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An Exploration of the Application of Massage Techniques in Different Periods of Sports Activities

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Abstract: *As a traditional Chinese medical treatment method, massage has been widely applied in the field of sports in recent years. Research shows that massage before exercise can effectively enhance muscle flexibility and joint range of motion, and prevent sports injuries during exercise, it helps relieve muscle fatigue and improve performance after exercise. It promotes blood circulation, accelerates the elimination of metabolic waste, alleviates muscle soreness, and facilitates physical recovery. This paper analyzes relevant literature to explore the specific application methods and effects of massage techniques at different stages of sports, providing a scientific reference for athletes and fitness enthusiasts.*

Keywords: *Massage techniques; Muscle fatigue, Sports injuries; Recovery*

1. Introduction

With the increasing emphasis on health and physical activity, the scientific and effective methods of exercise have become a focal point of public attention. Massage, as a traditional Chinese medical therapy, has gained widespread application in the field of sports in recent years. Through manual techniques applied to specific areas of the human body, massage can regulate physiological functions, enhance blood circulation, alleviate muscle fatigue, prevent sports injuries, and promote physical recovery[1].

This paper aims to explore the application and efficacy of massage techniques before, during, and after exercise, providing a scientific reference for athletes and fitness enthusiasts.

2. Overview of Massage Applications in Research

2.1 Pain Management

Massage therapy has accumulated substantial clinical evidence and theoretical foundations in the field of pain management. Numerous studies indicate that massage is highly effective for various types of chronic pain, such as neck, shoulder, lower back, and leg pain, as well as myofascial pain syndrome. The mechanisms of action are primarily manifested in three aspects:

Mechanical Stimulation: Massage techniques improve local microcirculation, promote tissue metabolism, and facilitate the clearance of inflammatory mediators[2].

Neurochemical Regulation: Massage modulates the levels of pain-related neurotransmitters, such as endorphins and enkephalins, which are endogenous analgesic substances[3].

Anti-Inflammatory Effects: Massage reduces the expression of pro-inflammatory factors (e.g., TNF-α, IL-6) while increasing anti-inflammatory factors (e.g., IL-10)[4].

Clinical research demonstrates that massage therapy for chronic lower back pain is comparable to conventional physical therapy, with fewer side effects. In postoperative pain management, massage as an adjunct therapy can reduce opioid dosage, shorten hospital stays, and significantly improve gastrointestinal function recovery, particularly after abdominal surgeries. Future research should focus on identifying the specific effects of different massage techniques on various types of pain and establishing standardized treatment protocols.

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2.2 Rehabilitation of Neurological Disorders

Massage exhibits unique advantages in the rehabilitation of neurological diseases. For stroke rehabilitation, massage improves blood circulation in affected limbs, modulates cortical excitability, and promotes neuroplasticity. Studies show that combining massage with conventional rehabilitation training significantly enhances motor function and daily living abilities in patients[5]. For peripheral nerve injuries, such as carpal tunnel syndrome and sciatica, massage alleviates symptoms by reducing nerve compression and improving nutritional status. Potential mechanisms include the regulation of nerve growth factor (NGF) expression and myelin repair[6].

Clinical observations reveal that massage is as effective as splinting for mild to moderate carpal tunnel syndrome, with better patient compliance. Additionally, the auxiliary role of massage in neurodegenerative diseases like Parkinson's and Alzheimer's is under exploration. Future research should elucidate the molecular mechanisms and targets of massage in neurological rehabilitation to provide more reliable scientific evidence.

2.3 Sports Medicine and Injury Rehabilitation

In sports medicine, massage has become a critical tool for preventing and treating sports injuries. For acute injuries like muscle strains and ligament sprains, massage reduces tissue edema, promotes hematoma absorption, and accelerates recovery. For chronic injuries such as tendinitis and bursitis, massage improves local blood circulation, alleviates tissue adhesion, and restores joint mobility.

In terms of post-exercise fatigue recovery, massage aids in clearing metabolic byproducts like lactic acid, reducing delayed onset muscle soreness (DOMS), and enhancing recovery efficiency. Research indicates that post-competition massage significantly lowers creatine kinase (CK) levels in athletes and shortens recovery time[7]. Moreover, massage is used to improve flexibility and joint range of motion, preventing sports injuries. Currently, sports teams widely incorporate massage as a routine recovery method, but personalized protocols are needed based on sport-specific demands and individual differences. Future studies should explore the long-term effects of massage on athletic performance.

