Gemetric Control of Directional Cell Migration

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Precise control of directional migration is critical to ensure normal tissue patterning,promote wound healing, and engineer functional tissues in vitro. In vivo, different cell types travel long distances through the filamentous meshwork of the extracellular matrix (ECM) to assemble functional structures characteristic of living tissues. The movement of individual cells is initiated by the directional extension of the leading edge through actin polymerization to form a lamellipodium that is subsequently attached to the ECM substrate. Cells attach to the extracellular matrix more tightly at the leading edge compared to the rear of the cell and this gradient in adhesive force generates the traction force required for movement. Migrating cells display a highly polarized cytoskeleton organization, with F-actin localized predominantly at the cell anterior. Our hypothesis is that by controlling cell shape and the organization of the internal cytoskeleton, we can guide the direction and path of cell migration. Recent studies have suggested that mammalian cells can respond to physical cues on the surface of micropatterned substrates by spatially redistributing their extracellular matrix and initiating new motile processes almost exclusively from the sharp corners of extracellular matrix patterns. In this study, we applied soft lithography and microcontact printing to form an array of ECM on culture dishes. Cells attached and spread to adapt to the shape of the ECM. The asymmetric shape of the ECM along set paths in a predetermined direction. These results demonstrated the potential in using novel micropatterned substrates to guide the directional cell migration.