Biomechanics of Smooth Muscle Cell Differentiation: Experimental Study using an Innovative *in vitro* Mechanical System

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Identifying mechanisms that regulate different smooth muscle cell (SMC) gene expressions is critical for understanding the SMC phenotype and genotype in both physiological and pathological conditions, as SMCs' primary role is to control the slow, involuntary movement of hollow organs such as blood vessels, airways, gastrointestinal, urinary and reproductive tracks. Previous *in vitro* studies indicated that specific genes were lost and there was a slight change in the physical structure of the SMCs. This was due to the overwhelming complexity of the *in vivo* environment which could not be accurately simulated *in vitro.* It is hypothesized that if SMCs are cultured *in vitro* by subjecting them to controlled mechanical stresses (cyclic strains at various frequencies and time durations), they will retain the same level of gene expression as *in vivo.* The objective is to evaluate subsequent changes in the SMC lineage based on gene expression changes. To accomplish this, a novel cell stretching device is being developed that will stimulate cultured SMCs by allowing both culturing and stretching of cells on the same unit. This also effectively reduces the working time needed by researchers to complete each run. The expected outcome will be the effects of different mechanical stresses on cell survival over time. Specifically, SMC lineage assessment and western blot analysis will be done. The results will hopefully prove that *in vivo* conditions of SMCs can be successfully simulated *in vitro.* The research will help in comparing the oxidative stresses, hyperglycemia, lipotoxicity and calcification responses on specific SMC types *in vitro*, and offer new insights into the genetic and environmental bases of SMC diseases. This is critical for research in areas such as drug screening and tissue engineering. For future research, co-culture systems may be studied as the device is capable of culturing two cell-types in the same environment.

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