Optimization of Adhesive, 3D-Printed Hydrogel Patches as a Drug Delivery System for Wound Healing

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Introduction: Chronic wounds impact >2.5 million people in the US annually[1]. Growth factors have shown success in promoting angiogenesis, but most are topical formulations which suffer from limited bioavailability due to rapid clearing[2,3]. We propose 3D-printed gelatin methacrylate-based (GelMA) hydrogel patches for the local, sustained delivery of platelet-derived growth factor (PDGF), an FDA-approved therapeutic for diabetic wounds. We optimized patches for PDGF delivery by investigating their degradation in collagenase, protein loading, and release efficiency.

Methods: To observe degradation, patches were placed in varying concentrations of collagenase and patch weights and areas were recorded for 25 days. Protein loading efficiency was modeled with green fluorescent protein (GFP), using ELISA to identify protein loading into the crosslinked patch. To investigate protein release, patches loaded with PDGF were placed in PBS and monitored for 3 days. ELISA was performed on patch supernatants each day to quantify the PDGF concentration released.

Results: Our data shows patches are resistant to degradation in physiological levels of collagenase (1μg/mL) for 25 days. GFP loading efficiency was determined to be around 78%. Protein release experiments confirmed successful loading of PDGF into patches and showed a sustained release profile over 3 days.

Discussion: Our patches' resistance to degradation in collagenase suggest they are suitable for long-term use as a wound healing drug delivery system. Future experiments will involve refining protein loading and ELISA protocols to increase protein detection. We also plan on optimizing patch composition to fine-tune PDGF release over time.

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