Effectiveness of physiotherapeutic treatment in athletes with rotator cuff injuries

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Abstract

Rotator cuff (RC) injuries in athletes are primarily caused by high loads on the shoulder joint, commonly seen in contact sports and in athletes who perform frequent overhead arm movements. These injuries may result from acute trauma or chronic overuse, leading to repetitive microtrauma. Diagnosis is based on a comprehensive clinical examination, which includes history taking, inspection, palpation, and assessment of active and passive range of motion, muscle strength evaluation, diagnostic imaging, and clinical provocation tests. Magnetic resonance imaging (MRI) and ultrasound (US) offer comparable sensitivity and specificity for the assessment of native RC. The primary goals of physiotherapy are to reduce pain and inflammation, restore glenohumeral (GH) joint mobility, and enhance stability, strength, and neuromuscular control. Conservative treatment involves a comprehensive rehabilitation program, anti-inflammatory medications, and corticosteroid injections. Key physiotherapy methods and techniques for treating RC injuries in athletes include kinesiotherapy, joint mobilization, kinesiology taping, thermotherapy, dry needling, laser therapy, and ultrasound. Deep shockwave therapy is also recommended for athletes with tendinopathy, with or without concomitant partial tears, who have not responded to other conservative treatment methods. Operative treatment is reserved only for athletes in whom conservative treatment has failed. Keywords: rotator cuff, athletes, conservative treatment, injuries, rehabilitation, physiotherapy

Učinkovitost fizioterapevtske obravnave pri poškodbi rotatorne manšete športnikov

Povzetek

Poškodbe rotatorne manšete (RM) pri športnikih nastanejo zaradi velikih obremenitev ramenskega sklepa pri kontaktnih športih in športnikih z značilnimi gibi rok nad višino glave kot posledica akutnih poškodb ali kronične prekomerne uporabe in ponavljajočih se mikrotravm. Postavitev diagnoze temelji na kliničnem pregledu, ki vključuje anamnezo, inspekcijo, palpacijo, oceno aktivnega in pasivnega obsega gibanja, oceno mišične moči, diagnostično slikanje ter klinične provokacijske teste. Slikanje z magnetno resonanco (MRI) in ultrazvok (UZ) imata podobno občutljivost in specifičnost za oceno nativne RM. Cilj fizioterapevtske obravnave je zmanjšanje bolečine in vnetja, izboljšanje gibljivosti glenohumeralnega (GH) sklepa ter izboljšanje stabilnosti, moči in živčno-mišičnega nadzora. Konzervativno zdravljenje vključuje celovit rehabilitacijski program, protivnetna zdravila in injiciranje kortikosteroidov. Fizioterapevtske metode in tehnike za zdravljenje poškodb RM pri športnikih vključujejo kinezioterapijo, mobilizacijo sklepa, terapijo s kineziološkimi trakovi, termoterapijo, terapijo s suhim iglanjem, terapijo z uporabo laserja in ultrazvoka. Pri športnikih s tendinopatijo s sočasno delno raztrganino ali brez nje, ki se na ostale metode konzervativnega zdravljenja ne odzivajo, se priporoča tudi terapija z globinskimi udarnimi valovi. Operativno zdravljenje je rezervirano le za športnike, pri katerih konzervativno zdravljenje ni bilo uspešno. Ključne besede: rotatorna manšeta, športniki, konzervativno zdravljenje, poškodbe, rehabilitacija, fizioterapevtska obravnava

