

MANUAL THERAPY IN MUSCULOSKELETAL INJURY REHABILITATION: A PAIN-MODULATION APPROACH

Emily Anne Smith

Department of Kinesiology and Applied Physiology, University of Delaware, Newark, Delaware, United States of America

Abstract: *Musculoskeletal injuries are common among athletic populations, posing a significant risk to athletes' performance and well-being. Various injury mechanisms, from muscle strains to fractures, can afflict athletes in contact sports. Athletic trainers (ATs) play a vital role in their recovery, employing therapeutic modalities and rehabilitation exercises. In early-stage injury rehabilitation, effective pain management and joint range of motion restoration are pivotal for a successful recovery.*

While pharmacological interventions are prevalent for pain management, non-pharmacological methods offer safe and effective alternatives. ATs often combine various therapeutic modalities with pharmacological interventions to expedite sports-related injury recovery. The well-established POLICE protocol (protocol, protection, optimal loading, ice, compression, and elevation) serves as the gold standard for acute athletic injury treatment.

The acute phase of injury, characterized by inflammation, demands effective management to prevent excessive swelling and hasten recovery. In rehabilitation settings, manual therapy techniques complement the POLICE protocol, facilitating pain reduction, joint mobility restoration, and overall recovery.

Keywords: *Musculoskeletal injuries, Athletic trainers, Rehabilitation, Pain management, Manual therapy techniques*

Introduction

Athletic populations frequently suffer from musculoskeletal injuries, particularly those who participate in contact sports. It presents a greater risk to their body and might affect how well they perform athletically. Athletes may experience various injuries due to different types of injury mechanisms, from muscle strains and ligamentous sprains to bony structure fractures. Given their crucial role in ensuring athletes' physical well-being and maintain peak performance, athletic trainers (ATs) frequently combine therapeutic modalities and rehabilitation exercises to facilitate a secure and efficient healing process.

In the early stages of injury rehabilitation, effective pain management and restoration of joint range of motion are critical for laying the groundwork for a successful recovery process. While pharmacological interventions are commonly used to lessen pain in clinical settings, non-pharmacological approaches offer safe and effective alternatives. To expedite the recovery

from sports-related injuries, athletic trainers frequently integrate various therapeutic modalities alongside pharmacological interventions. By minimizing inflammation and decreasing pain perception. The well-known POLICE (protocol, protection, optimal loading, ice, compression, and elevation) protocol serves as the gold standard for treating acute athletic related injuries^[1]. The acute phase of injury is the period from the time of injury until the signs of inflammation (pain, heat, swelling, redness, and loss of function) peak and subsequently begin to subside, which is a critical period in early

rehabilitation. Acute inflammation should be treated effectively to avoid excessive swelling accumulation and to speed up recovery^[2]. Within the rehabilitation clinical setting, manual therapy techniques are regularly employed as beneficial supplements to the POLICE protocol to promote pain reduction, joint range of motion restoration, and overall recovery.

Manual therapy is one of the common modalities used during the injury rehabilitation process. The various forms of manual therapy can produce different physiological effects on the body to help facilitate during different stages of rehabilitation. The term "manual therapy" refers to the evaluation and management of musculoskeletal injuries using hands-on methods^[3]. This hands-on intervention involves manipulating and mobilizing the affected tissues, joints, and structures to alleviate pain, restore range of motion, enhance tissue healing, and expedite the rehabilitation process as a whole. By utilizing various techniques, such as soft tissue massage, joint mobilization, Graston technique, cupping, passive stretches, and myofascial release, manual therapy produces various benefits to maximize rehabilitation outcomes. The article aims to evaluate the effectiveness of common manual therapy modalities as a non-pharmacological intervention for pain modulation and range of motion restoration in individuals with musculoskeletal conditions. The findings will provide valuable insights for healthcare professionals in selecting the most appropriate manual therapy modality for each patient's needs.

1. Physiological Effects of Manual Therapy

With its numerous physiological advantages that hasten the healing process, manual therapy is widely recognized as a therapeutic approach frequently used in musculoskeletal rehabilitation. Through its mechanisms of action, which include the modulation of pain pathways, promotion of endorphin release, alleviation of tissue restrictions, and optimization of joint mechanics, manual therapy generates physiological effects that support pain relief and enhanced functional mobility in individuals with musculoskeletal injuries.

