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REVIEW

Progress in the Treatment of Adhesive Capsulitis with External Therapies of Traditional Chinese Medicine: A Comprehensive Review

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Abstract: Adhesive capsulitis (AC), commonly known as frozen shoulder, is a common shoulder disorder featured by joint capsule contracture, pain, stiffness, and dysfunction. It has a prolonged course and a high recurrence tendency, which seriously impairs patients' quality of life and imposes a certain social and economic burden. At present, western medicine for AC has certain limitations, such as single intervention modality, potential risks of invasive procedures, obvious adverse reactions and a high long-term recurrence rate. External therapies of Traditional Chinese Medicine (TCM) are safe, effective, and minimally invasive with few adverse reactions. This review systematically summarizes clinical research and mechanisms of acupuncture, tuina (massage), topical Chinese herbal therapy, and combined external TCM therapies for AC. Key findings show that these therapies effectively relieve shoulder pain, improve range of motion, inhibit inflammation, and reduce joint capsule fibrosis via multi-target regulation. Combined TCM external therapies yield better efficacy than single modalities. However, standardization of manipulations and high-quality evidence remain insufficient. Given the challenges for systematic review posed by the heterogeneity of TCM external treatment techniques and the complexity of their potential mechanisms, this study critically summarizes the mechanistic basis and symptom-improving efficacy of current TCM external therapies for AC, aiming to construct a comprehensive theoretical framework, provide guidance for future related research, and optimize the standardized clinical application of TCM external therapies in the management of AC.

Keywords: adhesive capsulitis, external therapies of traditional Chinese medicine, acupuncture, massage, traditional Chinese medicine for external use

Introduction

Adhesive capsulitis (AC), also known as "frozen shoulder", is a fibrotic inflammation caused by the injury and degeneration of the soft tissue (tendon, tendon sheath, bursa, ligament, etc.) around the shoulder joint. Its core pathological feature is glenohumeral joint capsule contracture, and the main clinical manifestations are pain, stiffness and dysfunction of the affected shoulder. Although the disease is self-limited, the limitation of shoulder joint movement and pain symptoms can last for several years, some patients can not restore the full function of the shoulder joint for life, the course of the disease is prolonged and easy to recur.[1] Epidemiological survey shows that the prevalence of AC in the general population is 2%–5%, it has a higher incidence in women, who account for approximately 70% of all cases, and the peak age of onset is 40–60 years.[2] A large case-control study in the United States found that AC accounted for 4% of the diagnosis of shoulder diseases in the medical insurance beneficiaries aged 65 and above, and the ratio of male to female was 1: 1.8, and the disease was closely related to diabetes, hyperlipidemia, hypertension and Parkinson's disease.[3] Domestic regional studies have shown that the prevalence of AC in 2650 cases of epidemiological survey in rural areas of Henan was 2.72%, and AC accounted for 2.29% of 6276 patients aged 45 and above in a hospital in Shandong, suggesting that the incidence of AC in China is consistent with that in other countries.[4] AC mainly affects middle-aged

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workers aged 40 to 59, who account for about 50% of the total working population in China.[5] The disease not only seriously affects the daily activities and quality of life of patients,[6] but also reduces labor productivity and increases the consumption of medical resources, bringing significant social and economic burden to China. At present, the course of AC is clinically divided into three stages: freezing stage of pain (pain precedes loss of range of motion, lasting for 10 to 36 weeks), freezing stage (pain gradually alleviates, range of motion is still impaired, lasting for 4 to 12 months), and thawing recovery stage (range of motion gradually improves).[7] AC can involve both shoulders simultaneously or sequentially, and patients with unilateral involvement have a significantly higher risk of subsequent contralateral morbidity, while true recurrence of the same shoulder is relatively rare.[8] At the same time, 40% of AC patients fail to restore the normal range of motion of the shoulder joint and continue to have related clinical signs and symptoms, which has rendered this staging system controversial in clinical practice.[3]

The exact etiology of AC remains unclear, but studies have found that metabolic diseases are the core risk factors, including diabetes, hypothyroidism, hypertension, and dyslipidemia, all of which may increase the risk of developing the disease by affecting joint capsule metabolism and blood circulation. Local traumatic factors of the shoulder, such as shoulder joint or upper limb trauma, surgical history, and strains resulting from prolonged immobilization, decreased activity, or overuse, can directly damage the periarticular soft tissues of the shoulder or induce articular capsule adhesion, and then induce AC.[9] In addition, cardiovascular diseases such as coronary heart disease and cerebrovascular disease, as well as autoimmune connective tissue diseases such as rheumatoid arthritis, can also increase the risk of AC by affecting local blood supply and triggering systemic inflammation.[10] The pathophysiological process of AC is complex. The pathological process of AC initiates with inflammation and proliferation of shoulder joint rotator interval, joint capsule and glenohumeral ligament, accompanied by synovial congestion, fibroblast proliferation, and neovascularization, which is characterized by pain and early activity limitation, in which contraction of the rotator interval plays a pivotal role. As the disease progresses and inflammation resolves, fibroblasts differentiate into myofibroblasts under the action of transforming growth factor-β1 (TGF-β1), mechanical stress and other factors, and excessive disorganized type I and III collagen are deposited in the extracellular matrix, which leads to fibrosis, thickening and loss of elasticity of the joint capsule, ultimately resulting in global limitation of both active and passive shoulder motion, with external rotation being the first and most severely impaired movement. The pathophysiological process of AC also involves the genetic susceptibility caused by gene mutations such as *WNT7B* and *POU1F1*, as well as the involvement of immune-inflammatory disorders and neurogenic inflammation.[11,12] In addition, systemic diseases such as diabetes can increase the risk of AC morbidity and aggravate the condition by affecting collagen metabolism, microvascular function and tissue remodeling, though the exact causal mechanisms have not yet been fully elucidated.[13] The heterogeneity of the above pathophysiological links is an important reason for the individual differences in the clinical course, disease phenotype and treatment response of AC.[14]

