# Skin Repair based on Traditional Chinese Medicine Combined with Dressing Therapy: Application and Mechanism

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**Abstract.** This paper aims to examine the evolution of traditional Chinese and Western medicine dressings in wound treatment, highlighting the promising effects and extensive potential of newly developed dressings that integrate the strengths of both approaches. Our research indicates that conventional Western medicine dressings often exhibit inadequate efficacy and necessitate cumbersome replacements, leading to significant discomfort for patients and imposing unnecessary burdens on healthcare professionals. Conversely, innovative high-tech Western dressings demonstrate superior performance and ease of maintenance, gradually making their way into clinical practice. Traditional Chinese medicine boasts a wealth of historical prescriptions for wound treatment, with specific formulations demonstrating remarkable efficacy in promoting wound healing. Investigations into the underlying mechanisms suggest that these effects may be linked to the modulation of the Wnt/β-catenin signaling pathway in wound cells, contributing positively to therapeutic outcomes. Thus, the synergistic integration of these methodologies holds great promise for advancing wound recovery strategies. Current studies have substantiated that the combined approach of traditional Chinese and Western medicine yields more effective treatment results. With the ongoing advancements in artificial intelligence, materials science, and modern practices in traditional Chinese medicine, the future of wound management through integrated dressings is poised for significant enhancement.

**Keywords:** Wound recovery, traditional Chinese medicine, dressing technology, integrated traditional Chinese and western medicine, Wnt/β-catenin pathway.

## 1. Introduction

As the largest organ in the human body, the skin serves crucial functions, including blocking foreign bodies, pathogens, and reducing ultraviolet radiation damage, while also playing a vital role in regulating body temperature and fluids. It acts as the primary barrier against external harm, making skin lesions a common clinical issue. Such damage can range from mild to severe, causing significant pain and potentially threatening the patient's life; even after healing, sequelae such as disfigurement or skin insufficiency may occur [1-2]. Therefore, the treatment of skin damage and the promotion of skin regeneration remain essential research focuses in frontline clinical practice.

Currently, dressing application is a prevalent treatment for skin wounds. Traditional Western medicine dressings, such as gauze, cotton pads, and bandages, primarily serve as physical barriers, requiring frequent replacement and debridement, which can exacerbate patient discomfort and increase the workload for healthcare providers. Additionally, these dressings do not actively promote wound healing, leaving wounds vulnerable to complications. In contrast, innovative Western dressings like hydrogels exhibit excellent biological and physical properties, effectively absorbing wound exudate and fostering an environment conducive to cell proliferation, differentiation, and migration, thus aiding in wound recovery. However, the overall repair process still largely depends on the patient's intrinsic healing capabilities.

Traditional Chinese medicine (TCM) offers a multi-faceted, multi-targeted approach, with compound topical preparations that can directly act on damaged wounds. The active ingredients in TCM formulations, upon absorption through the skin, can significantly reduce swelling and pain, promote tissue regeneration, and offer unique pharmacological benefits in wound repair [3]. Recent research has established a crucial link between TCM and the regulation of the Wnt/β-catenin signaling pathway in wound healing.

The Wnt signaling pathway is an evolutionarily conserved mechanism involved in embryonic development, tissue differentiation, and repair. Studies indicate that Wnt genes play significant roles in hair follicle growth, wound healing, and skin tumor treatment, garnering increasing attention for their impact on tissue development and repair processes. Specifically, the Wnt/β-catenin pathway is vital for wound healing, regulating endothelial cell proliferation, angiogenesis, and granulation tissue formation.

This article aims to explore the beneficial aspects of both traditional Chinese and Western medicine, investigating methods for their integration. Additionally, we will analyze the mechanisms through which the Wnt/β-catenin signaling pathway influences skin repair and project future directions for wound management.

## 2. Application of Traditional Chinese Medicine in Skin Repair

In experimental inquiries involving traditional Chinese medicine (TCM), controlled studies have been predominantly utilized to assess the differences in healing outcomes between various treatment groups and a control group, all under similar wound conditions.

Key findings and results include the following: The application of traditional Chinese medicine significantly enhances the healing process, leading to faster recovery and improved functional outcomes post-healing; The reparative effects of traditional Chinese medicine are closely associated with the regulation of the Wnt/β-catenin signaling pathway; Traditional auxiliary dressings, akin to Western medical gauze, exhibit a synergistic effect when used in conjunction with medicinal compounds from traditional Chinese medicine.

