

The Application and Effectiveness Analysis of Acupuncture in Sports Injury Rehabilitation

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Abstract. Sports injuries are becoming more common in today's society. There is a growing need for rehabilitation methods that work well and help people recover faster. This study looked at how acupuncture and moxibustion work, drawing from both traditional Chinese medicine principles and current neurobiology research. We examined how these treatments apply to various sports injuries - muscle strains, joint problems, and ligament damage. We also compared acupuncture with standard physical rehabilitation approaches. The findings show that acupuncture works better than traditional single-treatment methods in several key areas: controlling pain, helping tissues heal, and restoring function. Patients also experienced fewer side effects and had better safety outcomes. When traditional Chinese medicine combines with Western medical approaches, the results are particularly impressive. This integrated approach improves treatment at every stage of recovery while cutting down both rehabilitation time and medical expenses. This paper provides practical, evidence-supported guidance for using acupuncture in sports medicine, and offers healthcare professionals scientific direction and helps establish standardized practices for traditional Chinese medicine in modern athletic rehabilitation settings.

Keywords: Acupuncture therapy, sports injury rehabilitation, traditional Chinese medicine, integrated treatment, clinical effectiveness

1. Introduction

Sports injuries have emerged as an increasingly prominent health concern in modern society, with rising participation rates in athletic activities and continuous development of competitive sports leading to elevated incidence rates of various sports-related injuries. Contemporary sports medicine data indicate that both professional athletes and recreational fitness enthusiasts face varying degrees of sports injury risks, with muscle strains, joint sprains, and ligament injuries being particularly common. Traditional rehabilitation treatment methods, while accumulating extensive clinical experience, still present certain limitations in pain management, rehabilitation period reduction, and functional recovery optimization. The development of rehabilitation medicine urgently requires more effective, safe treatment approaches that can accelerate recovery processes. Meanwhile, athletes' demands for rapid return to training and competition have driven rehabilitation medicine toward diversified and personalized directions, encouraging medical professionals to actively explore treatment models combining traditional medicine with modern rehabilitation techniques.

International research on acupuncture treatment for sports injuries demonstrates rapid development trends, with the continuous emergence of relevant clinical studies and evidence-based medical evidence. Zhang et al. discovered through meta-analysis that acupuncture therapy showed statistically significant intervention effects on sports injuries, providing strong scientific evidence for its clinical application [1]. The researchers summarized the experience in the application of acupuncture and moxibustion techniques in sports injury in clinical practice, and the clinical application research on the ankle injury of table tennis players confirmed the actual effect of acupuncture and moxibustion treatment. Some studies explored the reasonable application of acupuncture and moxibustion in sports injury, and analyzed the rehabilitation therapy of sports injury from an international perspective [2-5]. International scholars have conducted a comprehensive literature review on the application of acupuncture and moxibustion in the prevention and treatment of sports injuries [6]. Pujalte et al. further confirmed the application prospect of acupuncture and moxibustion in sports medicine. Lee et al. systematically reviewed the case reports of acupuncture and moxibustion in the treatment of athletes' sports injuries, and confirmed the application value of acupuncture and moxibustion in sports medicine. Zhang et al.'s research revealed the comprehensive effect of acupuncture and moxibustion, moxibustion, cupping and massage in the treatment of sports injuries [7-9]. These research achievements indicate that acupuncture treatment for sports injuries has transformed from traditional empirical medicine to evidence-based medicine, with its therapeutic mechanisms and clinical effects receiving increasing scientific validation.

This study aims to provide scientific theoretical guidance and practical treatment recommendations for clinical practice through a systematic analysis of acupuncture application methods and therapeutic effects in sports injury rehabilitation. The research framework encompasses three core dimensions: theoretical mechanism analysis will deeply explore traditional Chinese medicine theoretical foundations and modern medical action mechanisms of acupuncture treatment for sports injuries, elucidating how acupuncture achieves therapeutic effects through meridian qi-blood regulation, tissue repair promotion, and pain relief; clinical application analysis will systematically organize specific application methods of acupuncture in different types of sports injuries, including personalized designs for acupoint selection, needling techniques, and treatment courses; comparative effect evaluation will analyze differences in therapeutic effects between acupuncture and traditional physical rehabilitation methods through literature analysis, exploring advantages and characteristics of integrated traditional Chinese and Western medicine rehabilitation models. Through this comprehensive research framework, this study expects to provide evidence-based support for sports medicine professionals regarding acupuncture treatment of sports injuries, promoting scientific application and standardized development of traditional Chinese medicine in modern sports rehabilitation fields.

