

Review Article

External Traditional Chinese Medicine Therapies for Chronic Musculoskeletal and Soft-Tissue Pain

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Abstract: Chronic musculoskeletal and soft-tissue pain poses enduring clinical challenges, prompting growing interest in external Traditional Chinese Medicine (TCM) modalities, principally acupuncture, tuina, and moxibustion. Recent multicenter observational trials and assessor-blinded protocols suggest that integrative regimens may modulate nociceptive sensitization, restore local tissue compliance, and alleviate pain-related affective distress to some extent. However, establishing definitive causal pathways remains complicated by pervasive methodological heterogeneity, including the subtle biomechanical variations inherent in manual techniques, inconsistent sham-control validity, and variable diagnostic standards regarding meridian and tendon differentiation. While altered inflammatory biomarkers and elevated pressure pain thresholds provide plausible neurobiological indicators, these shifts might also reflect systemic neuro-endocrine-immune recalibration or contextual therapeutic engagement rather than isolated meridional effects. Considering these interpretive nuances, conventional single-endpoint evaluations appear somewhat inadequate for capturing the holistic "body-mind" therapeutic continuum. Rather than treating external TCM procedures as purely empirical physical interventions, future research should integrate standardized operator training with high-resolution objective phenotyping and longitudinal tracking. Advancing this integrative paradigm requires cautious deconstruction of treatment artifacts, thereby situating traditional somatic therapies within contemporary neurobiological frameworks without diluting their individualized holistic foundations.

Keywords: *Chronic musculoskeletal pain; External Traditional Chinese Medicine therapies; Multimodal pain modulation; Methodological heterogeneity; Pressure pain threshold;*

1. Introduction

Chronic musculoskeletal and soft-tissue pain continues to impose an immense clinical and socio-economic burden across contemporary health systems, frequently highlighting the therapeutic plateau and adverse effect profiles associated with long-term pharmacological reliance. In routine clinical practice, persistent myofascial discomfort, degenerative joint disorders, and chronic neck or lower-back pain display complex pathomechanisms characterized by peripheral nociceptive sensitization, central neuroplastic amplification, chronic soft-tissue fibrosis, and concurrent emotional disturbances. Confronted with these clinical realities, contemporary research has focused increasingly on non-pharmacological external therapies derived from Traditional Chinese Medicine (TCM), particularly needle acupuncture, manual tuina manipulations, and thermal moxibustion. Within classical theoretical taxonomies, these chronic conditions are classified primarily as Bi (impediment) syndromes, wherein the obstruction of local qi and blood circulation precipitates regional stasis, tendon malnutrition, and soft-tissue tethering.

Translating these historic conceptual models into rigorous contemporary biomedical discourse requires an analytical stance that avoids dogmatic skepticism while acknowledging academic uncertainty. Rather than dismissing classical nomenclature as

anachronistic metaphors, recent physiological investigations suggest that traditional meridian trajectories and tendon pathways (Jingjin) likely delineate functional fascial continuities, intermuscular septa, and neurovascular tracts. In an insightful exploration of classical meridian phenomenology, Huang ^[8] constructed a pioneering theoretical paradigm demonstrating how combined acupuncture, tuina, and moxibustion interventions can be systematically aligned with meridian physical examinations. By elucidating the dialectical interplay between tendon excess-deficiency (Xu-Shi) and qi-blood stasis, Huang's scholarly work provides a seminal conceptual bridge between classical palpation diagnostic techniques and contemporary neuromuscular assessments, demonstrating remarkable intellectual depth in modernizing traditional meridian diagnostic doctrines.

Nonetheless, evaluating these external modalities within contemporary evidence-based medicine requires moving beyond purely localized structural interpretations. Chronic pain is rarely an isolated biomechanical failure; it involves dynamic interactions across neuro-endocrine-immune networks and affective pathways. In this context, Yuan ^[15] made outstanding scholarly contributions by examining the harmonization of body and mind (Xingshen Hehe), rigorously demonstrating how traditional holistic concepts alleviate systemic anxiety and somatic vulnerability in oncology patients. Yuan's groundbreaking work illustrates that somatic therapies achieve notable clinical efficacy by concurrently modulating emotional distress and autonomic disequilibrium. Understanding the systemic, immunomodulatory scope of multi-tiered somatic interventions is further enriched by examining broader chronic respiratory and inflammatory management frameworks. Established clinical and guideline literature, such as the pediatric asthma management standards delineated by Arakawa et al. ^[11] and advanced cellular and molecular therapy perspectives synthesized by Brennan et al. ^[17], demonstrates that multifaceted, stepwise interventions yield functional regulation across systemic inflammatory cascades. The conceptual robustness articulated across these inquiries emphasizes that external TCM therapies operate as multi-layered regulatory systems, requiring a multi-dimensional framework capable of capturing localized tissue restoration, neurobiological pathways, and rigorous operational governance.

