Public Abstract
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Title: In Vitro Synovial Fibrochondrogenesis for Meniscal Tissue Engineering

The knee menisci are two c- shaped fibrocartilages in the knee joint, and serve to absorb and distribute weight bearing forces on the tibia, resolve femoral-tibial incongruity, and lubricate the joint; they also have proprioceptive function. These organs are composed of circumferential bands of collagen I and bound by radial tie fibers, which convert the compressive forces of weight bearing into hoop stresses. Meniscal injury is a common source of osteoarthritis and lameness in veterinary and human patients. Surgical attempts at inducing meniscal healing are usually unsuccessful within the avascular 2/3 of the meniscus. Tissue engineering is being investigated as a novel treatment solution for healing meniscal tears and promoting meniscal regeneration. Synovial membrane cells from the joint lining may be applicable to meniscal engineering because they modulate meniscal reparative responses and can form cartilage naturally and in the laboratory. In addition, knee joint synovium is abundant and can be arthroscopically harvested. The body of research presented in this dissertation investigates how we can grow synoviocytes on sponges and scaffolds under special culture conditions to form new, living, replacement meniscal fibrocartilage. It was shown that synoviocytes grow well on poly-glycolic acid scaffolds with fluid stimulation in a rotating bioreactor, but do not grow as well on polymer derivatives of lactic acid. A growth factor combination of basic fibroblast growth factor, followed by transforming growth factor beta- 1, and insulin like growth factor-1 stimulated the synoviocytes to express the most genes encoding extracellular matrix (ECM) constituents seen in the meniscus, which gives this organ its form and function. When trying to optimize this fibrochondrogenic process, it was also discovered that high cell seeding densities are important for producing tangible ECM, however, high numbers of cells seeded on scaffolds in the rotating bioreactor culture system resulted in low cell viability. In addition, osteoarthritic synoviocytes taken from patients with meniscal tears and other orthopedic diseases were found to produce less fibrocartilage than normal synoviocytes in culture, although the osteoarthritic cells expressed higher levels of genes encoding embryonic chondrogenesis. This work demonstrates that synovial membrane cells can undergo fibrochondrogenesis in culture, and provides justification for continued pursuit of autologous synoviocyte-based tissue engineering strategies for fibrocartilage repair and regeneration.