlight the potential future use, of augmentation materials in creation of hard tissues, in areas where soft tissues are normally present.

The third experiment was performed in order to evaluate the efficiency of Cerasorb bone augmentation material in bone healing. Cerasorb was applied into an artificial hole in the extremities of the test subjects and based on careful analysis of the radiographic and histological images, we found that Cerasorb gradually resorbed and was further replaced by newly formed bone.

By inserting a Titanium implant and screw in to the femur of a dead rabbit, our aim of the fourth study was to find an alternative method for preparing histological specimens of the bone-implant interface for the evaluation of osteointegration. By using a Confocal Laser Scanning Microscope (CLSM) it was possible to improve cost efficiency and time preparation whilst obtaining reliable and useful results.

We applied our successful alternative method in the fifth experiment by surgically inserting a Titanium implant into the femur of a living rabbit. The results were highly successful and provided an excellent view of the bone-implant interface. The images obtained by the CLSM showed the osteointegration between the bone and the implant structure. Our method was significantly less time consuming, more cost efficient and easier to carry out.

The sixth experiment was performed in order to examine and evaluate the osteointegration of dental implants with different laser treated surfaces and to compare them with the surfaces of sandblasted and machine treated implants. This was done by inserting them into the bones of four piglets under general anesthesia. Two doses of the antibiotic Tetracycline (TTC) were applied at different periods of time to show the regions of active bone formation. Due to the fluorescent property of TTC and the ability of the CLSM to detect this fluorescents we were thus able to detect the mineralisation and quantity of newly formed bone at the implant interface. After bone processing and staining for further histological analysis, we evaluated the osteointegration by measuring the bone-implant contact percentage (BIC %).
We found that the laser treated surfaces had a slightly higher BIC % than the sandblasted implant while the machined surface had the lowest BIC%. Based on our results, we concluded that the surface texture of an implant has a fundamental role in osteointegration, and that mechanically added roughness significantly increases the contact area between the implant surface and the peri-implant bone.