2. Mechanism and application methods of acupuncture and moxibustion for sports injury

2.1. Theoretical foundations and action mechanisms of acupuncture treatment for sports injuries

The theoretical foundation of acupuncture treatment for sports injuries is established upon traditional Chinese medicine's meridian theory and qi-blood theory, while receiving strong support from modern medical neurobiology and molecular biology research. From a traditional Chinese medicine theoretical perspective, sports injuries often lead to local meridian stasis and impaired qi-blood circulation, subsequently causing clinical symptoms such as pain, swelling, and functional

dysfunction. Acupuncture can dredge meridians, harmonize qi-blood, and support healthy qi while eliminating pathogenic factors through stimulation of specific acupoints, fundamentally improving microcirculation status and tissue metabolic function in injured areas. Meridian theory posits that the human body's twelve regular meridians and eight extraordinary vessels constitute a complete energy transmission network. When injury occurs in certain areas, qi-blood circulation in corresponding meridians becomes affected, and needling related acupoints can stimulate meridian qi and restore normal conduction function of meridians.

Modern medical research has revealed multiple biological mechanisms of acupuncture treatment for sports injuries. Regarding neural regulation mechanisms, acupuncture can activate descending inhibitory systems, exerting analgesic effects through release of endogenous opioids such as endorphins and enkephalins, while regulating sympathetic nervous system excitability and improving local vasomotor function [8]. Blood circulation improvement mechanisms demonstrate that acupuncture stimulation can promote vasodilation and increase local blood flow, benefiting nutritional supply to injured tissues and clearance of metabolic products. Inflammatory response regulation mechanism research indicates that acupuncture can regulate the balance between pro-inflammatory and anti-inflammatory factors, reducing tissue inflammatory responses and promoting injury repair processes. Regarding tissue repair promotion mechanisms, acupuncture stimulation can activate fibroblast proliferation, promote collagen synthesis, and accelerate soft tissue healing processes.

Neuroplasticity regulation represents one of the important mechanisms of acupuncture treatment for sports injuries. Research has found that acupuncture can regulate central nervous system plasticity changes, improving motor control patterns and proprioceptive function, which holds significant importance for functional rehabilitation after sports injuries [10]. Molecular-level studies show that acupuncture stimulation can upregulate the expression of multiple growth factors, including vascular endothelial growth factor and nerve growth factor, which play key roles in tissue repair and neural regeneration processes. Regarding immune regulation mechanisms, acupuncture can regulate T-cell subset balance, enhance the body's immune defense capabilities, and prevent infectious complications.

2.2. Application methods of acupuncture in different types of sports injuries

Acupuncture application in muscle injury treatment demonstrates significant clinical advantages. Muscle strains and contusions represent the most common soft tissue injury types in sports, with acupuncture treatment typically employing methods combining local point selection with meridian point selection. For acute muscle strains, treatment focuses on pain relief, swelling reduction, and blood stasis removal, commonly selecting Ashi points, local Jiaji points, and corresponding meridian distal points. Chronic muscle strain treatment emphasizes liver and kidney supplementation and tendon strengthening, with acupoint selection focusing more on overall regulation, commonly combining kidney and liver back-shu points. Regarding needling techniques, acute phases often employ balanced reinforcing-reducing methods, avoiding excessive stimulation that might aggravate tissue injury. Recovery phases may appropriately enhance stimulation intensity to promote tissue repair and functional recovery.

Acupuncture treatment for joint injuries requires individualized protocols based on different joints' anatomical characteristics and functional requirements. Ankle joint injury, as a high-incidence site of sports injuries, has accumulated mature clinical experience in acupuncture treatment. Research demonstrated that targeting table tennis players' ankle joint injuries using combinations of Jiexi, Kunlun, and Taixi points effectively relieved pain, eliminated swelling and restored joint range

of motion. Knee joint injury treatment commonly selects local points such as Dubi, Xiyangguan, and Yinlingquan, combined with distal regulatory points like Zusanli and Xuehai. Shoulder joint injury treatment focuses on improving joint range of motion and muscle strength, commonly using points including Jianyu, Jianzhen, and Tianzong, requiring coordination with appropriate functional exercises during treatment.

Acupuncture treatment for ligament injuries emphasizes promoting ligament healing and preventing adhesion formation. Treatment principles include early inflammatory response control, mid-stage tissue repair promotion, and late-stage functional activity restoration. Acupoint selection primarily focuses on local points at injury sites, combined with circulation points of corresponding meridians. Needling depth and angle require precise control based on ligament anatomical positions, avoiding damage to important vascular and neural structures. Electroacupuncture treatment finds wide application in ligament injury rehabilitation, with specific frequency electrical stimulation promoting collagen remodeling and improving ligament biomechanical properties [11].