INTRODUCTION

Rotator cuff (RC) injuries are a prevalent cause of shoulder pain and dysfunction in both elite and recreational athletes. The rotator cuff consists of four muscles. The supraspinatus muscle, which acts as the primary abductor of the humerus, the infraspinatus and teres minor muscles, which are the primary external rotators of the glenohumeral joint, and the subscapularis muscle, which is the primary internal rotator of the glenohumeral joint (Weiss et al., 2018). Dysfunction in any of these muscles often results in shoulder joint dysfunction (Edwards et al., 2016). According to Fitzpatrick et al. (2022), external impingement syndrome is commonly caused by tendinopathies and tears of the subscapularis muscle, while internal impingement syndrome involves entrapment of the tendons in the posterosuperior RC between the humeral head and posterior glenoid during abduction and external rotation (ER), potentially leading to tendon degeneration. RC injuries can range in severity, from contusions and tendinopathies to partial or complete tears. Diagnosis of the shoulder joint includes a thorough clinical examination with history, inspection, palpation, assessment of active and passive range of motion, assessment of muscle strength and diagnostic imaging (Weiss et al., 2018). Magnetic resonance imaging (MRI) is the gold standard for diagnosing rotator cuff pathology and other shoulder injuries (Zavatsky et al., 2020). Athletes with RC injuries often present with a positive painful arc sign, increased passive external rotation, and limited passive internal rotation, commonly referred to as glenohumeral internal rotation deficit (GIRD) (Weiss et al., 2018). Despite numerous cadaveric, imaging, and arthroscopic studies, the incidence of RC tears in athletes who perform repetitive overhead throwing motions remains unclear (Shaffer and Huttman, 2014). Weiss et al. (2018) found that articular-side tears of the RC are more common than bursal-side tears, and partial tears are more frequent than full-thickness tears, with a prevalence of 13% compared to 7% of all shoulder injuries (Edwards et al., 2016). RC injuries most commonly occur as a result of high shoulder joint loads in athletes with typical arm movements above head height and in contact sports (Mueller, Hoy and Branson, 2016). In younger athletes, RC tears are frequently associated with overuse of specific muscles and repetitive overhead movements where abduction combined with external rotation negatively affects the supraspinatus muscle in particular (Gill, Ayub and Qazi, 2023). The primary treatment for rotator cuff injuries in elite athletes is conservative treatment, including a comprehensive rehabilitation program, anti-inflammatory drugs and corticosteroid injections. If none of these methods are successful, Weiss et al. (2018) advise operative treatment. Shaffer and Huttman (2014) state that treatment depends on a variety of factors such as the athlete's symptoms, timing of the injury, degree of impairment, extent of pathology, response to treatment, associated diagnoses, and the athlete's competitive schedule. The shoulder examination after history taking starts with inspection, palpation, range of motion assessment, muscle strength assessment, and provocative tests (Alrabaa, Lobao and Levine, 2020). The initial goals of rehabilitation following RC injury are to reduce pain, inflammation, and swelling, and to restore normal range of motion. Physiotherapy management typically includes cryotherapy, electrical stimulation, laser therapy, and manual therapy, which involves joint mobilization, passive movement, and active-assisted exercises to restore proper kinematics and range of motion in the glenohumeral joint (Weiss et al., 2018). Gill et al. (2021) state that the rehabilitation of an athlete requires a highly structured, sport-specific plan, designed to prepare the injured tissue and the athlete both mentally and physically for peak performance. The integrated physiotherapy treatment lasts for at least three months (Liu et al., 2018).

METHODS

This study employed a descriptive research methodology based on a comprehensive review of professional and scientific literature. The literature search was conducted across multiple electronic databases, including PUBMed, ResearchGate, and the Slovenian reciprocal bibliographic system, COBISS. The key terms used in the literature search included: rotator cuff, athletes, conservative treatment, injuries, rehabilitation, and physiotherapy.

Inclusion criteria focused on studies adressing the effectiveness of kinesiotherapy, joint mobilization, kinesiology tape therapy, thermotherapy, dry needling therapy, laser therapy, ultrasound, and deep shock wave therapy in managing athletes with rotator cuff injuries. Only studies published in English or Slovenian between 2014 and 2024 were included. Eligible studies were limited to randomized controlled trials (RCTs), experimental studies, and comparative studies.
Exclusion criteria included incomplete studies and those with fewer than 25 participants.
The efficacy of physiotherapy methods for treating rotator cuff injuries in athletes was primarily evaluated using the following outcome measures: the Visual Analogue Scale (VAS), the Shoulder Pain and Disability Index (SPADI), and clinical testing.