Pain perception is a complex process of transmitting and interpreting sensory data inside the nervous system. Specialized sensory receptors called nociceptors are activated in response to an external injury, generating electrical signals that pass from the spinal cord to the brain^[4]. Through a variety of neurological mechanisms, manual therapy techniques like joint mobilization and soft tissue manipulation can modify pain perception. "Gate control theory" was proposed by Melzack and Wall in 1965. According to this theory, the spinal cord contains a "gate" that regulates the transmission of pain signals to the brain^[5]. When external injuries activate nociceptors, the brain receives noxious stimuli, but if another non-painful stimulus is created, such as the sensory input produced during manual therapy, it can activate the inhibitory response of the gate control theory in the spinal cord. The "gate" at the spinal cord will be closed to noxious stimuli created by external damage, which reduces the overall perception of pain^[6]. When it comes to manual therapy, techniques like soft-tissue massage and low-grade joint mobilization can generate non-noxious stimuli that send afferent information along with the noxious signal to the brain. The "gate" at the dorsal horn of the spinal cord will be closed on the stimuli caused by the tissue damage with the additional sensory input. Consequently, this mechanism contributes to a reduction in pain perception.

Manual therapy techniques have been shown to stimulate the release of endogenous opioids, which is naturally occurring pain-reduction substances produced by the human body, in addition to the gate control theory^[7]. Manual therapy activates specific sensory signals that are then sent to the brain via ascending pathways, causing the release of endogenous opioids. Endogenous opioids will be released after the sensory signals reach the area of the brain that processes pain information. The released opioids will eventually bind to opioid receptors in the central nervous system, preventing the release of noxious neurotransmitters and lowering the excitability of pain-transmitting neurons. As a result, there is a suppression of pain transmission, which has endogenous analgesic effects and reduces overall pain^[8]. In summary, manual therapy utilizes gate control theory and the release of endogenous opioids in the descending neural pathway as the primary neurophysiological mechanisms to influence pain

perception. These mechanisms play a critical role in easing discomfort and reducing pain perception during the manual therapy process.

Soft tissue technique is a form of manual therapy that targets the muscles, tendons, ligaments, and fascia surrounding the joint using mechanical treatment methods like massage, myofascial release, and trigger point release^[9]. Through the passive manipulation of tense tissues to restore the normal function of the soft tissue and promote overall mobility of the body. Stretching and pressure are applied rhythmically in manual techniques like massage to promote muscle relaxation. These techniques effectively alleviate muscle tension and reduce muscle tone, resulting in the release of muscle tightness and a decrease in muscle hypertonicity, which ultimately improves range of motion^[10]. Another advantage of using soft tissue techniques is that they improve blood flow to the specific region, promoting circulation and supplying muscles and other soft tissues with oxygen and nutrients. Additionally, this increased circulation aids in the efficient removal of metabolic waste products through lymphatic drainage^[11]. Improved circulation plays a crucial role in tissue healing, inflammation reduction, and the promotion of tissue elasticity. These combined effects contribute significantly to enhancing range of motion and tissue mobility.

Joint mobilization involves applying precise graduated forces to the joint surfaces in the passive manner to restore their normal range of motion, reduce pain, and improve joint function^[12]. By engaging joint mobilization, it can promote proper joint alignment and enhance the gliding and sliding of joint surfaces via concave and convex rule. In joint mobilization, the concave and convex rule directs the direction of the applied force based on the shape of the joint surfaces. According to the rule, the joint range of motion will improve in the same direction as the convexity when the convex surface moves on a fixed concave surface. Conversely, the range of motion in the opposing direction of the joint will be improved if a concave surface moves on the fixed convex surface^[13]. For example, the tibia and fibula form an ankle mortise to create the concave surface during an ankle mobilization rehabilitation exercise, and the singular talus becomes the convex surface. During dorsiflexion (bringing the foot upward), the convex talus bone moves in a posterior direction within the concave mortise, increasing ankle dorsiflexion.

Manual therapy is essential to the rehabilitation process in terms of physiological effects because it addresses pain management using "gate control theory" and "Descending pathway modulation" mechanisms. By addressing joint mechanics, alleviating muscle tightness, and enhancing tissue flexibility, manual therapy ultimately encourages the restoration of natural movement patterns and facilitates optimal range of motion.

This physiological impact is instrumental in the overall success of the rehabilitation process.

