Osteoblast Cell-Proliferation in vitro on Laser Sintered Polyetheretherketone Composites

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The following investigation focuses on bone substitutes for maxillofacial surgery made of polyetheretherketone (PEEK). Laser sintering is a very suitable processing technology for bone implants because of its ability to generate complex, individually shaped geometries including undercuts and pores. The implant is made layer by layer in the LS-machine from three-dimensional data generated by computer tomography of the patient. The advantages of laser sintering in comparison to other rapid-prototyping methods are the easy processing of the materials, the absence of unhealthy filler materials and an advantageous inner structure and surface properties. Laser sintering of the semi crystalline, high performance polymer PEEK is still a challenge, due to its high melting temperature of about 343°C. PEEK exhibits excellent biocompatibility and chemical resistance. It can be processed without any additives, ensuring that no low molecular weight products are released into the human tissue. Sterilization in a steam autoclave or by radiation is possible without encountering any significant change of its inherent properties. PEEK and PEEK-Composites are suitable for bone substitutes as their mechanical properties match the human bone properties. For this investigation the fine powder PEEK\textsuperscript{TM} 150 PF (Victrex Plc., Lancashire, UK), with an average particle size of about 56 µm and a low melt viscosity was used. As filler materials nano-sized carbon powder and tricalciumphosphate powder with an average grain size of several micrometers were used.

Different three-dimensional cell culture discs were laser sintered with a diameter of 12 mm and a height of 3 mm. Osteoblast cultures were cultivated on the PEEK discs and examined with scanning electron microscopy (Figure 1) and proliferation was measured with WST-1 (Figure 2). The findings demonstrate that osteoblasts can be grown on all PEEK surfaces. The data show that PEEK surfaces may promote osteoblast attachment and further bone formation.

Fig. 1. Osteoblasts on laser sintered PEEK/Carbon surface

Fig. 2. WST Testing

Keywords: Polyetheretherketone; Laser Sintering; Osteoblast