Skin Samples Preparation Using 3D Bioprinting Technology

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Abstract

In vitro skin equivalents continue to be developed to improve predictions of skin corrosivity, irritation, sensitization, phototoxicity, and toxicokinetics for a myriad of chemistries and drugs. Although fabrication of artificial epidermis, cartilage, and some soft tissues has been realized, one of the existing main challenges is the limited diffusion in the biomimetic scaffolds due to the absence of *in-situ* angiogenesis. Oxygen and nutrients are required to maintain the viability and functionalities of constructed tissues. To deal with this problem, we developed an effective *in vitro* approach of forming a vascular network within the engineered tissue constructs using 3D bioprinting. Firstly, an acoustic technique was utilized to rapidly form cell spheroids from suspending cells as bioink. Secondly, biocompatible scaffold (e.g., GelMA and fibrinogen) were fabricated using 3D bioprinting. As a result, HUVEC spheroids could be attached in a short period of time (within 1 hour per batch) and then proliferate well at least 7 days. The vascular network could be formed in GelMA construct from the differentiated HUVECs with the reduced culturing time (from 5 to 2 weeks). Lastly, the printed GelMA construct was found to have long-term structural stability, reliable compression modulus, and low swelling ratio. In the near future, it is anticipated that these techniques will be applied in the mass production of artificial skin samples for various biotechnology applications.

Keywords**:** *tissue engineering, 3D bioprinting, skin substitute, low-intensity pulsed ultrasound (LIPUS), surface acoustic wave (SAW)*