2.4 Chronic Disease Management

Massage is increasingly recognized in chronic disease management. For hypertension, massaging specific acupoints (e.g., Taichong, Quchi) regulates autonomic nervous function and the renin-angiotensin system, aiding blood pressure control[8]. Clinical observations show that combining massage with lifestyle interventions achieves better blood pressure management.

For diabetes and its complications, massage improves peripheral circulation and alleviates symptoms like numbness and pain caused by diabetic neuropathy. Studies suggest massage may lower blood glucose levels and enhance insulin sensitivity, though further research is needed to clarify the mechanisms[9]. Massage also shows promise for digestive disorders (e.g., functional dyspepsia, irritable bowel syndrome) and mental health conditions (e.g., insomnia, anxiety). While clinical evidence is accumulating, large-scale, high-quality randomized controlled trials are still lacking. Future research should standardize massage protocols and explore synergies with conventional treatments.

3. Massage During Exercise

3.1 Pre-Exercise Massage

3.1.1 General Warm-Up Massage

The primary objective of pre-exercise general warm-up massage is to elevate the overall body temperature and enhance flexibility, thereby preparing the body for the impending intense physical activity. Massage therapists typically employ gentle techniques such as kneading , rolling, and rubbing , which are systematically applied to major muscle groups throughout the body, including the neck, shoulders, back, waist, hips, and limbs.

For instance, the kneading technique involves the use of the thenar eminence or the base of the palm to adhere to specific muscle areas, where rhythmic and gentle circular motions are performed. This method effectively promotes localized blood circulation, causing vasodilation within the muscles and increasing blood flow. This process can be likened to "preheating" the body’s transportation

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channels, ensuring that oxygen and nutrients are delivered more efficiently to the muscle tissues. Additionally, kneading raises muscle temperature, rendering the muscle fibers more pliable and elastic, much like a rubber band that becomes more stretchable when warmed. This significantly reduces the risk of muscle strains.

The rolling technique utilizes the ulnar side of the hand or the metacarpophalangeal joints of the little, ring, and middle fingers to maintain contact with the target area. Through continuous flexion, extension, and rotation of the wrist joint, the rolling motion generates alternating light and deep stimulation on the muscles. This approach not only relaxes the muscles and alleviates tension but also further enhances muscular flexibility.

The rubbing technique involves the use of the palm or fingertips to perform circular or linear strokes on the skin's surface. This method regulates skin temperature, improves cutaneous sensory function, and exerts a calming effect on the nervous system. Consequently, it helps athletes achieve mental and physical relaxation, mitigating pre-exercise anxiety[10]

3.1.2 Targeted Activation Massage

Tailored to the specific demands of different sports disciplines, targeted activation massage focuses on stimulating key muscle groups to optimize performance. For example, sprinters require activation of the lower limb's explosive power muscles. In such cases, the massage therapist prioritizes the quadriceps femoris at the front of the thigh, the hamstrings at the back, and the gastrocnemius in the calf. Techniques like plucking are employed, where the fingers or elbows apply deep pressure to the muscle fibers, followed by transverse or oblique flicking motions. This action resembles the tuning of a musical instrument's strings, effectively stimulating muscle fibers, heightening excitability, and augmenting contractile strength.

For athletes engaged in sports requiring frequent jumps, such as basketball or volleyball, emphasis is also placed on the gluteus maximus, a critical muscle for generating explosive force during jumping. The therapist employs kneading, pressing, and plucking techniques to enhance blood circulation in the gluteal region, thereby improving muscle strength and elasticity. This enables athletes to achieve superior jumping performance.

From a biomechanical perspective, targeted activation massage also serves to rebalance muscle tension across the body. Athletes who specialize in specific sports often develop overused and tense muscles in certain areas, while others remain underutilized and weak. Through precise massage techniques, therapists can relax hypertonic muscles and strengthen weaker ones, thereby optimizing the body's mechanical structure. For instance, badminton players frequently experience tension in the supraspinatus and infraspinatus muscles due to repetitive overhead motions. By adjusting the tension in these muscles, massage ensures better synergy with other shoulder muscles, reduces joint stress, and prevents sports-related injuries.