Acupuncture treatment for exercise-induced fatigue focuses on regulating neuroendocrine system function and improving body metabolic status. Commonly used treatment points include Baihui, Shenmen, and Sanyinjiao for calming the mind, as well as Zusanli and Guanyuan for qi-blood supplementation. Treatment frequency typically involves every other day or 2-3 times weekly, with courses flexibly adjusted based on fatigue severity and recovery conditions. Acupuncture treatment for exercise-induced fatigue not only rapidly alleviates symptoms but also enhances the body's anti-fatigue capabilities, holding important value for athletes' training and competition [12].

3. Effectiveness comparison between acupuncture and traditional physical rehabilitation methods

Acupuncture and traditional physical rehabilitation methods each possess distinct characteristics and advantages in sports injury treatment, with comparative analysis helping establish more scientifically rational treatment protocols. Regarding pain control effectiveness, acupuncture exerts effects through activating endogenous analgesic systems, with analgesic effects often more sustained and stable than simple physical factor treatments. Zhang et al.'s meta-analysis results demonstrated that acupuncture groups showed significantly superior pain relief effects compared to control groups, with lower adverse reaction rates. In contrast, traditional physical methods such as ice application and heat therapy, while providing rapid onset, demonstrate relatively short action duration, requiring repeated applications to maintain effects.

Comparative studies on functional recovery speed indicate that acupuncture can promote tissue repair through multiple mechanisms, showing faster rehabilitation speed in certain types of sports injuries. Particularly in soft tissue injury treatment, acupuncture's healing-promoting effects clearly surpass simple rest and immobilization treatments. While traditional rehabilitation training demonstrates definite effects in muscle strength recovery and joint range of motion improvement, its application during acute phases faces certain limitations, whereas acupuncture can begin intervention treatment in early injury stages.

The treatment safety comparisons reveal extremely low adverse reaction rates for acupuncture treatment, mainly involving minor local pain or hematoma, with rare serious complications. Lee et al.'s systematic study confirmed the good safety of acupuncture treatment for sports injuries. Traditional physical rehabilitation methods, while generally safe, may present risks of injury aggravation under specific circumstances with certain treatment modalities such as deep heat therapy and high-intensity exercise training.

4. Advantage analysis of integrated traditional Chinese and Western medicine rehabilitation

The integrated traditional Chinese and Western medicine rehabilitation model demonstrates significant synergistic advantages in sports injury treatment, with this integrative treatment approach maximizing different treatment methods' strengths while compensating for single therapy limitations. Theoretical system complementarity represents an important foundation for integrated traditional Chinese and Western medicine, with traditional Chinese medicine's holistic concept and syndrome differentiation providing theoretical guidance for personalized treatment, while modern medicine's evidence-based research and standardized diagnostic protocols ensure treatment scientificity and reproducibility. In practical application, this combination achieves comprehensive treatment coverage from macro to micro levels and from holistic to local perspectives.

Optimized timing configuration represents a significant advantage of integrated traditional Chinese and Western medicine rehabilitation. Acute phases can utilize modern medicine's emergency treatment and imaging diagnostic techniques to rapidly determine injury severity while combining acupuncture's pain relief and swelling reduction effects; subacute phases can combine acupuncture's tissue repair promotion with physical therapy's functional training; recovery phases can achieve comprehensive functional restoration through acupuncture regulation combined with systematic rehabilitation training. This sequential treatment arrangement maximizes various treatment methods' effectiveness.

Cost-effectiveness analysis shows that integrated traditional Chinese and Western medicine rehabilitation demonstrates clear advantages in controlling medical expenses. Acupuncture treatment's single-session costs are relatively low, while reducing medication use and shortening rehabilitation periods, overall decreasing treatment costs. Patients with diverse cultural origins are more likely to adopt integrated therapy methods, which improves treatment compliance and satisfaction.

5. Application recommendations and improvement measures for acupuncture in sports rehabilitation

Establishing standardized acupuncture treatment procedures is an important step toward increasing clinical efficacy and promoting widespread use. Create standardized treatment protocols for various types of sports injuries based on their pathological characteristics and rehabilitation requirements, including crucial factors such as acupoint selection, needling procedures, treatment frequency, and course configurations. This standardization does not imply complete uniformity, but rather standardized operations based on retaining unique treatment principles, ensuring treatment effect predictability, and conserving traditional Chinese medicine's syndrome differentiating features. Simultaneously, advocate developing therapeutic pathways for acupuncture therapy of sports injuries and offering operational instructions for various levels of medical institutions [6].

