Combining tissue engineering with metal scaffolds in orthopaedics to improve osseointegration of endoprostheses

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Electron Beam Melting (EBM) technology allows the fabrication of free-formed metal scaffolds, thus creating the possibility of manufacturing patient-specific endo-prostheses. It also allows the production of highly-porous prostheses with an elastic modulus similar to that of bone. The porous can be filled-in with tissue engineering elements (i.e. osteogenic molecules, biomaterials, cells) in order to promote bone ingrowth inside them, thus improving the prostheses osseointegration. For this purpose, the surface of EBM-sintered titanium should permit cell adhesion, growth and differentiation to ensure a good metal-to-tissue interaction. Our goal was to evaluate the osteoconductivity of EBM-manufactured Ti_6Al_4V porous scaffolds.

Porous Ti_6Al_4V discs were manufactured by EBM-sintering, autoclave-sterilized and seeded with human and rat osteoblasts and mesenchymal stem cells (MSC). Cell adhesion, proliferation and differentiation were assessed by vital staining, MTT assay, RT-PCR and immunostaining techniques. Bone organ-explant culture was used to further assess osteoconductivity at tissue level *in vitro*.

Both osteoblastic and MSC attached to and grew on the titanium discs, covering up the entire metal surface, and even bridging the pores of the scaffold. Collagen type I, osteopontin, and osteocalcin expression confirmed the osseous differentiation of the cells cultured on the titanium discs. Bone explants placed on EBM-sintered titanium alloy spontaneously released cells that covered up the metal surface. Long-term cultured explants strongly adhered to the titanium.

EBM-sintered titanium scaffolds promote cell adhesion and can be populated by osteoblastic and MSC, which can normally differentiate towards the osteogenic lineage upon proper stimulation. These osteoconductive properties should promote the osseointegration of EBM-manufactured endoprostheses for bone replacement.