2. Common Manual Therapy Literature Review

2.1 Massage

A hands-on technique called manual massage is used to ease pain, loosen up tight muscles, increase muscle flexibility and extensibility, and ultimately regain proper ranges of motion for all joints. Recent studies provide strong evidence demonstrating the benefits of massage therapy on range of motion improvement and pain management. For instance, 53 participants in a study by Adams et al. in the acute care setting received a 30-minute massage therapy session. Measurements of pain were made both before and after the intervention. A significant decrease in acute pain levels among all participants, according to the posttest results^[14].

Similarly, another study looked at the effectiveness of massage therapy on chronic pain and range of motion. 24 participants with chronic back pain and restricted range of motion were divided into the treatment and control groups at random in this study. Pain levels were assessed using the McGill pain questionnaire and Visual Analogue Scale, while the range of motion was measured using the distance between anatomical marks. According to the findings, both the treatment and control groups experienced reduced pain levels and better range of motion. However, the participants in the treatment

group, who received massage therapy for five weeks, demonstrated a significantly greater improvement in both range of motion and pain management compared to the control group^[15].

2.2 **Graston Technique**

The Graston Technique is a type of manual therapy that is frequently employed in athletic training to target soft tissue restrictions and enhance range of motion (ROM). In order to identify and treat areas of fibrous tissue or scar tissue formation within muscles, tendons, and ligaments, this technique makes use of specially designed stainless steel instruments. The primary objective of the Graston Technique is to address soft tissue restrictions that cause discomfort and pain^[16]. By breaking down scar tissue and reducing adhesions, it can effectively relieve tension and pressure on sensitive structures, such as nerves, leading to pain relief. Moreover, it helps to remove soft tissue restrictions that limit the range of motion in a joint. It makes muscles and connective tissues more mobile by breaking down scar tissue and adhesions. As a result, this results in improved flexibility, enhanced joint mobility, and an overall increase in range of motion. These benefits allow athletes to perform movements more efficiently and comfortably.

Various kinds of rehabilitation instruments are employed or designed specifically to enhance manual therapy interventions. The Graston Technique, as an augmented soft tissue mobilization method, utilizes uniquely crafted stainless steel instruments with beveled edges to effectively address soft tissue lesions and fascial restrictions^[17].

A study conducted at Inje University in Korea investigated the effects of the Graston Technique on pain and range of motion in patients with chronic low back pain^[18]. The findings of the study showed that receiving Graston treatment significantly reduced both pain level and range of motion. Based on these findings, Lee et al. concluded that the Graston Technique can be a valuable rehabilitation tool for controlling pain and improving range of motion^[18].

2.3 **Cupping Therapy**

Athletic trainers have incorporated traditional Chinese medicine, including cupping therapy, into their treatment plans in addition to conventional rehabilitation techniques. For thousands of years, Cupping therapy has been a part of traditional Chinese medical practice. Cupping therapy is a traditional Chinese medicine technique that involves applying cups on the skin and creating suction. This suction promotes blood flow and lifts fluids that are stagnant to the surface. Increased blood flow enhances the delivery of oxygen and nutrients to the muscles, aiding in tissue repair and lessening pain. The soft tissues are mobilized by cupping therapy by creating a vacuum effect^[19].

Chi et al. carried out a study to evaluate the effectiveness of cupping therapy for the treatment of chronic pain. Sixty people with chronic neck pain participated in the study. They were split into two groups: one of whom received cupping therapy and the other receiving a placebo treatment. Variables like skin surface temperature, blood pressure, neck pain, and shoulder pain were measured during the post-test. The results demonstrated that the treatment group and the control group had significantly different approaches to managing pain. Pain levels decreased as a result of increasing skin surface temperature during cupping therapy^[20].

2.4 **Soft-Tissue Mobilization**

Techniques used in manual therapy, such as joint mobilization and soft tissue mobilization, have been shown to be effective in pain modulation and range of motion restoration.

