Investigating the Effects of Hemarthrosis on the Structure and Function of ACL Repair

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Anterior cruciate ligament (ACL) injury, which affects nearly 200,000 patients annually in the United States, can be accompanied by joint bleeding but the effects of whole blood components are not fully understood. Hemarthrosis, or articular bleeding, can induce inflammation and has been implicated in joint tissue degeneration. Additionally, iron homeostasis is vital to joint health as excess iron can lead to oxidative stress and is associated with osteoarthritis and hemophilic arthropathy. Prior work has shown that acute blood exposure upregulates pro-inflammatory cytokines and cellular damage. Here, analysis of the contributions of whole blood and its cellular constituents: intact and lysed red blood cells (RBCs) on the ACL in the context of cell viability, proliferation, pro-inflammatory cytokine production and ECM properties is performed. An in vitro 2D model is used to assess the biologic and wound healing response of ACL fibroblasts (ACLF) under blood treatment. The effects of blood components are then translated to a 3D model using a collagen gel contraction assay to recapitulate the physiological conditions of the joint environment following acute ACL injury and concurrent hemarthrosis. Overall, this study aims to characterize the impact of acute short-term blood exposure on the contractile phenotype of ACLF and its impact on construct ligamentous structure and function.