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Mechanisms and Evidence-Based Advantages of Traditional Chinese Medicine Wax Therapy in Chronic Disease Treatment

Jian Song*, Jing Yuan, Kaiqiang Meng

Shaanxi University of Chinese Medicine, Xianyang 712046, Shaanxi, China
**Correspondence Author*

Abstract: ***Objective:*** *To systematically elaborate the core mechanisms of Traditional Chinese Medicine (TCM) wax therapy in treating chronic diseases and provide evidence-based support for its standardized clinical application.* ***Methods:*** *Databases including CNKI, PubMed, and Web of Science (2010-2024) were searched to include clinical studies, basic experiments, and review articles on TCM wax therapy for chronic diseases (inclusion criteria: randomized controlled trials with Jadad score ≥3, cohort studies with sample size ≥50). Integrative analysis was conducted from four dimensions: theoretical basis, core mechanisms, disease-specific effects, and evidence-based efficacy.* ***Results:*** *TCM wax therapy exerts synergistic effects through "thermotherapy-herbal syndrome differentiation-transdermal delivery," significantly improving the local pathological microenvironment of chronic diseases: increasing blood flow velocity by 30%-50%, improving blood oxygen saturation by 15%-20%, inhibiting the release of prostaglandin E2 (PGE2) and tumor necrosis factor-α (TNF-α) by 42% and 38% respectively, and enhancing fibroblast activity by 35%. The total effective rate for chronic locomotor system injuries reached 92.3% (95%CI: 88.6%-95.1%), with an adverse reaction rate of only 2.1% (far lower than 15.6% in the oral Western medicine group).* ***Conclusion:*** *TCM wax therapy regulates local circulation, inflammation, and repair processes through multiple targets, demonstrating advantages of safety, efficacy, and convenience in chronic disease treatment. Its mechanism is closely related to "local microenvironment remodeling," and further research on molecular mechanisms and technical standardization is needed.*

Keywords: Traditional Chinese Medicine wax therapy, Chronic diseases, Transdermal drug delivery system, Thermotherapeutic effect, Evidence-based medicine, Local microenvironment**.**

1. Introduction

Chronic diseases have become a major challenge in global public health. According to the 2023 World Health Organization (WHO) report, there are over 1.6 billion chronic disease patients worldwide, among which the incidence of chronic locomotor system injuries (such as lumbar muscle strain and osteoarthritis) accounts for 23.7% of the adult population, and the prevalence of spinal diseases and hyperosteogeny in people aged 60 and above reaches 58.2% [1]. Data from China's National Health Commission in 2024 showed that among domestic patients with chronic locomotor system injuries, the incidence of lumbar and back injuries was 38.1%, knee injuries 34.5%, and ankle injuries 46.4%, with medical resource consumption accounting for 61.5% of total medical expenditure [2].

The pathological core of chronic diseases lies in "local microenvironment imbalance," manifested as a vicious cycle of microcirculatory disturbance, inflammatory factor accumulation, and decreased tissue repair capacity [3]. Traditional treatment methods have obvious limitations: oral non-steroidal anti-inflammatory drugs (e.g., ibuprofen) cause gastrointestinal mucosal injury in 28.3% of long-term users [4]; Western medicine paraffin therapy only relies on a single thermotherapeutic effect with efficacy lasting less than 6 hours [5]; TCM therapies like acupuncture have a home-based compliance rate of only 32.6% [6].

Derived from *Emergency Prescriptions Handy for Times* (Eastern Han Dynasty), TCM wax therapy integrates traditional TCM external treatment theory with modern transdermal drug delivery technology. Recent studies have shown its unique advantages in chronic disease treatment, using beeswax as the medium and syndrome-differentiated herbs as the core to achieve "safe thermotherapy + targeted drug delivery" [7,8]. This article systematically combs its theoretical basis, core mechanisms, and disease-specific effects to provide references for clinical promotion.

2. Theoretical Origin and Material Basis of TCM Wax Therapy

2.1 TCM Theoretical Basis: From Classical Principles to Modern Interpretation

TCM understanding of wax therapy traces back to the Eastern Han Dynasty. Zhang Zhongjing recorded wax's external treatment value in Emergency Prescriptions Handy for Times, while Li Shizhen expanded its indications in Compendium of Materia Medica (Ming Dynasty), emphasizing beeswax's property of "warming meridians and activating blood circulation" [9]. Modern TCM summarizes chronic disease pathogenesis as "three stagnations and one deficiency": qi stagnation and blood stasis, cold-dampness stagnation, and zang-fu organ deficiency [10].

TCM wax therapy targets this pathogenesis: using wax's "warming nature" to break "cold congealing blood stasis," and syndrome-differentiated herbs to regulate specific syndromes—e.g., promoting blood circulation for blood stasis, warming yang for cold-dampness [11]. Clinical studies confirm an 89.7% effective rate for syndrome-differentiated wax therapy, significantly higher than 62.3% for non-syndrome-differentiated therapy [12].

2.2 Modern Medical Material Basis

2.2.1 Wax Therapy Medium Advantages

TCM wax therapy uses medical-grade beeswax, containing 90.2%±3.5% octacosanol (OCL)—absent in paraffin. OCL inhibits PGE2 and TNF-α release to alleviate chronic inflammation and regulate muscle energy metabolism [13]. Beeswax's physicochemical properties (heat capacity: 2.1kJ/(kg·℃); thermal conductivity: 0.23W/(m·K)) maintain a stable 45℃-50℃ temperature range, avoiding scalding while ensuring close adherence to irregular anatomical structures [14].

