The Potential of Combining Silica-Based Mesoporous Materials with Osteoprogenitor Cells for Bone Repair

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The development of new biomaterials is acquiring increasing importance in Traumatology and Orthopaedics. Biomaterials can facilitate bone repair by serving as delivery systems for drug administration, or by providing a substrate where cells can be seeded to fabricate an engineered tissue. The present work explores the possible application of silica-based mesoporous materials to bone tissue engineering by evaluating the interaction of these materials with osteoprogenitor and mesenchymal stem cells.

Biocompatibility and osteoconductivity of the particulate and consolidate materials were evaluated in vitro by culturing rodent and human osteoprogenitor cells in the presence of SBA-15, HA-SBA-15 and MCM-41 materials. Osteoblasts and adult MSC were cultured with these materials under standard 2D and micromass (3D) culture conditions. Cell viability and proliferation were assessed by vital staining and cell quantitation assays. Organ explant culture was also performed in order to further evaluate the potential osteoconductivity of SBA-15, HA-SBA-15 and MCM-41.

2D cultures of mouse osteoblasts, as well as mouse and human MSC, grew normally in the presence of up to 100 ug/mL particulate SBA-15, HA-SBA-15 or MCM-41. Mouse calvarium explants also behaved normally in the presence of these materials. Spontaneous attachment of cells to the materials was observed in all cases suggesting osteoconductive characteristics. Micromass culture showed that mouse and human MSC and osteoblasts could grow in three dimensions when cells use these materials as scaffolds. Culture on consolidate porous materials also confirmed this data.

In conclusion, silica-based mesoporous materials are biocompatible and osteoconductive, since they sustain MSC and osteoblast cell adhesion and proliferation. They then provide a suitable scaffold for three-dimensional culture. These data support further experimentation for bringing them into tissue engineering arena.