The diagnosis of AC is based primarily on clinical assessment, which comprises detailed history collection and systematic physical examination, along with appropriate adjunctive investigations to rule out other shoulder pathologies. AC is typically characterized by an insidious and progressive onset of shoulder pain, which can last from several weeks to 2–3 years. The key finding on physical examination is a marked limitation of both active and passive range of motion of the shoulder, with a characteristic pattern of limitation, in which external rotation is affected first, followed by abduction, internal rotation, and flexion, and diffuse periarticular tenderness.[15,16] For adjunctive investigations, plain shoulder radiographs are obtained to rule out bony abnormalities, and magnetic resonance imaging (MRI) can demonstrate characteristic findings such as coracohumeral ligament thickening and rotator interval synovitis to assist in diagnosis and evaluation of the disease. Ultrasound-guided subacromial local anesthetic injection can help differentiate AC from diseases such as subacromial bursitis and rotator cuff tendinopathy, and pain relief following injection with persistent limitation of motion is suggestive of AC.[17,18] Clinically, attention should also be paid to identifying AC-related risk factors in patients and implementing timely symptomatic intervention, which provides a key target for the precise prevention and control of AC, and has important clinical significance in reducing the incidence of AC and improving the prognosis of patients. The primary therapeutic principles for AC are pain relief, improvement of the glenohumeral joint range of motion (ROM), restoration of limb function and enhancement of quality of life, in accordance with the principle of "non-surgical treatment as the first-line option, with surgical intervention as an adjunct". First-line clinical

interventions mainly include physical therapy, oral anti-inflammatory drugs, corticosteroid injection, extracorporeal shock wave therapy and ultrasound-guided hydraulic dilation of the joint cavity;[19,20] Surgical intervention is only indicated for patients with an inadequate response to non-surgical treatment for 9–12 months. The main surgical methods include arthroscopic capsular release, surgical release under anesthesia or the combination of the two. While such interventions can alleviate patient symptoms, they carry the risks of invasiveness and potential postoperative complications.[21] In general, conventional Western medicine still has several limitations in the management of AC: interventional approaches are often monotherapeutic, most invasive interventions only provide short-term symptom relief, and the overall efficacy is limited; long-term use of non-steroidal anti-inflammatory drugs (NSAIDs) and analgesics is associated with a high risk of adverse effects such as gastrointestinal disturbances and hepatorenal impairment, while certain analgesics may also cause drug dependence and even neurological injury; Invasive procedures such as local corticosteroid injections and arthrolysis may damage the periarticular soft tissues of the shoulder, and carry potential risks including infection and exacerbated articular capsule adhesion. Furthermore, all conventional Western medicine interventions are associated with a relatively high long-term recurrence rate, and the variability in efficacy among different regimens lacks high-quality evidence to support it, resulting in clinical treatment decisions being largely based on clinician experience, and hindering the development of standardized diagnostic and therapeutic guidelines.[22–25]

In Traditional Chinese Medicine, AC is categorized as "arthralgia syndrome (Bi Zheng)"and "shoulder arthralgia (Jian Bi)", its pathogenesis is primarily attributed to healthy qi deficiency, invasion by wind-cold-dampness pathogens, qi and blood stasis, and meridian obstruction, which ultimately result in local pain and motor dysfunction. As an essential component of TCM, external TCM therapy has evolved a unique theoretical system and clinical practice over thousands of years.[26] Based on the core principle of "treatment based on syndrome differentiation", individualized therapeutic regimens are formulated according to the patient's clinical condition, constitution, and environmental factors, with an emphasis on holistic regulation to achieve therapeutic goals by harmonizing qi and blood, balancing yin and yang, and enhancing the body's self-healing capacity.[27] In contrast to the local symptomatic management of conventional Western medicine, external TCM therapy offers distinct advantages including direct action, mild efficacy, minimal adverse effects, and high patient acceptability. Common clinical modalities include acupuncture, tuina (massage), external application of Chinese materia medica and combined TCM therapies, which can effectively alleviate local pain, improve shoulder joint range of motion (ROM), and modulate the local microenvironment.[28] This review systematically summarizes the latest research progress of external TCM therapies for the management of AC, including acupuncture, tuina (massage), and external application of Chinese materia medica, and summarizes their underlying mechanisms of action and clinical efficacy, aiming to provide a theoretical basis for the standardized clinical application of external TCM therapies in AC management, and to identify more optimal alternative therapeutic options for patients with AC.

Methods and Strategies

Literature Retrieval Strategy

Four major electronic databases were used for comprehensive literature search, including PubMed, Web of Science, CNKI, and Wanfang Data Knowledge Service Platform. Studies published in Chinese and English up to January 2026 were included. The search terms and their synonyms are as follows: "Adhesive capsulitis", "Frozen shoulder", "External therapy of traditional Chinese medicine", "Acupuncture", "tuina (massage)", "Cupping therapy", "Topical Chinese herbal therapy". Boolean operators (AND/OR) were used to optimize the search combinations and ensure the comprehensiveness of the search.

Inclusion Criteria

The inclusion criteria were as follows: (1) Subjects: adult patients (≥ 18 years old) with AC confirmed by clinical signs, symptoms, physical examination, or imaging examination; (2) Intervention: external therapies of traditional Chinese medicine, including but not limited to acupuncture, electroacupuncture, tuina (massage), cupping, blood-letting puncture and cupping, fire needle, moxibustion, and topical Chinese herbal therapy; (3) Control measures: conventional Western medicine treatment, placebo/sham TCM external treatment, conventional nursing, or baseline control; (4) Outcome

indicators: including at least one core indicator, such as shoulder pain, shoulder range of motion, joint capsule thickness, inflammatory indicators, clinical efficacy rate, intervention-related adverse reactions, or quality of life scores; (5) Study type: randomized controlled trials (RCTs), quasi-randomized controlled trials, cohort studies, case-control studies, and related systematic reviews or meta-analyses.

Exclusion Criteria

The following studies were excluded: (1) Editorials, reader letters, conference abstracts without complete data, and non-peer-reviewed data; (2) Case reports or case series with a sample size of less than 10 cases; (3) Studies not focusing on AC or unrelated to TCM external therapies; (4) Studies with duplicate publication, contradictory outcome data, or missing key data; (5) Studies including only the pediatric population without adult data; (6) Studies including patients with severe shoulder injuries, tumors, infections, or other serious comorbidities that may affect shoulder function; (7) Studies with unclear interventions, inconsistent treatment courses, or incomplete follow-up data.

Study Screening and Data Extraction

Two reviewers independently screened the retrieved literature in three stages: title, abstract, and full text. Disagreements were resolved through discussion with a third-party reviewer to reach a consensus. The core data extracted included the basic characteristics of the study (author, publication year, study country/region), demographic characteristics of the subjects, diagnostic criteria and sample size, detailed information of intervention and control measures (treatment plan, course of treatment, operating specifications), reported outcome indicators, efficacy data, and intervention-related adverse reactions. Due to significant clinical and methodological heterogeneity across studies, a narrative synthesis approach was used to integrate the evidence, and no quantitative meta-analysis was performed.

Treatment of AC with External Therapy of TCM

In recent years, the incidence of AC has increased year by year, and its adverse impact on the quality of life of patients has become increasingly significant. Western medicine plays a central role in relieving symptoms and improving range of motion of AC, but it has some limitations, such as obvious adverse reactions, poor treatment compliance and high long-term recurrence rate, which highlights the necessity of complementary treatment strategies and makes external treatment of traditional Chinese medicine become a hot spot in clinical research of AC. The external treatment of traditional Chinese medicine is guided by the theories of "syndrome differentiation and treatment", "dredging meridians", "promoting blood circulation and removing blood stasis", and plays a therapeutic role by stimulating local acupoints or targeting drugs at the lesion site, and its physiological mechanism is gradually being explained through the framework of modern biomedicine. This section will systematically discuss the clinical efficacy and mechanism of action of external treatment of traditional Chinese medicine in the treatment of AC, such as acupuncture, massage, external Chinese medicine therapy and combined application therapy, and sort out the commonly used clinical acupoints to provide reference for clinical application.