3.2 Intra-Exercise Massage

3.2.1 Rapid Recovery Massage During Short Breaks

In endurance sports such as marathons or road cycling races, athletes often have brief intervals of rest during competitions. At these moments, rapid recovery massage can alleviate muscle fatigue and help maintain optimal performance levels[11]. Therapists primarily utilize swift and gentle techniques, such as finger kneading and acupressure.

Finger kneading involves the use of the fingertip to perform rapid circular motions on areas exhibiting obvious muscle soreness or fatigue. This method swiftly enhances local blood circulation and accelerates the clearance of metabolic waste products, such as lactic acid. Since lactic acid accumulation is a primary contributor to muscle fatigue and soreness, finger kneading expedites its metabolism, effectively reducing discomfort and restoring muscle contractility.

Acupressure entails the application of finger or elbow pressure on specific acupoints or myofascial trigger points, such as Zusanli or Chengshan. These points are interconnected with the body's meridian system. Stimulating them regulates the flow of Qi and blood, activates the body's self-regulatory functions, relieves muscle fatigue, and enhances endurance. For example, during a marathon, applying acupressure to the Chengshan point on the calf can significantly alleviate fatigue, allowing the athlete to maintain strong leg power in subsequent segments of the race.

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3.2.2 Assistive Massage for Technical Adjustment

In sports requiring complex technical movements, such as gymnastics or figure skating, athletes may experience deviations in performance due to nervousness or physical strain. During brief pauses, therapists can employ massage to adjust relevant muscles and joints. For instance, if a gymnast feels restricted shoulder mobility after a routine, it may indicate muscle tension or minor joint misalignment. The therapist can use light pushing, kneading, or pressing techniques to relax the surrounding muscles. Subtle adjustments may also be made to the joint to restore its normal range of motion and flexibility, ensuring precise execution of subsequent movements.

From the perspective of neuromuscular control, assistive massage stimulates mechanoreceptors in the muscles and joints, transmitting sensory feedback to the central nervous system. The CNS then recalibrates motor commands, correcting aberrant muscle contraction patterns and refining movement execution[12]. Moreover, the tactile input from massage helps athletes regain body awareness and control, bolstering confidence and stabilizing competitive performance.

3.3 Post-Exercise Massage

3.3.1 Comprehensive Muscle Relaxation Massage

Post-exercise, athletes' muscles are in a state of fatigue, making comprehensive relaxation massage essential. Therapists employ a systematic approach, starting from the head and proceeding to the neck, shoulders, back, waist, hips, and lower limbs. For the back, a combination of rolling, kneading, and pressing techniques is used. Rolling broadly relaxes the back muscles, kneading delves deeper into the muscle fibers, and pressing targets major muscles like the erector spinae and trapezius, effectively alleviating soreness and stiffness.

For the lower limbs, the quadriceps, hamstrings, and calf muscles are first relaxed with kneading and rolling. The therapist then applies pinching , where the thumb and fingers alternately squeeze and release the muscles, akin to wringing a sponge. This promotes blood and lymphatic circulation, expediting the removal of metabolic waste. Additionally, plucking techniques are used to address cord-like muscle adhesions, restoring elasticity and extensibility.

From a physiological standpoint, post-exercise massage stimulates the parasympathetic nervous system while suppressing sympathetic overactivity[13]. During exercise, the sympathetic nervous system dominates, placing the body in a state of stress. In contrast, parasympathetic activation facilitates relaxation and recovery, lowering heart rate and blood pressure, enhancing digestion, and creating an optimal internal environment for recuperation.

3.3.2 Injury Rehabilitation Massage

If an athlete sustains an injury during exercise, post-exercise rehabilitation massage becomes a critical component of recovery[14]. In the acute phase (24-48 hours post-injury), gentle cold therapy and light massage techniques are combined. Light massage primarily involves rubbing motions around the injured area to promote blood circulation without exacerbating swelling. The primary goal is to enhance lymphatic drainage, which acts as the body's "cleanup crew," removing exudates and inflammatory mediators to reduce edema.

