IBI SEMINAR

“Bioengineering of Articular Cartilage and Synovial Fluid: Biomedical Science and Engineering Foundations”

Monday – September 10, 2012 – 2:15 p.m.
EPFL – room SV 1717a

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Abstract

Joint articulation involves the relative motion of apposing cartilage surfaces, sliding past each other in a synovial fluid solution. The tribological and load-bearing properties of cartilage facilitate biomechanical behavior and serve as design targets for tissue engineering. The load-bearing properties of cartilage vary markedly from the articular surface to the subchondral bone, due to the depth-varying content sulfated glycosaminoglycans interacting with the dense, resilient collagen network. The low-friction and low-wear properties of cartilage are due in part to lubricating molecules in synovial fluid, particularly proteoglycan 4 (PRG-4) and hyaluronan (HA). The shear to which the articular cartilage and indwelling chondrocytes are subjected is governed both by the friction-dependent shear stress within, and the shear modulus of, cartilage near the articular surface. The lubricating properties of synovial fluid for articular cartilage is often diminished in injury and disease due to changes in the concentration of PRG-4 and HA. Such alterations may disrupt the mechanobiology of the synovial joint. The bioengineering of articular cartilage and synovial fluid may be useful for both scientific and therapeutic purposes. Biotechnologies targeting cell expansion and assembly as well as bioreactor culture can facilitate both the formation of a porous material like articular cartilage and a liquid lubricant like synovial fluid. The quest to attain stable material phenotypes resembling native articular cartilage and synovial fluid challenges our understanding of the synovial joint at multiple scales in health and disease. The successful fabrication of osteochondral structures in joint-scale bioreactors may lead to next-generation therapies such as biological joint replacement.

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