Basic Theory of External Treatment of Traditional Chinese Medicine

External treatment of traditional Chinese medicine is based on the core theory of "holistic concept" and "treatment based on syndrome differentiation". The holistic concept holds that the human body is an organic whole, local lesions can affect the whole body, and systemic dysfunction can also be reflected in the local; the principle of treatment based on syndrome differentiation emphasizes "treatment based on syndrome differentiation", that is, individualized treatment plan is formulated according to the specific syndrome of patients, which reflects the individualized characteristics of traditional Chinese medicine treatment.[29] On this basis, the theory of qi, blood and body fluid and the theory of meridians and collaterals constitute the core theoretical support of external treatment of traditional Chinese medicine in the treatment of AC. Qi, blood, and body fluid are the material basis for the human body to maintain normal physiological functions: Qi is the driving force for the body's activities, and has the functions of promoting, warming, and consolidating; blood provides nutrition for the body's tissues, and circulates in the pulse to nourish the whole body; body fluid circulates in the limbs and bones, and has the functions of nourishing and lubricating the joints; the three complement each other,

transform each other, and jointly maintain the normal physiological activities of the body.[30] According to the theory of channels and collaterals, the channels and collaterals belong to the zang-fu organs and reach the joints of the limbs. They are important pathways connecting the zang-fu organs and the body surface. They have the functions of transporting qi and blood, regulating yin and Yang, and communicating the exterior and interior.[31] They integrate the zang-fu organs, tissues, and organs of the human body into an organic whole. Qi, blood, and body fluid of the body circulate in the channels and collaterals, and realize the steady regulation of the functions of the whole body through the conduction of the channels and. The shoulder joint is the place where the meridians of the human body converge, and is an important node for the circulation of qi, blood and body fluid and the conduction of the meridians. When the healthy qi of the human body is insufficient, the external defense is not solid, the wind, cold and dampness are attacked by the deficiency, or the local qi and blood stasis is caused by trauma and strain, it will lead to the blockage of the meridians and the obstruction of the circulation of qi and blood, that is, the pain caused by the obstruction in traditional Chinese medicine. Then the typical symptoms of AC such as shoulder pain, stiffness and limitation of movement occur.

The core treatment principle of external treatment of traditional Chinese medicine is "dredging meridians and collaterals, regulating qi and blood". By stimulating specific meridian acupoints or transdermal action of drugs on the lesion site, the normal circulation of qi and blood can be restored, and the treatment goal of "no pain" can be achieved. From the perspective of modern biomedicine, "dredging meridians and collaterals, regulating qi and blood" in traditional Chinese medicine corresponds to physiological processes such as improvement of local blood circulation, regulation of inflammatory response, and regulation of neuromuscular function.[32] Acupuncture, massage, cupping and other external therapies can expand local blood vessels, increase blood flow, and promote the metabolism and removal of inflammatory factors through physical stimulation; external Chinese medicine therapy can directly reach the affected area through skin penetration, play the role of promoting blood circulation and removing blood stasis, dispelling cold and relieving pain, regulate the metabolism of local qi, blood and body fluid, improve the fibrosis of joint capsule, and promote the repair of soft tissue.[33]

In addition, the external treatment of traditional Chinese medicine always follows the concept of "minimally invasive, mild and safe", emphasizes "obtaining the best curative effect with minimal intervention", avoids the adverse reactions of invasive treatment of Western medicine, and takes into account both local treatment and systemic conditioning, which is in line with the clinical treatment concept of "treating both symptoms and root causes", which is also an important reason for its unique advantages and high acceptance of patients in AC treatment.

Acupuncture

Acupuncture is one of the most widely used TCM external therapies in the world, with definite efficacy in treating various acute and chronic pains. Modern studies have shown that acupuncture can exert multi-target and multi-pathway analgesic effects through the central-peripheral neuro-immune-endocrine network, and its analgesic mechanism can be explained from both the TCM theory of qi-blood-body fluid circulation and meridian dredging, as well as the modern neuro-immune mechanism. It provides a safe and effective non-drug treatment for chronic pain, neuropathic pain, inflammatory pain, and visceral pain.[34] Eyal Ben-Arie et al[35] published a systematic review and meta-analysis on acupuncture for AC in 2020, which showed that acupuncture could significantly reduce shoulder pain, restore shoulder function, and improve flexion range of motion in AC patients, but there was no significant difference in the improvement of supination and abduction compared with other treatment methods The most commonly used acupoints in AC treatment are Jianyu (LI15) and Jianliao (TB14), often combined with Jianzhen (SI9), Jianqian (EX-UE12), Tianzong (SI11), Tiaokou (ST38), Yanglingquan (GB34), Hegu (LI4), and Waiguan (TE5). In a RCT conducted by Guo Shaoqing et al,[36] 80 AC patients were randomly divided into two groups The control group was treated with oral medication combined with functional exercise, while the study group was treated with meridian-alternating acupuncture. The results showed that after one course of treatment, the total effective rate of the study group was significantly higher than that of the control group, and no serious adverse events occurred in either group. The scores of the shoulder joint function rating scale and the simplified quality of life scale in the study group were significantly higher than those in the control group, while the pain-related indicators and the levels of C-reactive protein (CRP), interleukin-1β (IL-1β), and tumor necrosis factor-α (TNF-α) in the study group were significantly lower than those in the control group. This indicates that meridian-

alternating acupuncture can effectively relieve pain, improve shoulder joint function and daily living ability, and its mechanism may be closely related to reducing the levels of inflammatory factors in the body and promoting the recovery of shoulder joint function.

Other studies have found that both acupuncture and diclofenac sodium can significantly improve the Visual Analog Scale (VAS) score, shoulder function scale score, and serum 5-hydroxytryptamine (5-HT) level in AC patients, but the improvement effect of the acupuncture group was more significant, and the total effective rate of the acupuncture group (96.67%) was significantly higher than that of the diclofenac sodium group (66.66%). During the treatment period, no serious adverse events such as infection or bleeding occurred in either group, suggesting that acupuncture treatment has good safety. This study indicates that the efficacy of acupuncture in the treatment of AC is superior to that of oral diclofenac sodium sustained-release tablets, and its mechanism may be related to the inhibition of inflammatory responses and the down-regulation of serum 5-HT levels (a key peripheral pain transmitter). Abnormally elevated 5-HT levels are closely associated with pain sensitization and the progression of joint inflammation in AC patients.[37,38]

