A 3D printed microneedle system for transdermal drug delivery of anticancer drugs

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Background

Transdermal delivery of drugs is an attractive alternative to the conventional route of administration as oral delivery. The hypodermic injections are painful and less patient compliance. Microneedles (MNs) are micron-sized, minimally invasive needles to deliver a wide range of molecules (e.g., small, DNA, vaccines etc.) to the upper portion of dermis in a sustained and controlled manner, without causing any pain. The introduction of 3D printing technologies in the fabrication of MN will promote one step manufacturing tools and scale up for the delivery devices of anticancer drugs.

Methods

The 3D printed MN (3DMN) arrays were fabricated using Stereolithography (SLA), a photopolymerization-based technology, using a biocompatible Class I resin. The printed MN arrays were characterized using Scanning Electron Microscopy (SEM) and coating was evaluated through Fluorescence Microscopy (FM). The penetration efficiency of 3DMN was investigated through the Optical Coherence Tomography (OCT) into the skin in vitro. The delivery efficiencies of MN arrays to release anticancer drugs in vitro were investigated using Franz diffusion cells and vivo animal studies were carried out to determine the delivery of anticancer drugs and tumour regression effect in mice.

Results

3DMN arrays were successfully fabricated using SLA technology and the dimensions were reproducible. OCT studies have shown more than 80% penetration capability. In vitro and in vivo studies demonstrated the rapid transdermal delivery of anticancer drugs and regression of tumour in mice.

Conclusions

These 3DMNs may prove to be of great assistance for the delivery of anticancer drugs in near future in painess, precise and accurate manner.

Keywords:

Anticancer Drugs, Transdermal Drug Delivery, Microneedle, 3D Printing