During the recovery phase, as swelling subsides, the intensity and techniques of massage are gradually intensified. Therapists employ kneading, pressing, and plucking to address the injured tissues and surrounding muscles and tendons. Kneading and pressing improve local circulation, delivering nutrients to damaged tissues and accelerating fibrous tissue repair. Plucking is particularly effective for breaking down scar tissue and adhesions, restoring normal tissue elasticity and mobility. For example, in ankle sprain rehabilitation, massage of the surrounding muscles and ligaments helps restore joint range of motion and stability, mitigating chronic pain and dysfunction.

At the cellular level, rehabilitation massage stimulates the activity of damaged tissue cells, promoting proliferation and differentiation to hasten repair[15]. It also modulates inflammatory responses, creating a favorable microenvironment for healing.

4. Precautions for Massage Application in Different Phases

The application of massage techniques in different phases of sports requires adjustments based on stage-specific characteristics.

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Pre-Exercise Massage should primarily employ light and brisk techniques, such as kneading and rolling, with a duration controlled between 15-20 minutes. The focus should be on activating the target muscle groups while avoiding excessive stimulation that could lead to premature muscle fatigue. Special attention must be paid to individuals with specific conditions, such as hypertensive athletes, who should avoid excessive manipulation of sensitive areas like the neck. This phase of massage can also incorporate psychological regulation to help athletes achieve an optimal competitive state. However, it is crucial to complete the session 30-60 minutes before the event to prevent any negative impact on athletic performance.

Intra-Exercise Massage is primarily used during breaks or pauses in activity to address sudden issues such as muscle spasms or tension. Techniques like grasping and pinching should be applied briefly (3-5 minutes) to induce relaxation, avoiding deep pressure that might interfere with subsequent performance. In cases of acute injury, all movement should cease immediately, and calming techniques such as gentle stroking combined with cold therapy should be applied. Vigorous manipulations like kneading must be avoided to prevent exacerbating the injury. Environmental factors must also be considered—outdoor competitions require protection from wind and cold to ensure the massage does not disrupt the normal flow of the event.

Post-Exercise Massage is critical for recovery, with the optimal window being within 30 minutes after physical activity. Deep techniques such as kneading and pushing should be applied for 30-40 minutes to facilitate the clearance of metabolic waste products. However, athletes should first engage in 15-20 minutes of light activity to stabilize their heart rate. Different types of sports demand tailored approaches: endurance sports require full-body relaxation, strength sports emphasize targeted muscle groups, and skill-based sports necessitate fine adjustments to smaller muscles and joints. Recovery responses should be closely monitored to avoid secondary injuries from excessive manipulation. Integrating complementary recovery methods such as ice therapy and nutritional supplementation can further enhance effectiveness.

5. Conclusion

In summary, massage technology demonstrates multifaceted benefits across the entire exercise cycle. Pre-exercise, it primes the body through general warm-up and targeted activation, optimizing musculoskeletal readiness and injury prevention. Intra-exercise, rapid recovery and assistive techniques address fatigue and technical deviations, ensuring performance stability. Post-exercise, comprehensive relaxation and rehabilitation massage facilitate physical recovery and tissue repair at the cellular level.

Rooted in traditional Chinese medicine and enriched by modern science, massage has become indispensable in competitive sports. It not only alleviates physical strain and enhances performance but also injects innovative vitality into sports training and injury management.

6. Future Research Directions and Prospects

The future of massage research will embrace multidimensional innovation. Methodologically, artificial intelligence and big data analytics will establish digital evaluation systems for massage operations. Virtual reality will standardize training and technique protocols. In equipment development, smart massage robots will achieve precision mechanical control and personalized therapies, while wearable devices will enable real-time monitoring and dynamic adjustments.

Basic research will delve into massage's effects on cellular mechanotransduction, epigenetic regulation, and microbiome-host interactions. Clinical studies will explore its role in major diseases, such as cancer supportive care and immune modulation. Standardization efforts will unify terminology, operational norms, and efficacy assessment systems.

Interdisciplinary collaborations will expand into materials science, bioengineering, and computational science. Translational research will accelerate clinical applications and product development. The ultimate goal is to construct a modern scientific framework for massage therapy, enabling it to play a pivotal role in global health initiatives. Achieving these objectives requires increased research funding, interdisciplinary talent cultivation, and international collaboration networks.

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