Needle-knife therapy is a special form of acupuncture therapy invented by Professor Zhu Hanzhang, which combines TCM meridian-collateral theory with modern surgical technology. Using a needle-knife as a tool to incise, dissect, and penetrate local lesions, it can effectively eliminate adhesions and contractures, relieve soft tissue tension, and restore normal tissue function. This therapy has the advantages of minimal invasiveness, few complications, high safety, low cost, and high treatment efficiency, and is widely used in the clinical treatment of musculoskeletal diseases related to chronic soft tissue injury and bone and joint diseases such as AC.[39,40] Laboratory studies have confirmed that needle-knife therapy can regulate inflammatory responses and exert analgesic effects by modulating the levels of inflammatory cytokines such as substance P (SP), IL-1β, and TNF-α. At the same time, it can regulate superoxide dismutase (SOD) and total antioxidant capacity in serum and local muscles, reduce synovial thickening and tendon fibrosis, control local aseptic inflammation, reduce pain sensitivity, and promote local tissue repair.[41–43] A systematic review and meta-analysis of RCTs on needle-knife therapy for AC published in 2019 also showed that needle-knife therapy has significant advantages in alleviating local shoulder pain and improving shoulder joint function, making it an effective and safe method for AC treatment.[44] Existing studies have also found that different acupuncture techniques have specific therapeutic effects on AC: electroacupuncture has the best analgesic effect, manual acupuncture and warm acupuncture have more significant anti-inflammatory effects, and the manual acupuncture "tortoise acupoint exploration" technique is most effective in alleviating joint adhesions and improving shoulder joint range of motion.[45]

In summary, the mechanism of acupuncture in the treatment of AC has not been fully elucidated. Current studies suggest that the core mechanism is mainly reflected in three aspects: first, acupuncture stimulates local nerve endings, inhibits pain signal transduction, and promotes the release of analgesic substances such as endorphins and enkephalins to increase the pain threshold; second, acupuncture can dilate shoulder blood vessels, increase local blood flow, promote the metabolism and clearance of inflammatory factors such as TNF-α and IL-6, and reduce synovial inflammatory responses and tissue edema; third, acupuncture can directly act on adherent muscles, fascia, and joint capsules through mechanical stimulation, break the adhesion interface, promote tissue repair, and restore the normal motor function of the shoulder joint.

Tuina (Massage)

Tuina (massage) is an important part of TCM external therapy. Guided by meridian theory, it can relax the muscles and soft tissues of the affected shoulder by pressing, kneading, grasping, rolling, and twisting the muscles and soft tissues around the shoulder joint, thereby achieving the therapeutic effects of relaxing muscles, activating blood circulation, dredging meridians, and relieving pain. Clinical tuina (massage) treatment for AC focuses on local acupoint selection, with targeted operations for different acupoints: pressing and kneading Jianzhen (SI9) can regulate the Yang meridians, dredge meridians, activate collaterals, and relieve pain; pressing and kneading Jianliao (TB14) can regulate qi and blood, dredge meridians, and is effective in treating scapular pain and upper limb dysfunction; pressing and kneading Tianzong (SI11) can relax muscles and tendons, regulate qi, activate collaterals, and reduce swelling; pressing and kneading Quchi (LI11) can clear heat, relieve exterior symptoms, and dredge meridians; pressing and kneading Ashi points can enhance the local analgesic effect.[46] Compared with the systemic side effects of Western medicine and the high risks of surgical

treatment, tuina (massage) treatment for AC has the unique advantages of being non-invasive, highly safe, and convenient to operate, thus attracting widespread attention from patients.[47]

Modern studies have thoroughly elucidated the analgesic and functional improvement mechanisms of tuina (massage), which are mainly reflected in the multi-pathway regulation of pain signals and the improvement of the local microenvironment.[48,49] First, through the precise regulation of pain-related factors, it down-regulates the expression of pain-causing substances such as SP and 5-HT, and up-regulates the secretion of analgesic factors such as β-endorphin. At the same time, it can reduce the expression of SP in the dorsal root ganglion, inhibit the expression of pro-inflammatory factors IL-21 and 5-HT receptor protein, reduce serum lactic acid levels, and block pain conduction through multiple pathways. In addition, it can activate glial cells, inhibit T cell activity, and reduce pain perception by transmitting harmless stimuli to the spinal dorsal horn to occupy the pain conduction pathway. Second, mechanical stimulation from tuina (massage) manipulations improves local blood circulation, accelerates the metabolism and absorption of pain-causing substances and inflammatory factors, and further relieves pain and inflammation. Jian-Min Wang et al[50] conducted a clinical trial based on magnetic resonance imaging (MRI) to compare the efficacy of tuina (massage) and intermediate frequency electrotherapy in the treatment of AC The results showed that, compared with intermediate frequency electrotherapy, tuina (massage) could more quickly relieve the pain symptoms of AC patients, restore the function of the affected shoulder joint, reduce shoulder joint capsule edema, and restore rotator cuff muscle function, thereby shortening the natural course of AC.[50] In addition, "Luo's Tendon Flexibility", one of the schools of tuina (massage), is a high-quality external therapy for tendon injury diseases such as AC. By accurately locating the lesion site and performing layered operations, it achieves the purpose of dredging meridians and alleviating adhesions,[51] which has been confirmed by modern animal experimental studies. "Luo's Tendon Flexibility" can significantly reduce the levels of pro-inflammatory factors such as IL-1β, IL-6, IL-17, and TNF-α in serum and shoulder joint synovial tissue, and reduce inflammatory infiltration of synovial tissue. At the same time, it inhibits the protein and mRNA expressions of vascular endothelial growth factor (VEGF), connective tissue growth factor (CTGF), TGF-β1, and Smad3, weakens the transformation of fibroblasts into myofibroblasts, thereby inhibiting shoulder joint capsule fibrosis and blocking the vicious cycle of "inflammation-adhesion". Wang Qiaoying's research also confirmed that tuina (massage) can significantly improve the shoulder joint function score and VAS score of AC patients, effectively relieve shoulder pain, and improve shoulder joint function. Its mechanism may be related to reducing the levels of inflammatory factors such as serum IL-6 and CRP and alleviating local inflammatory reactions. The study also showed that only a few patients experienced slight local soreness and swelling during treatment, which could be relieved without special treatment, and no obvious serious adverse reactions occurred, further confirming the safety of tuina (massage) in the treatment of AC.[52]

Based on existing studies, the core mechanism of tuina (massage) in the treatment of AC can be summarized into four aspects: first, the mechanical stimulation of tuina (massage) manipulations directly acts on adherent muscles, fascia, and joint capsules, breaks the adhesion interface, separates adherent tissues, and restores the space for shoulder joint movement; second, it relaxes tense and spastic shoulder muscles, reduces muscle traction on the joint, relieves pain, improves muscle blood and oxygen supply, and promotes the recovery of muscle function; third, through mechanical compression and traction of manipulations, it dilates shoulder blood vessels, increases local blood flow, promotes the metabolism and clearance of inflammatory factors, and reduces tissue edema and inflammatory reactions; fourth, tuina (massage) can adjust the mechanical relationship of the shoulder joint, correct minor joint disorders, reduce joint capsule pressure, and delay the process of joint capsule contracture and fibrosis.[53] Despite the significant advantages of tuina (massage) in the treatment of AC, there are still many shortcomings in current related studies, such as a limited number of high-quality RCTs, small sample sizes, lack of evidence from large-sample, multi-center, long-term follow-up studies, and absence of a standardized efficacy evaluation system. The low standardization of manipulations and great differences in manipulation intensity, frequency, and duration among different doctors lead to unstable clinical efficacy. Research on indications and contraindications is insufficient: for AC patients with severe pain and significant joint capsule edema in the acute phase, the selection of manipulations, manipulation intensity, and treatment course standards are not clear. Basic research on the relevant mechanisms of action is insufficient, and the analysis of the combination of traditional Chinese tuina (massage) and modern biomedical mechanisms is still superficial. In view of the above problems, future studies should focus on formulating tuina (massage) operation norms, establishing an efficacy evaluation system, clarifying

indications and contraindications, and conducting large-sample, multi-center RCTs and in-depth basic mechanism studies, so as to provide evidence support for the standardized clinical application of tuina (massage) in the treatment of AC.