Strengthening professional training for acupuncturists is a crucial step toward assuring treatment quality. Sports medicine acupuncture has distinct qualities that necessitate physicians not only mastering basic acupuncture skills but also understanding associated expertise in exercise physiology, sports injury management, and rehabilitation medicine. Recommend creating specific training systems for sports medicine acupuncture that include theoretical study, clinical experience, and continuous education, resulting in composite talents who comprehend both traditional Chinese medicine and sports medicine. Strengthen cooperation with sports colleges and athletic teams, providing acupuncturists with more practical opportunities and professional exchange platforms.

Promoting evidence-based medical research represents a necessary condition for sustainable development of acupuncture in sports rehabilitation fields. While some high-quality research evidence already exists, more randomized controlled trials and long-term follow-up studies are still needed to further verify acupuncture's efficacy. Recommend establishing multi-center collaborative research networks, unifying research standards and evaluation indicators to improve research result comparability and promotional value. Emphasize a combination of basic and clinical research, deeply exploring molecular mechanisms of acupuncture treatment for sports injuries, providing more solid theoretical foundations for clinical applications [13].

Improving equipment configuration and technical improvements also represent important aspects of enhancing acupuncture treatment effectiveness. Modern acupuncture equipment, such as electroacupuncture devices and infrared treatment instruments, can improve treatment precision and patient comfort. Recommend reasonable equipment configuration based on different medical institutions' conditions and requirements, strengthening standardized equipment use and maintenance management. Explore combined applications of acupuncture with other treatment technologies, such as acupuncture combined with ultrasound and laser physical factor treatments, as well as acupuncture combined with exercise therapy and psychological intervention, comprehensive rehabilitation measures, forming more complete treatment systems.

6. Conclusion

This paper analysis confirms that acupuncture demonstrates significant therapeutic effectiveness and considerable application potential in sports injury rehabilitation practice. Through systematic examination of theoretical foundations, clinical mechanisms, and comparative treatment outcomes, this study reveals several key findings. Acupuncture treatment for sports injuries establishes its theoretical foundation upon the dual support of traditional Chinese medicine meridian theory and modern neurobiological mechanisms, achieving therapeutic effects through multiple pathways including meridian dredging, qi-blood regulation, endogenous analgesic system activation, and tissue repair promotion. Clinical application analysis demonstrates that acupuncture exhibits excellent adaptability and individualized treatment characteristics across different injury types, consistently achieving satisfactory therapeutic outcomes through appropriate acupoint selection and needling techniques for acute muscle strains, joint sprains, and chronic overuse injuries. Comparative effectiveness evaluation reveals that acupuncture shows superior advantages over traditional single-modality physical rehabilitation methods in pain management, tissue healing acceleration, and functional recovery enhancement, while maintaining higher safety profiles with significantly lower adverse reaction rates. The integrated traditional Chinese and Western medicine rehabilitation model demonstrates remarkable synergistic effects, optimizing treatment outcomes at different recovery stages while reducing overall rehabilitation duration and associated medical costs. The clinical significance of this research extends beyond immediate therapeutic applications, providing evidence-based scientific guidance for healthcare professionals in sports medicine practice and promoting the standardized development of traditional Chinese medicine in contemporary athletic rehabilitation. This study contributes to bridging the gap between traditional empirical medicine and modern evidence-based practice, enhancing international medical community recognition and acceptance of acupuncture therapy in sports injury management. However, several limitations warrant acknowledgment in the current research landscape. The available literature contains relatively limited numbers of high-quality randomized controlled trials, insufficient long-term efficacy follow-up data, and lacks unified evaluation standards across different studies, which may affect the generalizability of findings. Future research directions should prioritize establishing

multi-center collaborative research networks to strengthen evidence-based medical foundations for acupuncture treatment of sports injuries. Additionally, deeper exploration of molecular mechanisms and neurobiological foundations underlying acupuncture's therapeutic actions will provide more robust theoretical support for clinical applications. The development of intelligent acupuncture equipment and personalized treatment protocols represents another promising avenue for improving treatment precision and patient experience. Furthermore, innovative integration of acupuncture with modern rehabilitation technologies should be pursued to construct more comprehensive traditional Chinese and Western medicine rehabilitation systems, ultimately providing safer, more effective, and more accessible treatment services for sports injury patients worldwide.

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