RESULTS

A comprehensive search of the PUBMed and ResearchGate databases using specified keywords and keyword combinations resulted in 294 studies. The selection was refined based on study type (Meta-Analyses, Systematic Reviews, Randomized Controlled Trials), publication date (2014 to 2024), and sample size (excluding studies with fewer than 25 participants). This process narrowed the selection to 109 studies. Following a detailed full-text review, 10 studies were included in the final analysis. The literature was retrieved using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flowchart procedure.

DISCUSSION

The frequent improvement observed after non-operative treatment and the high percentage of athletes failing to return to the same level of performance after operative treatment underscore the importance of scientifically proven efficacy of various physiotherapeutic methods and techniques in conservative treatment (Liu et al., 2018). We analyzed the results of research conducted in the field of physiotherapeutic treatment of RC injury in athletes. We were interested in whether there is reliable scientific evidence on the effectiveness of physiotherapy methods and techniques in the treatment of athletes with RC injury. In the results, we presented a comparison of the effectiveness of treatment in RC injury in athletes based on the analysis of 10 studies.
We found that the studies differed in terms of the demographic characteristics of the groups studied, as the gender ratio in several studies (Zafar and Kumar, 2017; Leong and Fu, 2019; Zafar and Kumar, 2017; Sharma et al., 2021; Sharma, Hussain and Sharma, 2021; Gill et al., 2022) included an exclusively male population. The average age of the participants varied across the studies. The age group of athletes included in the studies (Sharma, Hussain and Sharma, 2021; Gill et al., 2022; Shih, Lee and Chen, 2018; Kamali, Sinaei and Morovati, 2019; Leong and Fu, 2019; Sharma et al., 2021; Chou et al., 2018) ranged from 17 to 52 years, while the age group of study participants that did not include athletes (Zafar and Kumar, 2017; Yavuz et al., 2014; Zafar and Kumar, 2017) ranged from 20 to 65 years. In the studies by Shih, Lee and Chen (2018), Kamali, Sinaei and Morovati (2019), Sharma et al. (2021), Yavuz et al. (2014), Sharma, Hussain and Sharma (2021), the authors exclusively studied impingement syndrome, which is the most common consequence of an RC injury. In the studies by Zafar and Kumar (2017) and Zafar and Kumar (2017), the researchers examined grade 1 and grade 2 rotator cuff injuries. Additionally, the authors Zafar and Kumar (2017), Zafar and Kumar (2017), and Yavuz et al. (2014) compared the effects of laser therapy versus ultrasound therapy combined with moist hot packs and exercises. Chou et al. (2018) compared the effect of deep shockwave therapy for tendinitis with or without concomitant partial tear, and Leong and Fu (2019) studied athletes with diagnosed tendinopathy compared to athletes without diagnosed tendinopathy.
In the study by Sharma et al. (2021), the first group performed progressive resistance exercises with elastic bands and stretching exercises in combination with joint mobilization, while the second group focused on motor control exercises targeting the isometric strength of the scapular muscles. In the study by Sharma, Hussain, and Sharma (2021), the first group engaged in exercise therapy, stretching

exercises, and strengthening exercises combined with oscillatory techniques and gliding, whereas the second group performed only stretching exercises and strengthening exercises.

In both studies, Sharma et al. (2021) and Sharma, Hussain and Sharma (2021) found that the two groups with the addition of manual therapy achieved greater performance in terms of isometric strength and scapulohumeral muscle activation. Additionally, in the study by Sharma, Hussain, and Sharma (2021), there was a significant reduction in pain intensity and an improvement in shoulder function (SPADI).

Manual therapy reduces local and referred pain by altering tissue reactivity and is therefore a recommended therapy of choice for the treatment of impingement syndrome (Birinci et al., 2020).

