

## Smart silk dressings - for treating chronic wounds

Breaching of integral structure of skin causes cutaneous wounds, healing of which becomes difficult in certain diseased or pathological conditions like diabetes, obesity, infection or traumatic injuries. According to the recent report from Diabetes Atlas, more than 400 million people are suffering from diabetes world-wide. The patients often develop diabetic foot ulcers due to failure of the self-healing power and thereby the wounds become non-healing ulcers or scar tissues. Patients with untreated wounds also get orthopedic, neurologic and metabolic complications over and over again leading to organ amputations. This has led to a huge demand for smart dressing materials to combat impaired healing and scarring problems. To treat the chronic wounds, we have developed a ready-to-use bioactive wound dressing using natural silk fibroin biomaterial functionalized with epidermal growth factor and antibiotic molecules. Silk fibroin is a cost effective natural biopolymer with excellent biocompatibility property. It has been extensively explored in wound healing and regenerative medicine since centuries in the form of sutures and has many advantages over synthetic polymers.



Fig. 1. Schematic representation of the development of silk based nanofibrous mats for treating chronic skin wounds and its potential for wound healing applications.

The whole fabrication process involved green synthesis methodology where aqueous solvents were used unlike the usage of harmful chemicals in conventional polymeric matrices. We

compared silk fibroin based matrices from three different silkworm varieties to investigate their potential in wound repair process. In order to explore the extraordinary properties of endemic Indian variety of non-mulberry silk (Muga and Eri), we fabricated the dressing patch in the best suited form and compared with already explored mulberry silk variety (*Bombyx mori*) for wound healing applications. Wound dressings were developed in the format of nanofibrous mat using electrospinning technique by which fiber-size ranging from 100 to 300 nm in diameter was successfully achieved. Electrospun materials meet most of the requirements outlined for wound-healing applications because their microfibrillar structures and interconnected porosity provide the desirable moist environment for accelerated wound healing process. The bioactive factors like antibiotics and epidermal growth factor were easily incorporated in the silk nanofibrous mat using electrospinning technique to prevent microbial infection and accelerate wound healing process respectively.



Fig. 2. Pictures of scientists: Dr. Biman B. Mandal (left) and Dimple Chouhan of IIT – Guwahati, India displaying the silk wound dressing developed in the laboratory.

The silk fibroin isolated from non-mulberry silkworm variety possesses cell binding motifs in the protein sequence which aid in better attachment of cells to the dressings, thereby recruiting cells for faster healing. The initial trials in rabbit model healed the wounds within 10-14 days giving improved results as compared to common surgical dressing (20 days). Silk dressing promoted more cellular proliferation and cellular recruitment towards the wound bed and accelerated the healing process. Investigation of regenerated skin post 14 days of healing revealed cell-material interaction properties of non-mulberry silk variety. The wound dressings interacted with fibroblast cells of the wound and influenced their secretion of extracellular matrix (ECM) components like collagen and elastin. The regular deposition of ECM fibers further helped in preventing the scarring of wounded tissue. The wound dressings indeed acted as an instructive platform for ideal skin regeneration. The unique peptide motifs of non-mulberry silk assisted the augmented recruitment

of fibroblast, keratinocytes and endothelial cells leading to accelerated wound repair. Early progression of mature granulation tissue, faster re-epithelialization and angiogenesis were also observed in the wounds in rabbit model. Early regeneration of skin appendages like hair follicles and sebaceous glands also forwarded the developed nanofibrous mats as potential wound dressing material for scarless healing. The remarkable results achieved from the developed wound dressing suggests great potential of bioactive silk dressing for treating chronic wounds in humans and is few steps away from being translated into a product at much lower cost than the current scenario.

***Dimple Chouhan, Biman B. Mandal***

*Biomaterial and Tissue Engineering Laboratory, Department of Biosciences and Bioengineering,  
Indian Institute of Technology Guwahati, Assam, India*

## **Publication**

[Role of non-mulberry silk fibroin in deposition and regulation of extracellular matrix towards accelerated wound healing.](#)

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