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Composite Poly(methyl methacrylate)/Poly(ethylene glycol) electrospun nanofibrous mats as a novel wound dressing for controlled release of an anti-scarring agent

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Wound healing outcome is regulated by a fine balance between deposition and degradation of extracellular matrix (ECM). Over healing process in skin is mediated by exaggerated ECM deposition and abnormalities in ECM degradation. Moving toward novel approaches to prevent skin fibrosis, we identified a small molecule having anti-scarring properties which is called Fibrosis Stop 2 (FS2). Although daily application of FS2 containing cream eliminates evidence of scarring in a fibrotic rabbit ear model, an effective wound dressing, releasing controlled doses of FS2, will be more beneficial for FS2 delivery to extensive burns where the wound dressing get changed every 4-5 days.

This study aims to develop novel biomedicated electrospun nanofibrouse mats for controlled delivery of FS2, directly to an injury site to improve the wound healing outcome. Nanofibers of Poly(methyl methacrylate) and different composite blends of Poly(methyl methacrylate)/Poly(ethylene glycol) with FS2, were successfully electrospun for the first time. Scanning electron microscopy was performed to determine the morphology and average diameter of the electrospun nanofibers. *In vitro* drug release evaluations showed that addition of PEG to PMMA has a proportional enhancing effect on the release of FS2 from nanofibrouse mats. While FS2-loaded PMMA/5% PEG mats showed significantly lower levels of burst release and prolonged release up to 5 days, medicated PMMA/20% PEG mats demonstrated complete drug release within 24 hours. The biological activity of the nanofiber incorporated FS2 was evaluated *in vitro* by determining the effect of these dressings on ECM components' expression by fibroblasts. These studies showed that nanofiber incorporated FS2 significantly decreases the expression of collagen-I and α-smooth muscle actin and increases the expression of MMP1 which indicate the preservation of FS2 biological activity during the electrospinning process.

Electrospinning of PMMA/PEG blend exhibited a useful and convenient method for controlling the rate and period of FS2 release in wound healing applications. The findings of this study confirmed that it is feasible to develop an anti-fibrogenic dressing for prevention of dermal fibrosis frequently seen upon burn, deep trauma and surgical procedures.

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