Topical Chinese Herbal Therapy

Topical Chinese herbal therapy is one of the important types of TCM external therapy. Through the skin penetration of Chinese materia medica, the medicine can directly reach the lesion site along the meridians and collaterals as well as with the circulation of qi and blood, thereby exerting a therapeutic effect. This therapy mainly includes TCM fumigation, external application of Chinese materia medica, external application of TCM ointment, and moxibustion, etc. Its core efficacy is to promote blood circulation and remove blood stasis, dispel cold and relieve pain, and dispel wind and remove dampness, which can promote the repair of damaged parts. The active ingredients of the medicine act directly on the lesion site, avoiding the gastrointestinal stimulation caused by oral administration, and achieving the synergy of local treatment and overall regulation. Among these, topical ointment is the most widely used in the clinical treatment of musculoskeletal injuries.[54]

TCM ointment is a commonly used form of TCM external therapy for the treatment of AC, and clinical studies have confirmed that a variety of ointments have good efficacy and safety for AC. A multi-center RCT study conducted by Xue Qingyun et al[55] included AC patients in the frozen phase and compared with conventional rehabilitation treatment to explore the clinical efficacy and safety of external Qizheng Xiaotong Plaster The results showed that Qizheng Xiaotong Plaster could significantly reduce the VAS score of patients, improve the range of motion of the shoulder joint and clinical signs and symptoms, and its total effective rate was significantly better than that of the control group. During the treatment period, the incidence of adverse reactions was low, the degree was mild, and the safety and tolerability were good, which provides high-quality evidence-based medical evidence for the topical treatment of AC in the frozen phase. Qizheng Xiaotong Plaster is composed of multiple Tibetan medicines such as *Lamiophlomis rotata, Curcuma longa, Myricaria, Oxytropis*, and *Cornu Bubali*, and each medicinal material exerts a synergistic effect:[56] *Lamiophlomis rotata* is the core medicinal material for promoting blood circulation and removing blood stasis, reducing swelling and relieving pain, and reuniting tendons and setting bones; *Curcuma longa* can break blood stasis, promote qi circulation, dredge meridians, and relieve pain, and the curcumin it contains enhances these effects; *Ramulus Myricaria* and *Herba Oxytropis* have the effects of clearing heat and detoxifying, dispelling wind, removing dampness, reducing swelling and pain, and alleviating joint swelling and pain; *Cornu Bubali* has the effects of clearing heat, cooling blood, detoxifying, reducing swelling, and relieving local inflammatory infiltration. Modern studies have clarified the anti-inflammatory and analgesic mechanism of Qizheng Xiaotong Plaster, which exerts a therapeutic effect mainly through a multi-target and multi-pathway regulatory mode. Specifically, Qizheng Xiaotong Plaster can inhibit the expression of pro-inflammatory factors such as TNF-α and IL-1β, thereby correcting the imbalance between pro-inflammatory and anti-inflammatory factors, and further mediating the relief of pathological pain. On this basis, Qizheng Xiaotong Plaster can regulate the activation of the nuclear factor-κB (NF-κB) signaling pathway, thereby reducing the abnormal immune activity of the dorsal root ganglion and spinal dorsal horn pain pathways, and ultimately blocking peripheral and central hyperalgesia. In addition, it can inhibit the synthesis of cyclooxygenase-2 (COX-2)-mediated pain mediators, down-regulate the production of its metabolite leukotriene B4, and reduce the release of inflammation-related pain substances. Qizheng Xiaotong Plaster can relieve the inflammatory pain of deep tissues by stimulating the superficial branch of C nerve fibers in the skin at the pain site and reflexively inhibiting the transmission of pain signals from the deep branch of C nerve fibers to the central nervous system. At the same time, *Qizheng Xiaotong Plaster* can inhibit the abnormal fibrosis of the shoulder joint through its anti-inflammatory effect, improve shoulder joint function, reduce the level of serum creatine kinase, alleviate the inflammatory reaction of muscle tissue, and promote the improvement of muscle strength and the recovery of tissue function. In summary, these regulatory effects together constitute a comprehensive anti-inflammatory and analgesic network, which is the therapeutic mechanism of Qizheng Xiaotong Plaster in relieving inflammatory pain and improving tissue function.[57–60]

Yin et al[61] studied the effect of TCM biological fermentation warming moxibustion ointment on shoulder joint function and inflammatory response in AC patients After selecting 200 AC patients for standard treatment, they found that the shoulder joint function score increased significantly and the VAS score decreased significantly after treatment. Meanwhile,

the serum levels of pro-inflammatory and pain-causing factors such as TNF-α, IL-6, SP, 5-HT, and granulocyte-macrophage colony-stimulating factor (GM-CSF) were significantly reduced, and the level of the anti-inflammatory factor IL-10 was significantly increased. Its core mechanism is to bidirectionally regulate the levels of inflammatory factors and pain-related neurotransmitters, thereby reducing local inflammatory responses and hyperalgesia. Yi et [62] conducted a retrospective analysis to compare the efficacy and safety of Tongbi Ointment and Compound Zhuifeng Ointment in the treatment of AC Both ointments have the effects of dispelling wind and cold, promoting blood circulation and removing blood stasis, and dredging collaterals and relieving pain. The results showed that both ointments could effectively relieve shoulder pain and improve shoulder joint function in AC patients, and only a few patients had slight local skin itching or redness, which could be relieved without special treatment, suggesting that both ointments had good safety. However, the total effective rate of the Tongbi Ointment group was significantly higher than that of the Compound Zhuifeng Ointment group, which may be related to the higher transdermal absorption rate of the active ingredients of Chinese materia medica in Tongbi Ointment and its more significant regulation of local inflammatory reactions.