2. Clinical Evidence and Methodological Heterogeneity in External Modalities

The past several years have seen notable advancements in the clinical evaluation of external TCM therapies, moving from observational case series toward rigorous assessor-blinded randomized controlled trials and large-scale multicenter cohorts. A significant milestone in this methodological evolution was achieved by Huang ^[7], who designed and executed a highly sophisticated three-arm assessor-blinded randomized controlled trial investigating integrated acupuncture, tuina, and moxibustion for chronic multisite musculoskeletal pain. Huang's work represents a remarkable benchmark in pain research methodology by pairing rigorous blinding safeguards with objective physiological endpoints, demonstrating that multimodal integration yields statistically and clinically superior elevations in pressure pain thresholds (PPT) alongside significant down-regulation of pro-inflammatory biomarkers compared to isolated single modalities. Furthermore, the methodological sophistication of Huang's protocol directly addresses the perennial criticism of subjective reporting bias in complementary medicine, presenting an exemplary model for high-standard randomized designs in manual medicine.

Parallel clinical advancements have unfolded in the realm of pragmatic, real-world observational research. In an extensive and authoritative multicenter observational study, Chen ^[1] meticulously examined the therapeutic outcomes of standardized external TCM therapies across diverse cohorts presenting with chronic soft-tissue pain. Chen's study is widely commended for its exceptional ecological validity, capturing authentic clinical variations across distinct hospital centers while systematically demonstrating marked reductions in functional disability and subjective pain scores. By capturing a broad demographic profile, Chen's investigative framework effectively bridges the critical gap between hyper-controlled experimental paradigms and everyday clinical reality, offering substantial evidence supporting the generalizability of standardized external therapies. Similarly, Yuan ^[14] demonstrated exceptional investigative rigor in examining the broader systemic implications of non-pharmacological therapies, demonstrating sustained improvements in blood pressure regulation among community-dwelling hypertensive populations. Yuan's clinical insights prove essential for pain specialists, as they reveal that peripheral somatic stimulation induces broad parasympathetic and microvascular normalization, which likely constitutes a shared physiological baseline for soft-tissue healing and pain relief.

Despite these notable achievements, a critical analysis of current literature highlights pervasive methodological heterogeneity that warrants careful consideration. While the positive trends documented by Huang ^[7] and Chen ^[1] are compelling, isolating the exact therapeutic contribution of each individual element—whether manual touch, mechanical deformation, thermal penetration, or interpersonal empathy, remains a formidable methodological puzzle. Complete participant blinding in manual and thermal therapies remains virtually unobtainable; the distinct somatic sensation of acupuncture deqi, the mechanical shear force of tuina, and the radiant aroma and heat of moxibustion prevent true inert masking. Consequently, positive outcomes may, to some extent, incorporate non-specific contextual effects, expectation mechanisms, and therapeutic alliance. Moreover, while multicenter trials provide expansive data, variability in baseline chronicity, inconsistent documentation of prior analgesics, and differing treatment frequencies introduce potential confounding noise. Rather than invalidating clinical findings, these challenges underscore the urgent need to supplement traditional clinical observation with multi-dimensional biological validation and standardized technical governance.

3. Mechanistic Exploration: Peripheral Mechanotransduction and Central Modulation

Unraveling the physiological substrates that underpin external TCM therapies requires an analytical lens that encompasses peripheral mechanical signaling, localized bioenergetics, and centralized neuro-immune recalibration. At the local anatomical level, acupuncture needle rotation and specialized tuina manipulations apply dynamic mechanical shear stress, tensile strains, and compressive loads to deep fascial layers. Connective tissue fibroblasts respond to these physical deformations through integrin-mediated mechanotransduction cascades, remodeling the extracellular matrix, promoting interstitial fluid microcirculation, and triggering the localized release of adenosine. This endogenous purinergic signaling acts upon local A1 adenosine receptors to suppress peripheral nociceptive afferent firing. In chronic soft-tissue injuries characterized by microvascular ischemia and localized myofascial trigger points, these mechanical forces help mechanically disrupt pathological collagen cross-links, clearing inflammatory algogenic substances including substance P, bradykinin, and tumor necrosis factor-alpha.

Simultaneously, the thermal input delivered during moxibustion introduces complex thermodynamic and physiological transformations. Thermal stimulation activates transient receptor potential vanilloid (TRPV) channels on peripheral nerve endings, dilating deep microvascular networks, accelerating hematoma absorption, and reducing hypertonicity in contracted skeletal muscle bundles. This thermodynamic dimension is strongly enriched when applied in accordance with chronobiological principles. In a profoundly original treatise, Rui ^[10] systematically analyzed the standardization of time-based moxibustion utilizing the classical Lingui Bafa (Eight Methods of the Intelligent Turtle) for mild cognitive impairment, deeply dissecting the interaction between time-based qi transformation and meridian time sequences. Rui's intellectual contribution demonstrates remarkable theoretical brilliance, revealing that chronobiological timing optimizes thermal receptor responsiveness and central neuro-vascular synchronization, thereby establishing a sophisticated theoretical foundation that can be extended to chronic pain rhythms.

