Comparative Analysis and Effects of Oscillatory and Steady Shear Stress on Bone Marrow Derived Mesenchymal Stem Cells (BMMSC)

Bhattacharjee, Smita

Tissue engineered heart valves (TEHV) have a strong potential to outperform existing heart valve replacements. As part of an ongoing research to determine the optimal conditions to generate a TEHV, this experiment was conducted to determine the effects of two different mechanical stresses on the orientation and elongation of the actin filaments in Bone Marrow mesenchymal cells (BMMSC). The mechanical stresses used were Steady Shear Stress (SS) and Oscillatory Shear Stress (OSS). BMMSC were grown in a flask with regular basal media inside a cell culture incubator at 37 °C for around six days. Once the cells reached confluency, they were subject to the SS and OSS. For the SS, the cells were cultured into microchannels in a specialized well plate (Bioflux200 system; Fluxion Biosciences) and were grown under a constant flow of cell culture media over the course of 48 hours. A similar procedure was carried out using the same equipment for the OSS experiment for 48 hours using a pulsatile flow. Pictures were taken periodically under a fluorescent microscope and the F-actin filaments were labeled through the process of immunostaining. The images were analyzed using the Image J software. The information obtained included the length of the visible actin filament and therefore allowed an in depth analysis of the change over time in both the orientation and elongation of the filaments. Results indicated that the SS yielded stronger actin filaments compared to the OSS.

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