Using Gene Transfer For Cartilage Tissue Engineering

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The management of articular cartilage injury and degenerative conditions e.g. osteoarthritis, is still a challenge in orthopaedic. Attempts made to improve patient outcomes range from medical to surgical interventions. Yet, there is no definitive cure for these medical conditions. Apart from conventional treatments, research into cartilage tissue engineering has been conducted actively to overcome the challenge. Formation of functional cartilage-like tissue using tissue engineering principles and gene transfer method have been advancing rapidly with the aim to restore normal tissue structure and function. To achieve this, there must be a balance between "cell source, biomaterial scaffold and signaling factors". These three substances are the minimum essential elements in tissue engineering. They must be optimized carefully for a successful in vitro tissue formation. The cartilage cell namely chondrocyte often loses its phenotype in a monolayer culture setting. After serially expanded, chondrocytes tend to adopt fibroblastic traits more than its original chondrogenic properties. Cellular or replicative senescence can be seen through gradual morphological changes of the cultured chondrocytes after several passages. One of the classical methods to subside dedifferentiation is by introducing multiple exogenous growth factors to the cells through culture media supplementation. This method promotes cellular proliferation but not the differentiation capacity. Comprehensive dose-response study needs to be conducted to understand the multilevel mechanisms involved. It is worthy but time-consuming and cost-ineffective. Although there is little understanding of the behavior of the variables involved, transfecting growth factors related genes into chondrocyte would help cells undergo a self-regulated chondrogenesis. The technique is simple especially the non-viral gene transfer method. The transfected cells are seeded into a biocompatible 3D scaffold. The scaffold supports cellular growth in in vitro culture. It accommodates cellular attachment and proliferation by mimicking the internal microenvironment of the body. Finally, proof of concept through in vivo animal implantation models is needed to confirm the effectiveness of the approach. While few researchers had embarked on clinical trials, there is still a long way to go in this area. Basic research is always necessary to uncover the full potential of this new cartilage treatment strategy. Are we on the right track?