

# Clinical Treatment of Pathological Scar: Current Situation and Future Trend





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## Abstract

Abnormal wound healing is most likely to induce scar formation. The large amount of deposition of collagen-based extracellular matrix and the excessive proliferation of dermal tissue give rise to dysfunction, deformity and psychological trauma in burn patients with pathological scar. The complex pathogenesis of pathological scar makes scar healing remains a challenge without an ideal cure way. Here, the clinical treatment experiences and research results of pathological scar were reviewed, and a novel therapeutic strategy based on soluble polymeric microneedles currently being on our radar, which seems to be a perfect solution for home-based treatment of scars.

**Keywords:** Wound Healing; Pathological Scar; Clinical Treatment; Polymeric Microneedles; Home Based Treatment

## Introduction

Following injury such as burn, surgery and anabrosis, normal skin may undergo morphological and histopathological changes, so that scarring is an inevitable outcome of wound repair, which is the manifestation human's self-defense, while excessive scarring should be regarded as morbidity [1-4]. Pathological scar is concerned to be one of the most common complication after burn and traumas. Scarring of the appearance and dysfunction, in some severe cases, bring great physical and psychological burden to patients [5-7]. Therefore, the pathogenesis of formation, prevention and treatment of scar are becoming the clinical focus in the surgery department. Though the precise pathogenesis of excessive scarring has not been fully understood, in recent years, researchers have gradually explored the formation and regression mechanism of pathological scar from different perspectives and obtained a relatively consistent views: Pathological scar is characterized by the increased inflammatory, proliferation of myofibroblasts and disorder of collagen metabolism caused excessive extracellular matrix (ECM) deposition. TGF- beta 1/smad signaling pathway is also closely related to these excessively scarring lesions [5, 8-10]. Based on the known pathogenesis, Regulating the proliferation, differentiation, migration and apoptosis of myofibroblast, collagen

metabolism and arrangement, and other relevant signal pathways are main effective approaches for scar treatment [11-13].

## Current Treatment Strategies

Currently, surgical excision, pressure, radiation therapy, chemotherapy, and other medication surgical treatments are the major therapy strategies. In the latest Chinese expert consensus on clinical prevention and treatment of scar and other review literatures, the available clinical therapies including topical preparations with onion-extract, mitomycin C, and imiquimod. Intralesional injections with bleomycin, corticosteroids, and 5-fluorouracil. Pressure therapy with silicone gel, and hypoallergenic microporous tape. Radiotherapy with radiofrequency ablation. Photodynamic therapy with intensive pulsed light, pulsed dye laser, and fractional laser. And cryotherapy, surgery, as well [3,6,9,14-17]. Moreover, there were reports about intra-lesional injections of collagenase, [11] botulinum toxin-A, [12] stem cell therapy [18] and autologous chyle fat grafting [19] for the treatment of hypertrophic scars.

However, these monotherapies remain unsatisfactory therapeutic effect due to their defects such as pain, drug side effects, radiogenic cancer risks, low transdermal efficiency,

ulceration, [9] and because of the complexity of scarring mechanism and persistently evolving process [3]. So far, available clinical experiences and experimental-based data have suggested that a combination approach is more effective, using multiple modalities of therapy strategies (e.g., the combination of onion extract preparations and silicone gel sheet, [20] or triamcinolone acetonide, [14] CO2 fractional laser combined with 5-fluorouracil [21]. But the optimal combination therapy is still to be investigated and determined depending on the individual case.

### New Microneedles-Based Approach

Polymeric microneedles (MNs) are emerging as an excellent transdermal delivery system to overcome the limitations of conventional needle injection, owing to it allows both macro and micro-molecules traversing the stratum corneum in a minimally invasive way and even controlled release, and further can be conveniently self-administered by patients [22-25]. During the last year, amounts of studies have worked on this feasible technique for the effective transdermal administration of drugs and tried to promote research of MNs trend to market applications [26-28]. The successful clinical use of the microneedle in vaccine therapy inspired our group to realize that self-administered MNs appeared to be an attractive alternative method for clinical treatment of scars. Meantime, we noticed that Liu's group have tried to apply peptide-loaded microneedles to a keloid scar model and demonstrated a potential therapeutic effect [29].

### Conclusion

With the development of clinical technologies and patients' growing desire to improve the treatment process, a trend is currently observed toward the indication of less invasive isolated or combined techniques in the treatment of scars. Thus emerging novel therapeutic approaches including microneedles-based strategy need more research to enable the improvement of strategies on scar management.

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