Harnessing Electroceuticals for Stem Cell Fate Control

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Electrical stimulation directs human mesenchymal stem cell differentiation, without exogenous growth factors, towards different cell tissue types. Electrical stimulation conditioning offers a promising approach in directing stem cell fate, providing a tailored treatment targeting the desired differentiation outcome. However, the cellular mechanisms that trigger specific phenotype differentiation in the presence of electrical stimulation are poorly understood, restricting the intelligent design of stimulation protocols for targeted differentiation.

Here I will present our research platform which explores the impact of electrical stimulation on stem cell response; from biomedical engineering approaches using custom electrical stimulation culture devices, through to advanced bio atomic force microscopy (AFM) to capture real-time changes in stimulated cells. The elegant mechanical approach of AFM enables a gentle, non-destructive in situ measurement of biological systems, and with our advanced AFM for biological analyses we perform biomechanical mapping of entire living stem cells over short time scales, and move forwards to single cell biopsies for longitudinal biomolecular analyses.

Our broad, multi-disciplinary approach to understanding how electrical stimulation can manipulate stem cell response takes us closer to harnessing this for multi-lineage stem cell fate control.