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Augmenting the fixation of orthopaedic implants with stem cells

Orthopaedic implants are extremely successful however in some instances fixation to the surrounding bone is problematic. In patients with bone cancer a massive prosthesis is used to replace the diseased bone. At the same time patients receive chemotherapy to treat and stop the spread of the cancer. In these cases the loosening rate is high, which leads to prostheses being removed and revised. Bone cancer occurs in young patients and these patients may be faced with numerous revision operations throughout their life, therefore, enhancing fixation of these implants is important. We have shown that augmentation with materials such as hydroxyapatite does reduce loosening but there still remains a number of cases where loosening occurs. The aims of this study were to use mesenchymal stem cells to enhance implant fixation to the bone surface (osteointegration). We carried out an investigation on femoral bone defects in rats, which showed that incorporating mesenchymal stem cells within fibrin enhanced bone formation even in those animals given a chemotherapy regime similar to that received by humans. Fibrin glue was chosen as the carrier as this could be sprayed onto the surface of the implant and formed a stem cell layer. Stem cells survived and proliferated within the fibrin glue and they remained viable after spraying the cells onto the implant surface. In an ovine model autologousstem cells were sprayed onto the surface of the implant at a concentration of 1 million cells per ml. After 6 months increased osteointegration of over 100% was measured. Increasing the number of the cells within the glue up to 10 million per ml had a significant affect. Using cells that had been differentiated into osteoblasts also increase osteointegration. However, using autologous mesenchymal stem cells resulted in little new bone formation and in osteoclastic resorption.

Biography

Gordon Blunn is a Bioengineer at the Institute of Orthopaedics and Musculoskeletal Science at University College London; he is based at the Royal National Orthopaedic Hospital. He has been at this Institution for 25 years and during this period of time he has investigated the use of the fixation of implants to the skeleton. He has translated a number of novel treatments and designs into patients, which has enhanced implant fixation. He is currently the President of the British Orthopaedic Research Society.

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