

factors or bone morphogenetic proteins (BMPs) together or individually to create polymer-ceramic composite scaffolds. This illustrates that scientists have shifted from bioinert to more bioactive materials that integrate with biological molecules or cells and help with the regeneration of tissue (Stevens 2008). The ideal premise of biomaterials is that they should be able to be reabsorbed and replaced over time by the body's own regenerated biological tissue (Stevens 2008). For these reasons, Hydrogels have become of increasing interest in this sector of research.

Current Strategies and Materials

Modern medicines provide several options for patients with severe bone loss, of which autologous bone grafting is considered to be the gold standard. In general, during this treatment, bone from the iliac crest of the patient's own pelvis is transplanted to the site of the defect. Despite the prevalence of this technique it has severe drawbacks, such as donor site morbidity, additional pain and risk of infection. Furthermore, the autologous grafts can often be insufficient due to the limited supply of suitable donor tissue from one individual, anatomical and structural problems and high resorption levels. Another opinion is surgical transplantation of bone tissue from other donors (allografts). However, this requires the patients to be treated with immunosuppressive drugs during the remainder of their lives. Treatment with allografts also introduces the risk of disease transmission (Saito et al. 2003; Gautschi et al. 2007).

The aforementioned limitations of the existing treatments motivated the search for alternative materials, which would enhance bone formation via one or several of the three basic mechanisms: Osteoconduction, osteoinduction and osteogenesis. During osteoconduction bone formation is triggered from existing bone by the introduction of a scaffold with a three-dimensional structure similar to that of bone tissue. Osteoinduction implies that endogenous or transplanted osteoprogenitor cells in response to biomolecules, e.g., growth factors, form new bone. Osteogenesis can be initiated by manipulating the natural process of bone remodelling, e.g., by inhibiting bone resorption (Athanasίου et al. 2000).

Bone morphogenetic proteins

Bone morphogenetic proteins (BMPs) were discovered in 1965 by an orthopaedic surgeon, Dr. Marshall R. Urist, who showed that extracts of demineralised bone could induce ectopic bone and cartilage formation when it was implanted in non-skeletal tissue in rats (Urist 1965; Urist and Strates 1971). This discovery commenced a new research era, the main goal of which was to identify, purify and employ new growth factors to regenerate damaged or missing tissue. Some of the most frequently used growth factors in modern regenerative medicine are listed below.

Due to short biological half-life of these proteins, many carrier systems have been developed for sustained and local delivery with a common goal to retain its bioactivity at the site implantation long enough for the cells to migrate in and initiate differentiation into osteoblasts (Seeherman et al. 2002; Bessa et al. 2008). Some of the major materials and carriers used are listed below.