Docket #: S23-158

3D-printed Microarray Patch (MAP) Designs for Intradermal Delivery and Sampling

Stanford researchers have developed novel designs for 3D-printed microarray patches (MAPs) that can improve intradermal drug delivery and sampling. These designs support the use of microneedles for minimally invasive therapy administration and diagnostics.

Delivering medicine transdermally is highly desirable because in the dermis there is a lack of sensory nerves as well as a higher migratory immune cell population than in the subcutaneous layer. Delivering therapeutics to the dermis is difficult, however, because microneedles need to be able to penetrate the outermost layer of skin and remain retained in the skin while delivering a payload or drawing up fluid. MAPs need to overcome viscoelastic forces in skin and pressure due to interstitial fluid and surrounding tissue.

This invention uses 3D printing techniques to create MAPs with complex geometries to address these challenges. These new designs enable MAPs to be widely adopted in clinical settings to deliver therapeutics and collect samples for diagnosis. MAP drug delivery platforms are minimally invasive, self-administrable, and have the potential to provide therapeutic medication to patients with chronic illnesses such as diabetes and cardiovascular conditions. This invention can increase the efficacy of medicine payloads, improve the safety of administration, and increase access to medical treatment to address global healthcare disparities.

Stage of Development

- Proof of concept

Figure:

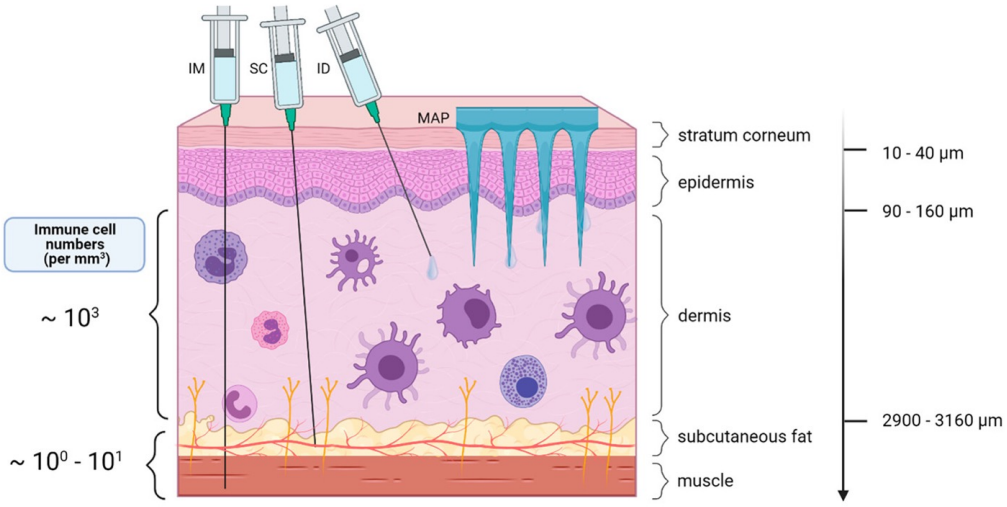

Figure description: Routes of drug delivery. Layers of the skin and drug delivery strategies to access each layer. IM = intramuscular; SC = subcutaneous; ID = intradermal; MAP = microarray patch.

Image credit: https://pubs-acs-org.stanford.idm.oclc.org/doi/full/10.1021/jacsau.2c00432

Applications

- Intradermal therapeutics delivery
- Intradermal sampling for diagnostics

Advantages

- **MAP drug delivery:**
  - Higher migratory immune cell population than subcutaneous/muscle layer
  - Lack of sensory nerves
  - Minimally invasive
  - Self administrable
- **Solves challenges of MAP geometry:**
  - Successful penetration of skin for reproducible and reliable dosage
  - Increased efficacy of payloads
  - Improved safety of administration

Publications

- Netra U. Rajesh, Ian Coates, Madison M. Driskill, Maria T. Dulay, Kaiwen Hsiao, Dan Ilyin, Gunilla B. Jacobson, Jean Won Kwak, Micah Lawrence, Jillian Perry, Cooper O. Shea, Shaomin Tian, and Joseph M. DeSimone (2023). "3D-Printed Microarray Patches for Transdermal Applications. ." *JACS Au* 2(11), (2023): 2426-2445.

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