TCM hot compress, also known as TCM hot ironing and TCM fumigation, is an external TCM therapy in which compatible Chinese materia medica is heated by frying, steaming, or boiling, then wrapped in a cloth bag and applied to the lesion site of the shoulder joint. It is a commonly used warming and dredging external treatment in the clinical treatment of AC, integrating the pharmacological effect of Chinese materia medica and the physical effect of warming, which cooperate to exert a therapeutic effect. It has the characteristics of simple operation, direct action, and high patient compliance.[63] According to TCM theory, TCM hot compress can warm and dredge the meridians around the shoulder joint, dissipate local cold coagulation and blood stasis, promote the circulation of qi and blood, relieve meridian obstruction, and achieve the goal of "no obstruction, no pain" through the dual effects of "warming heat to dispel cold" and "dredging meridians". Experimental studies have clarified the basic mechanism of TCM hot ironing: it can directly act on the local tissue of the shoulder joint through warm stimulation, promote vasodilation, accelerate local lymphatic reflux, improve local microcirculation, and promote the regression of local edema. At the same time, it can significantly reduce the local content of IL-1, IL-6, and TNF-α, inhibit the synthesis of inflammatory factors at the transcriptional and expression levels, reduce the release of inflammatory factors, promote the absorption of inflammatory exudates, reduce local aseptic inflammatory reactions from the source, and promote the process of inflammation regression,[64] laying a solid experimental foundation for clinical efficacy. Clinical studies have confirmed that TCM hot compress alone or combined with other therapies has a significant effect on AC, and different combinations of TCM hot compress have shown good therapeutic effects in clinical practice. Tian Hongjun et al (2009)[65] conducted a clinical controlled study to explore the therapeutic effect of TCM hot ironing on AC patients The results showed that TCM hot ironing could effectively promote local blood circulation of the shoulder, soften and release the adherent soft tissues around the shoulder joint through its warming effect, and at the same time, with the help of the core effects of dredging collaterals, relieving pain, promoting blood circulation, and removing blood stasis of the Chinese materia medica itself. It can effectively relieve shoulder pain symptoms, significantly improve the range of motion of the shoulder in directions such as flexion, abduction, and external rotation, greatly improve the clinical treatment efficiency, and provide a practical treatment plan and reliable clinical basis for the clinical external treatment of AC. Wei Hongxin (2025)[66] conducted a clinical study on the treatment of AC with Jingubi Reyan Bao, which was applied to the affected part of the shoulder after standard steaming and heating treatment, and systematically observed the degree of shoulder pain, the range of motion of the shoulder joint, and the level of serum inflammatory factors before and after treatment. Jingubi Reyan Bao can directly promote local blood circulation of the shoulder and loosen the adherent tissues of the shoulder joint through its thermal physical effect, and the serum IL-6 level of patients after treatment showed a significant downward trend, confirming that this prescription has a clear advantage in inhibiting local inflammatory reactions. At the same time, combined with the pharmacological effects of dispelling wind and removing dampness, dredging collaterals and relieving pain of the Chinese materia medica in the prescription, it can effectively alleviate the common residual shoulder pain during the course of AC patients, improve the core symptom of limited shoulder joint movement, and enhance the daily living ability of patients. Jingubi Reyan Bao is mainly composed of *Fructus Evodiae, Fructus Foeniculi, Semen Pruni*, and *Semen Phaseoli*. Its anti-inflammatory and analgesic effects are closely related to the active ingredients of the single drugs. Evodiamine in *Fructus Evodiae* can exert an anti-inflammatory effect and reduce local inflammatory infiltration by

regulating inflammatory signaling pathways and inhibiting the expression of inflammatory factors. The volatile oil in *Foeniculum vulgare* Mill can directly inhibit the release of inflammatory factors and further enhance the overall anti-inflammatory effect.[67] The compatibility of various drugs achieves a synergistic effect, making the warming effect of TCM hot ironing more closely combined with the pharmacological effect.

Moxibustion is a characteristic form of TCM external therapy, which uses *Artemisia argyi* as raw material, acts on local acupoints and lesion sites of the shoulder joint through the warming effect produced by combustion, and combines with the medicinal effect of *Artemisia argyi* ("warming meridians and dispelling cold, promoting blood circulation and removing blood stasis, dredging collaterals and relieving pain") to exert a therapeutic effect. It has a significant effect on chronic joint pain, activity limitation, and functional rehabilitation in the convalescent period. Commonly used clinical moxibustion methods include moxa stick moxibustion, mild moxibustion, warm needle moxibustion, ginger moxibustion, and garlic moxibustion, etc, which are easy to operate and can be individually selected according to the patient's condition, constitution, and tolerance.[68] Yin et al (2025)[69] used infrared thermal imaging technology as an objective evaluation method to study the therapeutic effect of double-headed moxibustion on AC patients The results showed that double-headed moxibustion had definite clinical efficacy and high safety in the treatment of AC, which could effectively alleviate shoulder pain and improve shoulder joint function. After treatment, the serum levels of SP and TNF-α in both the double-headed moxibustion group and the conventional Western medicine comprehensive rehabilitation group were significantly decreased, and the serum level of IL-10 was significantly increased. The serum levels of SP and TNF-α in the double-headed moxibustion group were significantly lower than those in the conventional rehabilitation group, and the serum level of IL-10 in the double-headed moxibustion group was significantly higher than that in the conventional rehabilitation group. After 4 weeks of treatment, the skin temperature at Jianyu (LI15), Jianliao (TE14), and Binao (LI14) in the double-headed moxibustion group decreased significantly, which was positively correlated with the improvement of clinical signs and symptoms. The study also confirmed that infrared thermal imaging technology can intuitively and quantitatively reflect the local blood circulation and inflammatory state of the shoulder. As an objective evaluation method for double-headed moxibustion in the treatment of AC, it provides a scientific and feasible method for the optimization of moxibustion protocols and efficacy evaluation.

The core mechanism of TCM external therapy in the treatment of AC can be summarized into two aspects. First, the active ingredients in TCM external preparations (ointments, hot compress medicines) are absorbed through the skin, directly targeting local shoulder joint lesions, promoting blood circulation and removing blood stasis, dispelling cold and relieving pain, dispelling wind and removing dampness, relieving local muscle spasm, and quickly alleviating pain. At the same time, they can dilate shoulder blood vessels, improve local microcirculation, accelerate the metabolism and clearance of inflammatory factors, reduce synovial inflammation and tissue edema, and create favorable conditions for the repair of damaged tendons, fascia, and joint capsules. Second, the warming effect of moxibustion and TCM hot compress can warm and dredge meridians, dispel pathogenic wind, cold, and dampness, effectively improving the typical symptoms of shoulder aversion to cold and pain aggravated by cold, dilate local capillaries, improve the circulation efficiency of blood and lymph, continuously remove inflammatory mediators, and reduce the tension of local tissues; soften the adherent muscles, fascia, and joint capsules around the shoulder, relieve tissue contracture, further break the adhesion interface through acupoint stimulation or drug action, loosen fibrous connective tissues, and gradually restore the movement space of the shoulder joint. In addition, the warming effect can also enhance skin permeability, promote the transdermal absorption of active ingredients of Chinese materia medica, and achieve a synergistic effect.

