Video Article

generation of cardiac tissue constructs with an array of small diameter channels

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URL: http://www.jove.com/video/2311
DOI: doi:10.3791/2311

Keywords:

Date Published: 6/15/2015

Citation: Maidhof, R. generation of cardiac tissue constructs with an array of small diameter channels. *J. Vis. Exp.* (), e2311, doi:10.3791/2311 (2015).

Abstract

Robert Maidhof, May 2009 An important challenge that remains in the tissue engineering field is to culture functional patches of relevant size for repair or study of diseased tissue. Static culture, for example in Petri dishes or stirred flasks, limits the ability to generate thick tissue constructs because oxygen transport by diffusion can only supply a thin cell layer (~80-100 m thick), especially with highly metabolically active cells such as those in cardiac tissue. To increase the viable thickness one can use perfusion bioreactors to flow oxygen-rich culture medium through these constructs, but the sheer stresses associated with perfusion have been shown to damage cardiomyocytes. Our solution has been to use a combination of porous channeled scaffolds and medium perfusion to decrease the oxygen diffusion distance. One millimeter thick poly-glycerol sebacate (PGS) scaffolds were cut with a laser system to create scaffolds with channels 250μm in diameter. To seed cardiac cells onto these scaffolds we developed a novel technique that utilizes direct perfusion of a cell suspension through the PGS pores to distribute cells homogeneously throughout the construct. By stacking two of these channeled scaffolds in a perfusion cartridge, one can effectively block the flow of medium through the channels, thus forcing the fluid to travel through the scaffold pores. During seeding the cells in suspension become trapped in the PGS pores and are distributed throughout the construct. Following seeding the constructs can be removed from the perfusion cartridges and separated to begin perfusion culture. The scaffold channels remain open and are not blocked by cell aggregates during the short 2 hour seeding process. Here we present the steps involved in generating uniformly seeded constructs with a parallel channel array, including PGS laser machining and sterilization, cardiac cell isolation, and perfusion cartridge setup. The procedures outlined are specific to our engineered cardiac constructs but the techniques may be more generally applied to different types of scaffold, channel geometry, or cell type that can be tailored to the desired application or tissue of interest.

Disclosures

No conflicts of interest declared.