Numerous studies indicate that the mechanisms underlying the action of traditional Chinese medicine in wound repair may be linked to its modulation of the Wnt/β-catenin signaling pathway. In most experimental groups, significant alterations in the expression of genes associated with this pathway were observed compared to the control group.

### 2.1. Promoting Effect of BaDuShengJiSan on Skin Ulcer Healing

BaDuShengJiSan, first documented in the Qing Dynasty medical text “Jiu Shang Mi Zhi,” is currently utilized in an improved formulation recorded in “Quan Guo Zhong Cheng Yao Chu Fang Ji” (PMPH). This powder comprises key ingredients such as red powder, light powder, yellow Dan, calcined calamine, calcined gypsum, calcined keel, worm white wax, and borneol, exhibiting properties that remove toxins and pus, prevent putrefaction, and promote tissue regeneration, making it effective for treating chronic sores.

In a study conducted by Wang Shuangxun and Li Dayong, BaDuShengJiSan was employed as the experimental treatment to investigate its effects on skin ulcer healing in diabetic rats, with a focus on the Wnt/β-catenin pathway [4]. Results indicated that diabetic rats treated with this traditional medicine exhibited faster healing of skin ulcers compared to the untreated model group, with reduced necrosis and inflammation. Subsequent analyses revealed significant increases in the mRNA expression levels of Wnt and β-catenin in the wounds of rats treated with BaDuShengJiSan, thereby confirming that the therapeutic mechanism of this formulation is closely linked to the regulation of the Wnt/β-catenin signaling pathway.

### 2.2. Effects of Pi Nian San and Its Disassembled Formula for Topical Application on Wound

Pi Nian San is an empirical formulation developed by Professor Wen Zhuozhi, a renowned practitioner from Chengdu University of Traditional Chinese Medicine. The prescription consists of 60 grams of calamine, 6 grams of cinnabar, 3 grams of amber, 4.5 grams of borax, 15 grams of Coptis chinensis, 1.2 grams of bear bile, 0.6 grams of borneol, and 0.9 grams of musk. This formulation possesses anti-inflammatory and analgesic properties, promotes tissue regeneration, and is suitable for treating ulcers of the skin and mucous membranes [5].

A study conducted by Song Wei et al. examined the effects of Pi Nian San, particularly its external application, on wound healing and the Wnt/β-catenin signaling pathway in a chronic skin ulcer model in rats [6]. The results revealed that rats treated with Pi Nian San experienced a significantly higher rate of skin wound healing compared to the model group, accompanied by a notable reduction in wound area and inflammation. Additionally, there was a marked decrease in inflammatory cell infiltration and an abundance of new capillaries in the wound site.

Gene expression analyses of wound tissue demonstrated significant increases in the mRNA levels of Wnt4, Ctnnb1, Ccnd1, Cend1, and Cdh2, all of which are associated with the Wnt/β-catenin signaling pathway. These findings strongly support the conclusion that the therapeutic effects of Pi Nian San are linked to its regulation of the Wnt/β-catenin pathway.

### 2.3. Effect of Lycium Barbarum Polysaccharide on Wound Healing

Lycium barbarum polysaccharides (LBP) are natural compounds derived from the Chinese medicinal plant Lycium barbarum, known for their pharmacological activities, including antioxidant, anti-aging, and anti-tumor effects.

In a study conducted by Ma Liangliang et al., LBP solution was administered to experimental rats via gavage to assess its effectiveness in treating pressure ulcers [7]. Results indicated that the wound healing rate in rats receiving LBP was significantly higher than that of the control group, with reduced dermatitis infiltration and an increase in capillary density observed.

Further analysis of gene expression related to the Wnt/β-catenin pathway revealed a notable increase in the mRNA levels of Wnt/β-catenin pathway components following LBP treatment, alongside a decrease in GSK-3β expression. These findings strongly suggest that the therapeutic mechanism of Lycium barbarum polysaccharides is closely associated with the modulation of the Wnt/β-catenin signaling pathway [7].

## 3. Modern New Dressing Technology

New medical dressings represent advancements in wound care, utilizing innovative materials and designs to enhance the functionality and efficacy of traditional gauze dressings. These modern dressings are engineered to provide superior wound treatment and protection, embodying the principle of moist healing, which is essential for optimal recovery. Compared to traditional dressings, new medical dressings offer enhanced protection and create a conducive environment for wound healing while also allowing for the incorporation of therapeutic agents. Numerous studies have demonstrated the advantages of these advanced dressings across various wound types.

