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Printable low-cost, sustained and dynamic cell stretching apparatus

Samer Toume[1], Amit Gefen[2], and Daphne Weihs[1],*

[1] Faculty of Biomedical Engineering, Technion-Israel Institute of Technology, Haifa 3200003, Israel

[2] Department of Biomedical Engineering, Faculty of Engineering, Tel Aviv University, Tel Aviv 6997801, Israel

* Corresponding author: Daphne Weihs, Ph.D., Faculty of Biomedical Engineering, Technion-Israel Institute of Technology, Haifa 3200003, Israel. Tel. +972-4-8294134, Fax. +972-4-8294599, E-mail. daphnew@technion.ac.il

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Abstract

Deformations that are applied on body tissues during daily activities, as a result of morbid conditions, or during various medical treatments, affect cell viability and biological function. Such mechanobiological phenomena are often studied *in vitro*, in monolayer cultures. To facilitate such studies cost effectively, we have developed a novel, printable cell stretching apparatus. The apparatus is used to apply tensile strains on cells cultured on elastic, stretchable substrata, either by sustained or by dynamic-cyclic application. Most of the apparatus parts are three-dimensionally printed (excluding motors), and stretching is automatically performed by two direct current geared motors that are controlled by a programmable microcontroller platform. To demonstrate functionality of this novel printable device, which can be produced in multiple copies in research labs at a cost of under 100 US$ per unit, including motors and controller, we performed cell culture studies monitored by fluorescence microscopy. Specifically, we have applied sustained and cyclic, radial stretching at large strains to NIH3T3 mouse fibroblasts, and have demonstrated that cell viability, adhesion and morphology were maintained following stretching. Our apparatus is designed to be low-cost, rapidly manufactured at a university or small-company setting, and simple to use and control, where its flexible, versatile design allows users to experimentally induce different stretching regimes with varying amplitudes and frequencies.

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