Combination Therapy

The combination of TCM external therapies is an important development direction in the clinical treatment of AC, based on the principles of "treatment based on syndrome differentiation" and "giving consideration to both symptoms and root causes". It is mainly divided into two types: the combination of TCM external therapies and the combination of TCM external therapies with Western medicine. By combining two or more therapies, it can achieve complementary advantages and synergistic effects, make up for the limitations of single therapies, further improve clinical efficacy, and shorten the treatment cycle,[70] while maintaining the safe and mild characteristics of TCM external therapies. Among these, TCM hot compress, as a warming and dredging external therapy, is often combined with needle-knife, tuina, and

acupuncture, and has become an important part of clinical combination therapy. In addition, scraping and cupping are also classic types of TCM external therapy, which can be used alone or in combination with other therapies in the treatment of AC, and can also be combined with warming and dredging therapies such as TCM hot compress and moxibustion to enhance the effects of warming and dispelling cold, promoting blood circulation, and removing blood stasis. Scraping uses special instruments to systematically and mechanically scrape the body surface, while cupping acts on local skin and subcutaneous tissue through negative pressure stimulation. The core mechanisms of the two are similar, mainly through physical stimulation to dilate local capillaries, improve microcirculation and blood circulation, and promote local metabolism. They can accelerate the discharge of pain-causing substances and inflammatory factors in the body, relieve local tissue spasm and adhesion, and realize the nerve regulation and metabolic regulation of local tissues through physical stimulation, ultimately relieving joint pain and restoring normal joint function.[71] Both are easy to operate and highly safe, and are often used as adjuvant treatments for AC in combination with acupuncture, tuina, TCM hot compress, and other therapies. The combined application of multiple TCM external therapies can exert analgesic, adhesion-loosening, and anti-inflammatory effects in multiple ways, significantly improving the therapeutic effect, among which the combination of TCM hot compress with other therapies has become a research hotspot.

Wang Shanjian used warm acupuncture combined with trigger point tuina therapy to treat AC, compared with conventional functional exercise. The results showed that the combined therapy could significantly improve the shoulder pain symptoms of AC patients, restore joint function, and significantly reduce serum CRP, nitric oxide (NO), and prostaglandin E2 (PGE2) levels. It is suggested that the combination of warm needle moxibustion and trigger point tuina has good anti-inflammatory and analgesic effects, which can effectively relieve joint swelling and pain and promote the recovery of joint function.[72] Huang et al (2022)[73] used Canggui acupoint electroacupuncture therapy combined with shoulder joint functional exercise to treat AC, and the results confirmed that the combined regimen had definite clinical efficacy and high safety, which could effectively alleviate shoulder pain and improve shoulder joint function Its mechanism is related to reducing the levels of serum inflammatory factors (IL-6, TNF-α) and pain-related mediators (5-HT, PGE2), alleviating local inflammatory reactions, and blocking pain conduction.

Fire dragon cupping therapy combines the advantages of various TCM external therapies and has shown good efficacy in the treatment of AC. Fire dragon cupping therapy is an innovative external treatment method that integrates TCM techniques such as tuina, moxibustion, scraping, and cupping. It acts on acupoints and meridians on the body surface through the warm stimulation of the cupping body, negative pressure effect, and combined with professional techniques such as kneading and pressing, exerting a multi-dimensional curative effect in AC treatment: the warming effect dilates local capillaries, improves microcirculation and tissue metabolism; negative pressure and mechanical stimulation release the adherent tissues around the joint and relieve muscle spasm; at the same time, it can reduce the levels of serum CRP, IL-1β, TNF-α, and other inflammatory factors, inhibit local inflammatory reactions, regulate nerve function, and reduce pain perception, ultimately achieving the therapeutic goal of relieving joint pain and improving the range of motion of the shoulder joint in all directions.[74] In some studies, 116 AC patients were randomly divided into two groups. The control group was treated with simple fire dragon cupping, while the observation group was treated with fire dragon cupping combined with Compound Qianggui Zhitong Ointment for 12 weeks. The results showed that the scores of the Simplified McGill Pain Questionnaire and the levels of serum CRP, IL-1β, and TNF-α were significantly improved in both groups; the range of motion of the shoulder joint in all directions was significantly improved, and the incidence of adverse reactions was low. The improvement degree of each efficacy index in the observation group was significantly better than that in the control group. The study confirmed that the combination of fire dragon cupping and Compound Qianggui Zhitong Ointment could achieve a synergistic effect in the treatment of AC. Its mechanism is related to the warm stimulation of fire dragon cupping to promote local blood circulation and release joint adhesion, as well as the transdermal absorption of the active ingredients of Chinese materia medica in Compound Qianggui Zhitong Ointment, which further regulates the level of inflammatory factors and strengthens the effect of dredging collaterals and relieving pain.[75] This combination regimen is convenient to operate, has significant curative effect, and gives consideration to both symptoms and root causes, providing a more efficient choice for the clinical treatment of AC.

The combination of TCM external therapy and conventional Western medicine treatment can realize the complementary advantages of TCM and Western medicine, further optimize the therapeutic effect of AC, and reduce the adverse reactions

of Western medicine treatment, among which the combination of TCM hot compress with Western medicine physical therapy and drugs has a good clinical effect. Di Yi et al (2022)[76] studied the clinical efficacy of TCM hot ironing + needle-knife + tuina combined with oral celecoxib capsules + rehabilitation functional exercise in the treatment of AC, and compared it with oral celecoxib capsules combined with rehabilitation functional exercise The results showed that the VAS score of shoulder pain in the observation group combined with TCM external therapy was more significantly reduced; the scores of activities of daily living, shoulder joint range of motion, muscle strength, and WHOQOL-BREF were significantly higher. At the same time, the hemorheological indexes and the levels of inflammatory mediators (TNF-α, COX-2, IL-1β) of the patients in the observation group were significantly decreased. The study showed that the combined application of TCM hot ironing, needle-knife, tuina, Western medicine, and rehabilitation exercise could better improve local blood microcirculation, release local adhesion, and improve tissue oxygen supply. At the same time, it inhibits the expression of inflammatory mediators to exert an anti-inflammatory effect and blocks the stimulation of local nerves and blood vessels by pain-causing mediators, thus more effectively alleviating shoulder pain and delaying the progression of the disease. Other studies have confirmed that various integrated TCM and Western medicine combinations, such as shoulder tuina + thunder fire moxibustion combined with extracorporeal shock wave therapy,[77] TCM tuina combined with Hanbi San acupoint application + conventional Western medicine treatment,[78] and shoulder three acupoints (LI15, TE14, SI9) + joint mobilization + shock wave therapy,[79] have significant efficacy. Their core mechanism is to reduce the levels of inflammatory factors such as TNF-α, IL-6, and CRP, and pain mediators such as SP, 5-HT, and PGE2, reduce local inflammatory reactions, release joint adhesion, improve local blood circulation, and block pain conduction. On this basis, adding TCM hot compress can further improve the efficacy of the combination regimen; its warming effect can enhance the tissue release effect of extracorporeal shock wave and joint mobilization, while reducing the dosage of Western medicine and the risk of adverse reactions.

