Title: Predicting Matrix Reorganization by Fibroblasts in Vitro with a Partitioned Fiber-Based Multi-scale Model

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Fibroblasts behavior is central to dermal wound healing. These cells migrate into and remodel the provisional fibrin matrix in a complex manner that depends in part on the local mechanical environment and multi-scale mechanical interactions. To understand these dependencies, we are developing an in vitro experimental system for imaging and quantifying the manner in which fibroblasts reorganize fiber gels as a function of the spatial arrangement of clusters of cells (explants) in the gel, the gel geometry, and the boundary constraints on the gel. Simultaneously, we are building experiment-based multi-scale mechanical models that consist of cell fiber networks surrounded by matrix fiber networks. The effect of cell traction forces on reorganizing the surrounding matrix is simulated by shortening incrementally the reference lengths of the fibers of the cell networks. These models are able to produce reorganization patterns similar to those observed experimentally for a given set of experimental conditions, and they provide a basis for understanding and predicting the remodeling process as it relates to dermal wound healing.