Recently developed composite wax blocks (soy wax + herbal layer + beeswax layer) extend effective treatment time to 1.5 hours. The herbal layer, prepared via "alcohol purification + rosin-neutral resin-adhesive blending," increases active component dissolution by 60% [15].

2.2.2 Targeted Mechanism of Herbal Components

Herbal formulas for different syndromes have clear targets: ferulic acid in *Angelica sinensis* improves microcirculation; gingerol in *Zingiber officinale* activates TRPV1 channels; total flavonoids of *Drynaria fortunei* promote osteoblast activity; berberine in *Phellodendron chinense* regulates intestinal flora [16].

3. Core Mechanisms of TCM Wax Therapy

3.1 Physiological Regulation by Thermotherapeutic Effect

3.1.1 Microcirculation Optimization

Thermotherapeutic effect (45℃-50℃) activates skin TRPV1 channels, expanding capillaries by 30%-50% and increasing blood flow velocity from 1.2mm/s to 2.1mm/s in chronic lumbar strain patients. It accelerates clearance of metabolites like lactic acid (decreased by 48% after 1 hour) and improves blood oxygen saturation from 82.3%±4.5% to 97.6%±2.1% [17,18].

3.1.2 Pain Regulation

Thermotherapy clears algesic mediators (PGE2 decreased from 68.5pg/mL to 39.7pg/mL after 10 days) and inhibits pain signal transmission via the "gate control theory." fMRI shows a 52% reduction in pain activation in the primary somatosensory cortex [19,20].

3.1.3 Muscle Relaxation

Thermal stimulation increases muscle temperature by 3℃-5℃, enhancing sarcoplasmic reticulum calcium pump activity by 40% to relieve spasm. For knee osteoarthritis patients, joint flexion-extension range expands from 95°±8° to 125°±6° [21].

3.2 Targeted Intervention by Herbal Syndrome Differentiation

3.2.1 Chronic Locomotor System Injuries

Cervical-shoulder strain: The formula "Pueraria lobata-Spatholobus suberectus-Chaenomeles speciosa" (3:2:1) inhibits platelet aggregation and improves muscle spasm, achieving a 92.3% total effective rate [22].

Lumbar muscle strain: Four-type differentiation (cold-dampness, damp-heat, kidney deficiency, blood stasis) uses targeted formulas. A randomized trial of 480 cases shows a 78.5% cure rate, higher than 50.2% for non-differentiated therapy [23].

3.2.2 Chronic Visceral Diseases

For chronic gastroenteritis (spleen-stomach deficiency-cold), the formula "Zingiber officinale-Atractylodes macrocephala - Poria cocos" promotes mucosal repair, with an 89.1% symptom remission rate [24]. For chronic pelvic inflammation, "Angelica sinensis-Ligusticum chuanxiong - Artemisia argyi" reduces recurrence to 12% [25].

3.3 Transdermal Drug Delivery Synergy

Thermotherapeutic effect expands stratum corneum intercellular spaces (15nm to 30nm) and increases hydration (15% to 45%), boosting puerarin's transdermal rate by 40%-60% [26]. Beeswax acts as a stable carrier, maintaining drug concentration within the therapeutic window (10-20μg/mL) for 1 hour [27]. Transdermal delivery avoids the "first-pass effect," with a 2.1% adverse reaction rate—far lower than 15.6% for oral Western medicine [28].

4. Disease-Specific Mechanisms

4.1 Chronic Locomotor System Injuries

TCM wax therapy accelerates tissue repair (fibroblast activity +35%), inhibits inflammation (TNF-α decreased from 85pg/mL to 42pg/mL), and improves function (lower limb radiating pain remission rate 89%) [29,30].

4.2 Spinal Diseases and Hyperosteogeny

Rehmannia polysaccharide inhibits osteoclast activity (32% reduction in TRAP-positive cells), while thermotherapy reduces nerve root edema by 45%. It relieves paravertebral muscle tension to correct spinal stress [31].

4.3 Chronic Gynecological Diseases

Lower abdominal thermotherapy dilates pelvic blood vessels (blood flow velocity 1.0→1.8mm/s), and cinnamaldehyde inhibits uterine spasm (contraction frequency 8→3 times/min). Inflammatory exudate absorption reduces pelvic effusion by 52% [32].

5. Evidence-Based Advantages and Limitations

5.1 Evidence-Based Advantages

Safety: A meta-analysis of 3856 cases shows a 2.1% adverse reaction rate, lower than 15.6% for oral Western medicine [33].

Efficacy: A meta-analysis of 4230 cases shows a 92.3% total effective rate for locomotor injuries, with VAS score reduced by 3.2 points [34].

Convenience: Home-based compliance reaches 85.6%, higher than 32.6% for acupuncture [6].

5.2 Limitations and Improvements

Limitations include non-standardized herbal formulas, lagging medium innovation, and unclear molecular targets. Improvements involve network pharmacology for formula screening, nano-beeswax development, and animal models to explore PI3K/Akt pathway regulation [35,36].

6. Conclusion and Prospect

TCM wax therapy's core mechanism lies in "local microenvironment remodeling" via thermotherapy, herbal syndrome differentiation, and transdermal delivery. With a 92.3% effective rate and 2.1% adverse reaction rate, it is safe and effective for chronic diseases. Future research should focus on standardization, technological innovation (nanotechnology, intelligent temperature control), and multi-center RCTs to support its inclusion in clinical guidelines [7].

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