Subchondral Bone Engineering: Regeneration of Cartilage-Bone Interface to Replace Knee Prosthetics

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Articular cartilage damage is the most common injury in the musculoskeletal system. Since cartilage is avascular, injured tissue cannot spontaneously heal and, if not treated, can lead to osteoarthritis (OA) a degenerative joint disease affecting 237 million people worldwide. Although a variety of methods have been proposed to address articular cartilage damage, there are currently no effective therapies that result in viable tissue repair. Tissue engineering strategies help provide a less invasive treatment for osteoarthritic patients. This project investigated the effectiveness of bioprinted scaffolds to facilitate cell migration. The objective of this study was to engineer an in vitro cartilage-bone interface using mesenchymal stem cells (MSCs). This interface, known as the tidemark, would mimic the natural transition between calcified cartilage and bone to promote natural cartilage regeneration through knee salvage rather than knee replacement surgery. Chondrocytes and MSCs were cultured in a bioprinted scaffold made of alginate and chitosan in a 1:1 ratio. The scaffolds were mechanically tested and tissue quality was assessed histologically. Articular cartilage in the scaffold was shown to have a well-defined cartilage-bone interface. The reported Young's modulus for articular cartilage is 0.5-0.9 MPa and the seeded and crosslinked scaffolds achieved strength within this range. The scaffolds can be introduced into osteoarthritic joints to combat cartilage erosion. Future investigations will involve refining the scaffold by inserting collagen arches to further cell migration as well as testing in animal models.

Awards Won: