Syndesome-Based Dressings for Enhanced Wound Healing in Diabetic Ulcers

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Incidence of chronic non-healing wounds has significantly increased over the last decade due to a rising epidemic in type-II diabetes and peripheral arterial disease (PAD). Previous research has attempted to use growth factor proteins or genes to enhance the healing of cutaneous wounds but have achieved only limited success in healing chronic wounds in the long-term. Our previous work has demonstrated a significant reduction of syndecan-4 protein due to long-term diabetic condition and co-delivery of syndesomes (syndecan-4 proteoliposomes) with FGF-2 enhanced angiogenesis. In this study, we tested the efficacy of a novel wound dressing that delivered FGF-2 with syndesomes in ob/ob mice.

To recapitulate the human disease state, we used ob/ob mice and fed them a high fat diet for 15 weeks. We utilized a splinted, excisional wound model and implanted 2% alginate disks containing treatments into the wound, which were fabricated using a custom made high throughput mold. We monitored the perfusion of the wounds over time using laser speckle imaging.

At day 14, wounds treated with syndesomes (S4PL) and FGF-2 healed the wound significantly more than all other groups (A, B). Histological analysis demonstrated increased re-epithelialization of the wounds treated with S4PL with FGF-2 (C, D). Laser speckle imaging of the wound showed increased perfusion in the S4PL with FGF-2 treated group. Furthermore, immunostaining for the M1 macrophage marker (CD86) showed significantly reduced inflammatory macrophages in both S4PL+FGF-2 and S4PL groups (E, F). Staining for an M2 macrophage marker (CD163) revealed enhanced levels when the syndesomes were delivered, compared to control and FGF-2 groups (G, H).

Taken together, our studies support that syndesomes significantly enhance FGF-2 activity in wound healing in diabetic mice. Thus, syndesome-containing wound dressings may be useful in treating chronic wounds and restoring growth factor activity in diseased states.