The core advantage of TCM external therapy in the treatment of AC lies in its synergistic effect. Different external therapies exert analgesic effects through different mechanisms: for example, acupuncture regulates the neurohumoral system and releases analgesic substances; moxibustion/TCM hot compress relieves muscle spasm and dilates blood vessels through a warming effect; cupping/scraping relieves pain by removing blood stasis and promoting tissue regeneration. Combined application can block pain signal conduction from both peripheral and central pathways, significantly enhancing the analgesic effect. Single therapy targets a certain link of shoulder joint adhesion, while combined therapy can achieve multi-level release: for example, tuina and needle-knife directly release adherent tissues through mechanical stimulation; acupuncture and moxibustion indirectly alleviate adhesion by regulating local metabolism; TCM hot compress and external TCM preparations prevent adhesion by reducing synovial inflammation and tissue edema, thereby improving shoulder joint function. Different external treatment methods can regulate inflammatory reactions through different pathways: for example, acupuncture reduces the level of inflammatory factors; external TCM preparations inhibit the NF-κB signaling pathway; tuina and TCM hot compress improve circulation and promote the clearance of inflammatory factors. Combined application can achieve multi-target anti-inflammation, effectively blocking the pathological cycle of "inflammation-fibrosis-adhesion". In addition, warming therapies (moxibustion, TCM hot compress) can enhance the drug absorption efficiency and tissue action effect of other therapies, and become a "synergist" in combined therapy.

Patient Compliance and Experience with TCM External Therapies

Treatment success for AC depends not only on objective therapeutic efficacy but also on patient compliance, which is closely associated with treatment comfort, time commitment, session frequency, and ease of use. TCM external therapies are generally associated with favorable safety and tolerability. Acupuncture is well-tolerated by most patients, with transient local soreness or numbness as common mild sensations and rare severe discomfort. Each session lasts 20–30 minutes, with a typical schedule of 3–5 sessions per week for 2–4 consecutive weeks. High patient acceptance stems from its non-invasive nature and stable analgesic effect.[35] Tuina (massage) is associated with excellent patient tolerance and high satisfaction in the management of AC, primarily due to its soothing mechanical stimulation that effectively relieves pain and relaxes tight periarticular soft tissues. Transient local soreness may occur in a small proportion of patients but is generally mild and self-resolving. A typical treatment session lasts 30 to 45 minutes, with

most protocols administered 2 to 3 times weekly. Patients commonly exhibit good treatment adherence owing to prompt symptomatic relief. However, compliance may gradually decrease over the course of treatment due to the substantial time commitment and reliance on therapist availability, which may limit consistent long-term participation.[47,50,52] Topical Chinese herbal therapy shows the best compliance profile among single TCM external therapies. It is non-invasive and easy to administer, with rare mild skin reactions (itching, redness) that are self-limiting. Herbal plasters and ointments take only 5–10 minutes daily for self-application, while herbal hot compress or fumigation requires 20–30 minutes per session. Most modalities can be used daily at home, strongly supporting sustained self-management and long-term adherence.[55,62,66] Moxibustion provides a warm, soothing sensation that most patients find comfortable, although improper operation may carry a small risk of mild burns. Each session takes 15–30 minutes, often applied 5–7 times weekly.[69] In summary, patient compliance with TCM external therapies for AC is generally favorable owing to good safety and tolerability.

Conclusion

Adhesive capsulitis (AC) is an increasingly common musculoskeletal disease with a high incidence among chronic shoulder disorders in middle-aged working populations, which has brought great distress to patients' quality of life and work ability. The disease course is prolonged, and its pathological mechanism is complex, being closely associated with inflammation and joint capsule fibrosis. Western medicine treatment can relieve symptoms in a short time but has obvious limitations, making it difficult to achieve the therapeutic goal of treating both symptoms and root causes. Guided by the TCM holistic concept and the principle of treatment based on syndrome differentiation, TCM external therapy exerts positive effects in alleviating shoulder pain, improving glenohumeral range of motion, relieving joint fibrosis, and inhibiting local inflammatory reactions through methods such as acupuncture, tuina, and topical Chinese materia medica. It has become an important supplement and alternative for AC treatment due to its non-invasive nature, mild efficacy, few adverse reactions, and ability to regulate body functions.

Acupuncture can achieve analgesic and functional improvement by regulating the neuro-immune network, inhibiting inflammatory factors, and loosening adherent tissues. Tuina effectively relieves muscle spasm and adhesion through mechanical stimulation, although its standardization needs improvement. Topical Chinese herbal therapy achieves targeted anti-inflammation, blood circulation promotion, and collateral dredging via transdermal absorption or warm stimulation. The combination of multiple TCM external therapies or integration with Western medicine can enhance efficacy and shorten the treatment course, representing an important direction for clinical application.

However, there are still many deficiencies in current research on TCM external therapy for AC: first, the number of high-quality randomized controlled trials is limited, some studies have small sample sizes and short follow-up periods, and the level of evidence needs to be improved; second, the mechanism of action of various therapies has not been fully clarified, especially the integration of TCM theory with modern biomedical mechanisms is not in-depth enough; third, therapies such as tuina and moxibustion lack unified operational standards and efficacy evaluation criteria, and differences in operation among different doctors lead to unstable efficacy; fourth, research on the optimization of TCM external therapy combination regimens is insufficient, and there is a lack of clear basis for formulating individualized treatments.

To advance the clinical translation and global application of TCM external therapies for AC, future investigations should prioritize high-quality, multi-center, randomized controlled trials with long-term follow-up to generate robust evidence. Standardized operational procedures, unified outcome measurements, and objective evaluation systems should be established to improve reproducibility and comparability across studies. In-depth mechanistic research combining omics, molecular biology, and medical imaging is warranted to elucidate the biological basis of meridian regulation, anti-inflammatory effects, and anti-fibrotic actions. Moreover, the development of syndrome-specific individualized regimens, intelligent therapy tools, and integrated TCM-Western medicine protocols will further promote precise, personalized, and standardized care for patients with adhesive capsulitis. This will provide more scientific, efficient, and safe treatment strategies for the clinical treatment of AC, and promote the standardized and internationalized application of TCM external therapy in musculoskeletal diseases.

Abbreviations

AC, Adhesive capsulitis; TCM, Traditional Chinese Medicine; TGF-β1, Transforming growth factor-β1; ROM, Range of motion; RCT, Randomized controlled trials; CRP, C-reactive protein; IL-1β, interleukin-1β; TNF-α, Tumor necrosis factor-α; VAS, Visual Analog Scale; 5-HT, 5-hydroxytryptamine; SP, Substance P; SOD, superoxide dismutase; MRI, Magnetic resonance imaging; VEGF, Vascular endothelial growth factor; CTGF, Connective tissue growth factor; COX-2, cyclooxygenase-2; PGE2, Prostaglandin E2.

Data Sharing Statement

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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The authors report no conflicts of interest in this work.

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