Gill et al. (2022) conducted a study in 2022 aimed at developing an effective rehabilitation plan and providing recommendations for accelerating the healing process of acute and chronic RC injuries. The eight-month program included 125 athletes who performed specific overhead arm movements. The control group consisted of 25 athletes selected for further comparison of results. In the presence of pain or swelling, the participants were required to follow the R.I.C.E. protocol including rest, ice, compression and elevation prior to initiating rehabilitation, to ensure that they began the process without pain. The therapy involved isometric and isotonic exercises, exercises to enhance range of motion, joint mobilization exercises, and resistance training using elastic bands. The study found statistically significant improvements in shoulder muscle performance. After completing the rehabilitation and recovery program, all athletes returned to their sports activities. Researchers monitored the participants for an additional two months post-injury and found that none had re-injured (Gill et al., 2022).

Kamali, Sinaei, and Morovati (2019) investigated the effects of dry needling on active myofascial trigger points in the upper trapezius and supraspinatus muscles. The study involved 40 athletes who performed repetitive overhead arm movements and were diagnosed with unilateral impingement syndrome. The participants were randomly divided into two groups, one received direct dry needling to the myofascial trigger point of the upper trapezius muscle, while the other received direct dry needling to the myofascial trigger point of the supraspinatus muscle. Each group underwent three treatments over two days.

The study found a statistically significant reduction in pain intensity and an improvement in upper limb function, as measured by the Disabilities of the Arm, Shoulder, and Hand (DASH) scale. Kamali, Sinaei, and Morovati (2019) concluded that dry needling of active myofascial trigger points in the infraspinatus muscle could be as effective as dry needling in the upper trapezius muscle for reducing pain intensity and improving range of motion. Furthermore, it may provide a better alternative due to enhanced patient comfort compared to direct dry needling of the upper trapezius muscle.

Active myofascial trigger points in the infraspinatus muscle can lead to localized pain that may radiate to the anterior shoulder, the upper trapezius region, and down the arm. This symptomatology can sometimes be misinterpreted as cervical radiculopathy (Gerwin, 2016).

In elite athletes, scapular adhesive tapes are commonly employed to prevent and treat shoulder joint injuries. The primary mechanism of these adhesive tapes lies in their ability to mechanically correct scapular positioning (Leong, Ng, and Fu, 2017). This function prompted investigations by Leong and Fu (2019) as well as Shih, Lee, and Chen (2018) into the efficacy of adhesive tapes on the scapular region.

In the study conducted by Shih, Lee, and Chen (2018), the researchers assessed the immediate effects of kinesiology tape on positioning accuracy, kinematics, and muscle activation among 30 athletes diagnosed with impingement syndrome, all of whom performed repetitive overhead arm movements. The participants were randomly divided into two groups. The experimental group received kinesiology tape, while the control group utilized tension-free kinesiology tape or a placebo setup. The straps were placed over the upper and lower part of the trapezius muscle. The study found that kinesiology tape therapy produced a statistically significant positive impact on the athletes' proprioceptive awareness and movement control at the scapular joint. Notably, the kinesiology tape group exhibited a significant reduction in errors related to scapular upward/downward movement and forward/backward tilting

during protraction, compared to the control group. However, both groups demonstrated similar levels of upper trapezius muscle activation. For more reliable results, the researchers recommend monitoring scapular position over a longer period and involve larger sample sizes from the general population.

Leong and Fu (2019) investigated the immediate effects of applying rigid scapular tape to the subacromial space in amateur volleyball players with RC tendinopathy and those without diagnosed tendinopathy. The tape was applied from the inferior medial third of the clavicle, traversing over the fibers of the upper trapezius muscle, extending fully to the thoracic spine at the level of the Th12 vertebra. Participants were randomly assigned to one of three groups, a control group that did not receive tape application, a treatment group that had rigid tape applied with tension, and a placebo group that had rigid tape applied without tension. The findings revealed that the subacromial space in athletes with RC tendinopathy experienced a statistically significant increase when utilizing rigid scapular tape during arm abduction from 0° to 60°. In contrast, no notable differences were observed in the subacromial space for athletes without tendinopathy. Furthermore, the application of therapeutic tape did not impact the subacromial space in athletes with RC tendinopathy during arm rest at 0° of abduction. Despite the promising results, the study should be repeated and conducted over a longer period with a larger sample size for more reliable results.

