Articular cartilage provides a near frictionless, load-bearing surface which is essential for good skeletal joint mobility. These functional properties are entirely dependent on the anisotropic structure and composition of the extracellular matrix of this hyaline cartilage. The tensile strength of articular cartilage is attributed primarily to the dense, cross-linked network of collagen II fibrils; whereas proteoglycans exhibit a swelling pressure giving cartilage its compressive properties. Articular cartilage has a low capacity for self-repair. Hence, significant injury or degenerative joint diseases, such as osteoarthritis, compromise the integrity of the extracellular matrix initiating progressive loss of matrix components which can result in ensuing progressive loss of joint mobility.

Developing tissue engineering methodologies offer real potential to provide engineered cartilage grafts to replace/regenerate the defective tissue. There are two main cell-based approaches to cartilage repair. The first is that of implanting chondrogenic cells directly into the cartilage lesion (autologous cell implantation). The second approach combines chondrogenic cells and a scaffold material followed by a varying period of in vitro culture. The ultimate goal of both of these approaches is to create a replacement graft which can be used to restore full tissue function.

To date, cartilage constructs with varying degrees of hyaline characteristics have been developed using various biomaterial scaffolds and chondrogenic cell sources (both native chondrocytes and mesenchymal stem cells). However, current protocols produce tissue that is relatively immature and does not match native cartilage in biochemical composition, cell organisation or mechanical strength. This presentation will review the achievements of cartilage tissue engineering and examine the structure, matrix quality, mechanical and tribological properties of in vitro engineered constructs which can be achieved currently. By examining what we can achieve we can identify those areas where further developments are needed. In particular, developments are needed in the fabrication of scaffold materials to mimic the topography of the extracellular matrix; and a greater understanding of chondrogenic differentiation, cell-matrix/scaffold signalling in matrix formation and turnover.