Şenbursa et al. conducted a study to evaluate the efficacy of joint and soft tissue mobilization in patients with supraspinatus tendinopathy. Three groups of 77 patients, ranging in age from 30 to 55, were formed: Group 1 received an exercise program under supervision; Group 2 received an exercise program under supervision combined with joint and soft tissue mobilization; and Group 3 underwent a home-based rehabilitation program. All three groups were evaluated prior to, after the fourth week, and after the final 12 weeks of their respective programs. A visual analogue scale was used to measure pain levels, a goniometer was used to measure range of motion, and muscle strength and functional assessment were evaluated using a manual muscle test and the Modified American Shoulder and Elbow Surgery

score. All groups showed increased functionality and decreased pain, but Group 2, which underwent supervised exercises and joint and soft tissue mobilization, exhibited that the greatest improvement in functionality. The researchers concluded that joint and soft tissue mobilization contributed to enhanced functionality^[21].

The impact of angular joint mobilization on a patient with shoulder adhesive capsulitis was investigated in a different study by Kim and Lee. One participant, a 53-year-old woman with shoulder adhesive capsulitis, took part in the study. Over the course of six weeks, the patient underwent 12 joint mobilization sessions that included rotary oscillations that were pushed to their physical limits. After the treatment period, the patient experienced improvements in pain levels, range of motion, and disability. Pain, which was initially rated at 58 out of 100 on a scale, dropped to 3 out of 100 after treatment. The range of motion improved by at least 38% in all measured categories. These outcomes show that after receiving angular joint mobilization therapy, the patient showed improvements in each area that was evaluated^[22].

2.5 **Stretching Techniques**

In the field of athletic training, stretching techniques are essential for enhancing flexibility, increasing range of motion (ROM), and controlling pain. Muscle length and flexibility can be increased through stretching^[23]. Muscles that are tight or shortened can cause pain and restrict ROM. Stretching exercises make the tissues more malleable, improving joint mobility and putting less stress on the muscles and nearby structures.

Numerous studies have looked into how stretching affects pain management and ROM. Thomas et al. thoroughly analyzed the effects of various stretching protocols on ROM after long-term stretching. Twentythree articles that met their criteria were included in a quantitative synthesis for their study. The articles reviewed various stretching techniques, such as static, ballistic, and proprioceptive neuromuscular facilitation (PNF) stretches, and they showed sustained increases in ROM. Comparing the different stretching protocols, static stretching outperformed ballistic or PNF protocols in terms of ROM gains. The study also revealed that the amount of time spent stretching per week is more crucial than the duration of stretching within a single session. In comparison to stretching on a single day, stretching a joint for longer 5 minutes per week led to greater ROM improvements. These findings resoundingly validate the effectiveness of stretching in enhancing ROM.^[24]

3. **Conclusion**

In the context of athletic training, the current review provides a comprehensive analysis of the scientific literature on the effects of manual therapy on pain modulation and range of motion (ROM) restoration. The findings consistently show that manual therapy techniques are effective at treating pain and enhancing ROM in athletes.

The reviewed studies consistently demonstrate that manual therapy interventions are effective at reducing pain in athletic populations with musculoskeletal conditions. The neurophysiological mechanisms involved in these effects include the modulation of pain perception through the release of endogenous opioids and the gate control theory. Additionally, by improving blood circulation to injured or painful areas, manual therapy techniques promote tissue healing and reduce inflammation. Techniques like massage and myofascial release help with pain relief and improved muscle function by encouraging muscle relaxation and tension release.

The literature indicates that manual therapy interventions have a significant positive impact on ROM improvement. Increased tissue mobility and reduced stiffness are the results of myofascial release and instrument-assisted soft tissue mobilization, which target adhesions and restrictions in the fascia and other connective tissues. Joint mobilization techniques restore joint mechanics and enhance ROM by addressing joint restrictions, aligning joint surfaces, and lowering inflammation. Furthermore, manual therapy interventions that enhance neuromuscular facilitation and proprioception, such as proprioceptive neuromuscular facilitation (PNF) stretching, optimize muscle activation patterns and movement effectiveness to restore normal range of motion.

Although there is evidence that manual therapy is effective in pain management and ROM improvement, individualized approaches are crucial. When designing manual therapy treatment plans, it is essential to take into account each athlete's specific needs, injury characteristics, goals, and sport-specific requirements. A comprehensive athletic training rehabilitation program that incorporates manual therapy interventions along with other strategies like exercise, stretching, and strength training can also further enhance outcomes and offer a holistic approach to pain management and ROM improvement.

Despite the promising findings, several research gaps and potential directions need to be considered. More research is needed to determine the long-term effects, optimal dosages, and relative efficacy of various manual therapy techniques.

4. References

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