Based on the current evidence, we recommend non-operative treatment for patients with tendinitis or partial tear of the RC tendon.

Deep shockwave therapy is supported by substantial evidence for its effectiveness in promoting tissue regeneration (Chou et al., 2018). In their study, Chou et al. (2018) assessed the efficacy of deep shockwave therapy for treating tendinitis, both with and without concurrent partial tears. In partial tears, shock waves were applied to the area around the injury. The study included 13 elite athletes in the first group and 23 non-athletic individuals in the second group. Treatment was initiated 7.9 to 15.5 months post-injury, following more than three months of unsuccessful conservative management with peroneal medications and physical therapy. Participants were monitored at three, six, and twelve months post-therapy. The results of the study showed that deep shockwave therapy significantly reduced pain intensity and improved Constant-Murley scores, which evaluate pain, night pain, strength, activity, and mobility. Notably, all elite athletes returned to their pre-injury performance level within three months of undergoing the therapy. One year after treatment, satisfaction rates were comparable, with 53.8% in the elite athlete group and 52.1% in the non-athlete group reporting high satisfaction.

For more reliable results, the authors recommend repeating the study with a larger sample size.

Deep shock wave therapy is effective and less invasive than surgery and is recommended for the treatment of athletes with tendinitis or partial tears before arthroscopic treatment (Chou et al., 2018).

Shoulder girdle injuries are prevalent among individuals aged 25 to 40 years, often arising from activities that involve overhead arm movements, repetitive motions, and mechanical inflammation. In throwing athletes and individuals over 40 years of age, the bursa often becomes thickened and fibrotic (Zafar and Kumar, 2017). In Zafar and Kumar (2017), Zafar and Kumar (2017) and Yavuz et al. (2014), the authors compared the efficacy of laser therapy versus ultrasound therapy combined with moist hot packs and therapeutic exercise.

The study by Zafar and Kumar (2017) involved 30 male participants diagnosed with RC injuries classified as grade 1 and 2. Participants were randomly assigned to one of two treatment groups. Group A received ultrasound therapy along with moist hot packs, pendulum exercises, and resistance exercises, while Group B underwent low-intensity laser therapy combined with the same moist hot packs and exercises. The therapy lasted for four weeks, totaling 20 treatment sessions, with ultrasound applied for eight minutes and laser therapy for ten minutes during each session. Assessments were conducted at baseline, 30 days post-treatment, and 90 days post-treatment. Following therapy, all patients received instructions on performing exercises at home. Statistical analyses revealed a significant reduction in pain intensity and notable improvement in functional status for both groups. Notably, the low-intensity laser therapy group exhibited more pronounced clinical improvements

compared to Group A. The mechanism behind these benefits is linked to the effects of low-intensity laser therapy, which induces vasodilation, promoting the relaxation of smooth muscles associated with the endothelium. This is particularly important for managing joint inflammation, as vasodilation enhances oxygen delivery to the treated cells and increases the influx of immune cells to the affected tissue (Zafar and Kumar, 2017).

Yavuz et al. (2014) reported similar findings in their study. 31 patients with diagnosed subacromial impingement syndrome were randomly assigned to two treatment groups. Group 1 received low-intensity laser therapy combined with moist hot packs, range of motion exercises, and progressive resistance exercises, while Group 2 underwent ultrasound therapy in conjunction with moist hot packs and the same exercise regimen. The treatment lasted for three weeks, with a total of 15 sessions, each utilizing the physical modalities for five minutes.

