Microneedle Drug Delivery Patch to Treat Autoimmune Skin Disease

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Regulatory T cells (Tregs) are a subset of immune cells crucial for maintaining immune equilibrium. Disruptions in Treg levels contribute to multiple autoimmune skin diseases. Hence, restoring Treg levels could represent a promising therapeutic approach for conditions such as alopecia areata (AA), psoriasis, vitiligo—many of which lack FDA-approved treatments. However, local targeting of therapies is critical in order to avoid systemic immunosuppression.

The Artzi lab at BWH developed a novel microneedle (MN) patch designed to combat autoimmune skin diseases by igniting powerful immune responses locally. This innovative approach offers a non-invasive method for delivering immunomodulators with minimal local discomfort while avoiding the side effects often associated with systemic immunosuppression—the current standard of care.

Our initial focus has been on leveraging our MN platform to treat AA, a T cell-mediated autoimmune disease that causes hair loss with a chronic, relapsing/remitting course. 91% of AA patients suffer from mild-to-moderate symptoms manifesting as focal, patchy lesions. The significant social and psychological effects of AA and lack of FDA-approved treatments for patchy or focal AA drive patients to seek off-label solutions like local corticosteroid injections despite minimal benefits and adverse side effects.

We used our MNs to locally deliver a combination of biologics, CCL22 and IL2, that synergistically recruit and expand Tregs. In murine models of AA and humanized skin transplant models, this treatment altered the immune profile in AA and transplant lesions (Fig 1 A and B, respectively). Further, hair regrowth persisted for over two months post-treatment cessation; these same agents failed to induce hair growth when delivered with conventional hypodermic needles (Fig 2).

Our MN technology offers a groundbreaking alternative by delivering effective, long-lasting therapy that directly addresses the immune imbalance within hair follicles, the root cause of AA. The platform holds potential to transform the treatment paradigm for AA and other autoimmune skin conditions such as psoriasis and vitiligo. We have initiated proof-of-concept studies in murine models for these indications. Our startup, Lybra Bio, is seeking partners to commercialize our technology and develop these applications.

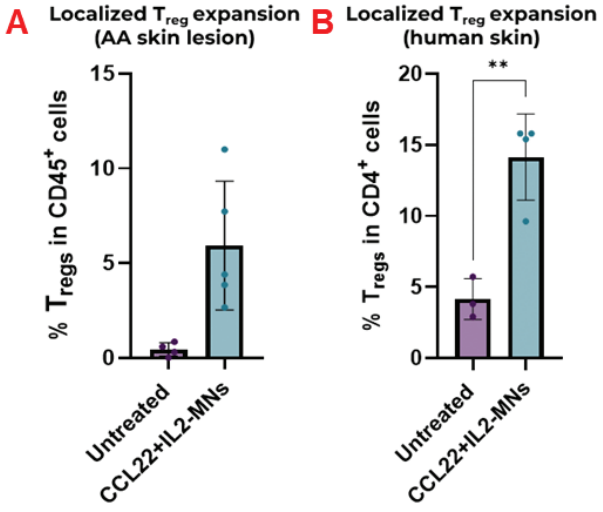

Figure 1.

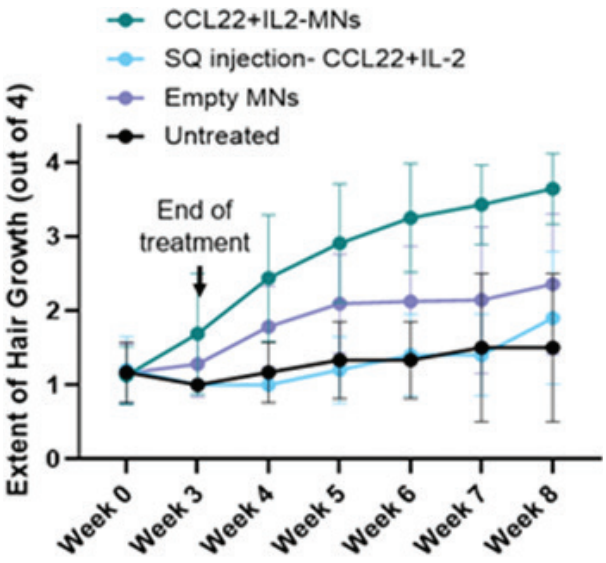

Figure 2.