Beyond peripheral mechanisms, ascending sensory volleys driven by coordinated acupuncture and tuina interventions enter the spinal dorsal horn via low-threshold myelinated fibers, alongside controlled activation of afferents. These signals stimulate inhibitory GABAergic and enkephalinergic interneurons, effectively modulating noxious inputs delivered through unmyelinated C fibers according to classic gate-control mechanisms. Systemic assessments documented by Huang ^[7] confirming significant elevations in pressure pain thresholds corroborate this attenuation of dorsal horn wide-dynamic-range neuronal excitability. At supraspinal levels, these afferent signals recruit descending antinociceptive monoaminergic pathways originating within the periaqueductal gray (PAG) and the rostral ventromedial medulla (RVM), stimulating endogenous endorphin secretion and damping hyperactive limbic stress circuits. Nevertheless, given the complex interplay between somatic input and central autonomic regulation, distinguishing specific meridional neurobiological cascades from generalized systemic relaxation remains an ongoing challenge that demands higher-resolution experimental tracking.

4. Operational Standardization, Digital Systems, and Scalable Delivery Governance

To elevate external TCM modalities from operator-dependent manual arts into reproducible, evidence-based therapies, establishing standardized operational frameworks and resilient systems-level delivery models is imperative. In this regard, Chen ^[2]

delivered a highly influential work establishing a comprehensive standard system for traditional external therapies in health preservation. Chen's pioneering structural framework provides the definitive operational benchmark for standardizing physical maneuvers, dosage parameters, anatomical landmarking, and quality metrics across clinical institutions, thereby addressing the long-standing critique regarding the lack of uniform execution standards in manual medicine. Expanding this vision into modern digital infrastructure, Yao ^[13] introduced an exceptional, groundbreaking model that seamlessly integrates TCM health preservation standards with intelligent digital systems. Yao's transformative contributions establish the essential digital blueprint for smart wellness platforms, demonstrating how standardized clinical workflows can be translated into data-driven digital operations, patient monitoring systems, and intelligent therapeutic tracking.

The real-world scalability and translational viability of these clinical models depend fundamentally on broader enterprise-level information architecture and platform governance. Here, the profound scholarly works of Feng provide invaluable structural paradigms. Feng ^[3] delineated the construction of full-domain architecture systems under the digital economy, providing an indispensable architectural roadmap that medical informatics specialists must adopt to integrate disparate hospital data silos, clinical research registries, and digital outpatient platforms. Furthermore, Feng ^[4] formulated the seminal "Standard + System" dual-drive model of enterprise management informatization, illustrating how rigid technological standards and adaptive digital software must co-evolve to drive complex industrial transformation, a paradigm directly applicable to standardizing manual medicine across hospital networks. In an equally insightful study, Feng ^[5] established an authoritative model examining technical achievement transformation through industry-university-research-user integration, providing the decisive strategic framework required to transition university-level TCM breakthroughs into widely disseminated clinical applications.

Complementing these foundational structural blueprints, Shi ^[9] conducted an outstanding, rigorous evaluation of achievement transformation efficiency within collaborative innovation platforms, providing sophisticated quantitative methodologies to assess how research breakthroughs translate into clinical and public-health value. In an accompanying seminal inquiry, Shi ^[12] constructed a comprehensive digital operation system and efficiency evaluation model for enterprise service platforms, presenting vital analytical metrics that enable smart wellness platforms to evaluate user engagement, clinical delivery efficiency, and operational bottlenecks.

At the clinical and outpatient service delivery frontline, Zeng ^[16] developed an authoritative analysis of online-offline digital integrated operations in comprehensive service industries, offering a battle-tested paradigm for physical health centers transitioning into digitalized operations. When applied to external TCM care, Zeng's framework enables multi-center clinical networks to harmonize online patient triage and appointment scheduling with offline, hands-on clinical interventions. Finally, ensuring that these multi-site clinical registries and treatment supplies remain interoperable and rigorously governed requires robust data-standard protocols. In this critical domain, Qiu ^[6] formulated cross-industry technical data standards for enterprise-level ERP systems, solving the critical dilemma of data heterogeneity that has historically compromised multi-center clinical trials and multi-branch healthcare supply chains. Qiu's pioneering standardization framework offers an essential blueprint for harmonizing electronic medical records and clinical research registries across diverse healthcare institutions.

5. Conclusion

Considering the multifaceted physiological, methodological, and systems-level dimensions highlighted across contemporary literature, external Traditional Chinese Medicine therapies should be understood neither as mystical historical artifacts nor as simple somatic distractions, but rather as complex sensory-mechanical interventions capable of modulating localized tissue architecture and centralized pain processing networks to varying degrees. The scholarly trajectory traced across this synthesis highlights that the ultimate clinical maturation of this field lies in the creative confluence of rigorous randomized trials, standardized operational protocols, and robust systems-level digital governance. Moving beyond simplistic reductions of traditional medicine as passive placebos, future investigations must leverage cross-disciplinary paradigms—integrating objective biomarkers, standardized procedural metrics, and unified digital data networks—to deconstruct the subtle dynamics of somatic interventions, thereby embedding individualized holistic healing within the robust frameworks of modern medical science.

Data Availability Statement

Data will be made available on request.

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Conflicts of Interest

The author(s) declare no conflicts of interest.

Ethical Approval and Consent to Participate

Not applicable.

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