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ORIGINAL ARTICLES

Fabrication of Polymer Microneedles Using a Two-Photon Polymerization and Micromolding Process

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Abstract

Background:

Microneedle-mediated drug delivery is a promising method for transdermal delivery of insulin, incretin mimetics, and other protein-based pharmacologic agents for treatment of diabetes mellitus. One factor that has limited clinical application of conventional microneedle technology is the poor fracture behavior of microneedles that are created using conventional materials and methods. In this study polymer microneedles for transdermal delivery were created using a two-photon polymerization (2PP) microfabrication and subsequent polydimethylsiloxane (PDMS) micromolding process.

Methods:

Solid microneedle arrays, fabricated by means of 2PP, were used to create negative molds from PDMS. Using these molds microneedle arrays were subsequently prepared by molding eShell 200, a photo-reactive acrylate-based polymer that exhibits water and perspiration resistance.

Results:

The eShell 200 microneedle array demonstrated suitable compressive strength for use in transdermal drug delivery applications. Human epidermal keratinocyte viability on the eShell 200 polymer surfaces was similar to that on polystyrene control surfaces. *In vitro* studies demonstrated that eShell 200 microneedle arrays fabricated using the 2PP microfabrication and PDMS micromolding process technique successfully penetrated human stratum corneum and epidermis.

Conclusions:

Our results suggest that a 2PP microfabrication and subsequent PDMS micromolding process may be used to create microneedle structures with appropriate structural, mechanical, and biological properties for transdermal drug delivery of insulin and other protein-based pharmacologic agents for treatment of diabetes mellitus.

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Abbreviations: (2PP) two-photon polymerization, (CAD) computer-aided design, (KGM-2) keratinocyte growth medium-2, (PDMS) polydimethylsiloxane, (UVB) ultraviolet B

Keywords: microneedle, photopolymer, transdermal drug delivery

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