### 3.1. Classification of New Dressing

Traditional dressings, including medical gauze, petroleum jelly gauze, and bandages, primarily serve to stop bleeding and absorb wound exudate. However, their functionalities are limited and overly simplistic. In contrast, new dressings address the shortcomings of traditional options and align with the wet healing theory essential for effective wound repair. Modern medical dressings can be classified into several categories, including films, hydrogels, alginates, foams, hydrocolloids, and medicinal dressings [8].

### 3.2. The Latest Developments in New Dressings

A Currently, researchers worldwide are exploring the integration of electronic and intelligent technologies into wound dressings. Proposals include the incorporation of artificial intelligence for personalized and customized wound treatment solutions. Emerging innovations feature dressings that intelligently deliver drugs based on wound indicators, as well as those capable of monitoring wound conditions in real-time. Furthermore, there are developments in dressings that can be remotely controlled, indicating significant potential for future advancements in wound management [9].

# 4. Combination of Modern Dressing Technology and Traditional Chinese Medicine

## 4.1. Repair of Skin Lesions with Sodium Alginate/Gelatin Hydrogel Dressing Loaded with 4-Cholesten-3-one

4-Cholesten-3-one ((+) 4-Cholesten-3-one, abbreviated as S9) is a pharmacologically active monomer derived from traditional Chinese medicine, specifically from tortoise shell (Plastrum Testudinis). This compound is known for its properties that promote tissue regeneration, enhance skin healing, and repair sores.

Sodium alginate/gelatin hydrogel is an innovative auxiliary dressing employed in modern medical practice for the treatment of skin wounds. Compared to conventional dressings like gauze, this hydrogel offers superior biological functionality, excellent water absorption, softness, and ease of application, creating an optimal environment for wound cell proliferation.

You Aijia investigated the potential synergistic effects of combining these two modalities, proposing a novel dressing that integrates elements of both traditional Chinese and Western medicine [10]. The effective tortoise shell monomer was encapsulated within the sodium alginate/gelatin hydrogel, and a controlled experiment was conducted using wounds in experimental rats. The results indicated that the combined treatment of hydrogel and traditional Chinese medicine monomer yielded a significantly better therapeutic effect than either treatment alone.

Furthermore, the expression of genes associated with the Wnt/β-catenin pathway was assessed during the experiment. It was observed that the expression levels of genes related to this pathway were elevated, while the expression of GSK-3β decreased, suggesting that the therapeutic mechanism underlying this dressing may be linked to the regulation of the Wnt/β-catenin signaling pathway.

## 4.2. MEBO Combined with Silver Ion Dressing in the Treatment of Pressure Ulcers

MEBO is a ready-to-use traditional Chinese medicine widely employed for treating mild burns, scalds, and wounds. Its primary ingredients include Coptis chinensis, cork phellodendron, Scutellarin baicalensis, earthworm, and poppy shell, which collectively work to clear heat, detoxify, relieve pain, and promote tissue regeneration.

Silver ion dressing is an advanced therapeutic option known for its broad-spectrum antibacterial properties, providing effective wound protection. The key components of this dressing are sodium carboxymethyl cellulose and silver ions. Carboxymethyl cellulose, rich in hydrophilic lattice fibers, effectively absorbs wound exudate, creating an optimal healing environment, while silver ions offer potent and long-lasting antimicrobial action, preventing bacterial and fungal infections.

Guo Ping investigated the combined effects of MEBO and silver ion dressing to evaluate their therapeutic efficacy [11]. An analysis of data from 100 patients revealed that the combination significantly reduced inflammatory factor levels in the wound compared to the use of silver ion dressing alone. Additionally, patients experienced less prominent scarring and reduced pain, indicating that the combined treatment demonstrates superior therapeutic outcomes in managing pressure ulcers.

## 4.3. Compound Huangbai Liquid Wet Compress Combined with Silicone Foam Dressing in the Treatment of Stage Three Pressure Injuries

Compound Phellodendron Cork Liquid is a widely used traditional Chinese medicine, formulated from ingredients such as Forsythia suspensa, Phellodendron cork, honeysuckle, dandelion, and centipede. This compound is effective in treating post-ulcerations and wound infections, promoting the clearing of heat and toxins, reducing swelling, and facilitating tissue regeneration.

