Manipulation of Cell Proliferation and Migration Employing Surface Acoustic Waves and Hydrophobic/Hydrophilic Structured Substrates

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Tissue engineering for the purpose of nerve or spinal cord repair has become an emerging topic in biophysical and medical research. Addressing this issue relies on an understanding of the principles of tissue growth and applying this understanding to produce functional replacement tissues for clinical use after injury. During wound healing, the damaged tissue layer is reassembled and regenerated through cell proliferation and migration. Thus, any type of external stimuli being able to improve this process of cell regeneration could be highly useful for accelerating wound repair. To study such an external wound healing parameter, we use surface acoustic waves (SAW) for dynamic in vitro manipulation of living cells in a precise controlled manner. In our investigations, we use osteoblastic SaOs-2 cells on a Si02-covered piezoelectric LiNbO3 substrate which we irradiate with SAW continuously for 72hours. Employing a conventional wound healing assay, we show the SAW -treated cells exhibit significantly increased proliferation and migration, respectively, as compared to control samples. Apart from quantifying our experimental findings, we also demonstrate the biocompatibility and biofunctionality of our SAW reactor by using LDH assays. We can neglect parasitic or beneficial side effects such as changing substrate temperature or nutrient flow rate through (OR ‘by closely’) monitoring the temperature and flow field using infrared microscopy and micro particle image velocimetry. Indeed, our results show that the SAW-induced dynamic, mechanical, and electrical stimulation directly promotes cell growth by increasing cell regeneration and migration rates. Our next goal is to guide the cells along certain tracks using hydrophobic/hydrophilic trails in combination with SAW.