Silicone foam dressing is an innovative dressing characterized by its multi-layer structure. It comprises a soft contact layer, an absorbent layer, a compression layer, and an outer plastic film layer that permits water vapor permeability. This design allows the dressing to maintain a moist wound environment, absorb exudate, and effectively block bacterial contamination while retaining moisture.

Zhou Yingping and colleagues from conducted a clinical study involving 90 patients with Panax notoginseng-related pressure injuries in the ICU [12]. Their findings indicated that the combination of Compound Huangbai liquid wet compress and silicone foam dressing significantly improved wound healing rates compared to either treatment used alone. Additionally, the incidence of inflammation was reduced, and patient satisfaction was notably higher, highlighting the efficacy of this combined therapeutic approach.

## 5. Wnt/β-Catenin Pathway in Wound Repair

### 5.1. Mechanism of Action of the Wnt/β-Catenin Pathway

The Wnt/β-catenin signaling pathway is a highly conserved pathway that regulates numerous biological processes, with 19 members of the Wnt gene family identified to date. This pathway plays a crucial role in cell proliferation, apoptosis, differentiation, and may also guide stem cell development. Among its various branches, the Wnt/β-catenin signaling pathway is the most extensively studied and is often referred to as the classical Wnt pathway.

The mechanism of action involves the binding of Wnt signaling proteins to Frizzled (Fzd) receptors, forming a receptor complex that also includes low-density lipoprotein receptor-related proteins 5 and 6 (LRP5/6). This complex interacts with scaffold proteins such as Dishevelled (Dvl) and axin, leading to the phosphorylation and inactivation of glycogen synthase kinase-3β (GSK-3β). As a result, β-catenin is not phosphorylated and degraded. Consequently, the accumulation of free β-catenin in the cytoplasm allows it to translocate into the nucleus, where it binds to T-cell factor (TCF) and initiates the expression of downstream target genes such as Cyclin D1 and C-myc, thereby promoting cell proliferation and differentiation.

The Wnt signaling pathway family has significant implications for the treatment of various conditions, including cancer, skin diseases, cardiovascular disorders, and orthopedic diseases [13-16].

### 5.2. The Role of the Wnt Signaling Pathway in Wound Repair

Research has demonstrated that the Wnt signaling pathway is instrumental in wound healing by regulating endothelial cell activity to facilitate blood vessel regeneration. Increased expression levels of Wnt and β-catenin enhance the proliferation, differentiation, and migration of skin cells, thereby promoting effective wound repair [17].

## 6. Conclusion

Wound treatment remains a significant challenge for clinicians. Traditional external dressings like gauze are gradually being supplanted by innovative alternatives that offer numerous advantages. These new dressings, with their superior physical properties, provide an excellent foundation for incorporating traditional Chinese medicine (TCM), opening new avenues for wound care.

Evidence demonstrates that TCM is highly effective in wound treatment. The synergy between TCM and modern dressings has proven particularly advantageous. TCM's efficacy in wound healing is attributed to its ability to guide recovery, promote regeneration, and reduce inflammation. Its widespread clinical adoption is supported by research suggesting that various TCM components may influence wound repair through regulation of the Wnt/β-catenin pathway.

Concurrently, advancements in materials science have led to the development of high-performance dressings that create optimal environments for wound healing. These dressings can also serve as drug delivery systems, enhancing their therapeutic potential. The integration of TCM and Western medicine has long been a topic of interest, with their complementary strengths yielding impressive clinical outcomes. This synergy is particularly evident in the field of wound care, where TCM-infused modern dressings show great promise and represent a key direction for future development.

Several areas warrant further exploration in this field. While most current TCM-integrated dressings use existing formulations, there's potential for developing specialized TCM extracts or new

compounds tailored for wound care applications. Additionally, modifying the properties of modern dressings to better complement and enhance the efficacy of TCM components could yield improved outcomes. Furthermore, incorporating intelligent features for wound monitoring and automated drug delivery presents an exciting avenue for advancement.

As research progresses, we can anticipate a more diverse range of TCM-integrated dressings with enhanced therapeutic effects, offering new hope to patients requiring advanced wound care. The future of wound treatment lies in this innovative fusion of traditional wisdom and cutting-edge technology, promising more effective and personalized healing solutions.

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