As observed in the study by Zafar and Kumar (2017), both groups in the Yavuz et al. (2014) study demonstrated significant reductions in pain intensity and improvements in shoulder function, as measured by the Shoulder Pain and Disability Index (SPADI). However, they did not find statistically significant differences between the effectiveness of low-intensity laser therapy and ultrasound therapy. Consequently, they concluded that low-intensity laser therapy serves as an effective alternative to ultrasound therapy, particularly when ultrasound treatment is contraindicated. In their subsequent study, Zafar and Kumar (2017) applied moderate-intensity laser therapy, setting it apart from the previously mentioned studies (Zafar and Kumar, 2017; Yavuz et al., 2014). 30 men diagnosed with RC injury grade 1 and 2 were randomly divided into two groups. Group A underwent ultrasound therapy combined with moist hot packs and active exercises, while group B underwent laser therapy combined with moist hot packs and active exercises. The therapy lasted for four weeks, four times a week. Measurements were taken at baseline, after 21 days and on the last day of therapy. The studies concluded that the therapeutic effects of laser therapy and ultrasound therapy were more effective with the addition of moist hot packs. Laser therapy was found to be more effective than ultrasound therapy, which is similar to the findings in a previous study (Zafar and Kumar, 2017).

In all studies (Zafar and Kumar, 2017; Yavuz et al., 2014; Zafar and Kumar, 2017), the authors consistently found that both laser therapy and ultrasound therapy were effective in treating RC injuries, with significant reductions in pain intensity. However, it is important to note that these studies exclusively involved participants from the general population, highlighting the need for further research specifically focused on athletes with RC injuries.

All ten studies demonstrated reliable scientific evidence supporting the effectiveness of physiotherapy methods and techniques in the treatment of athletes with RC injuries. However, due to the increasing prevalence of RC injuries among athletes, further research is recommended to enhance prevention and develop more effective treatment strategies.

Based on the results, we recommend the use of physical methods such as mobilization, kinesiotherapy, kinesiology taping, dry needling, thermotherapy, shockwave therapy, laser, and ultrasound, in the physiotherapeutic management of RC injuries in athletes.

From the research, several recommendations can be made for the treatment of RC injuries in athletes (Table 1). Given the wide range of variability and the presence of concomitant pathologies across different sports and stages of injury, we advise the application of conservative approaches to treatment.

The rehabilitation program should focus on reducing initial pain and inflammation, improving glenohumeral joint mobility, and enhancing stability, strength, and neuromuscular control. Due to the different pathophysiological mechanisms in the different stages of RC injuries, we recommend the use of specific physiotherapy methods for each stage and level of injury. In the initial phase, to reduce pain intensity and inflammation, we recommend combining physical methods with manual therapies. Cryotherapy is recommended before starting treatment if pain or swelling is present. Ultrasound and laser therapy are recommended for athletes diagnosed with subacromial impingement syndrome and for RC injuries grade 1 and 2 to relieve pain, treat inflammation and increase joint functionality. Dry

needling therapy with application to the myofascial trigger points is recommended to reduce pain intensity and increase joint function, especially in unilateral impingement syndrome. However, attention should be given to potential side effects of the therapy. After the acute inflammation has subsided, thermotherapy with moist hot packs is recommended for athletes to improve local circulation and soft tissue extensibility, especially in combination with laser and ultrasound therapy for RC injuries grade 1 and 2. Grade 1 and 2 mobilization techniques, combined with passive range of motion exercises, are recommended to restore normal kinematics and improve joint range of motion. Kinesiotherapy is recommended at all stages of rehabilitation, focusing on pendulum and stretching exercises, range of motion exercises, resistance exercises, strengthening exercises and motor control exercises. The exercises are adapted based on the individual's pain level, range of motion, and severity of the injury. In the intermediate phase, strengthening stability and muscle power is crucial. We incorporate exercises to strengthen the rotator cuff muscles and the use of kinesiology tapes to enhance proprioception and control during joint movement, particularly in athletes diagnosed with impingement syndrome. Deep shockwave therapy is recommended, particularly for athletes diagnosed with tendinopathy, with or without concomitant partial tears, after more than three months of unsuccessful treatment with peroneal medications and physical therapy, especially when they do not respond to other forms of conservative treatment.

The use of rigid scapular taping is recommended for athletes diagnosed with RC tendinopathy to stabilize the scapula and reduce the subacromial space during early shoulder abduction. In the later phase of rehabilitation, particularly for athletes diagnosed with impingement syndrome, we recommend kinesiotherapy focused on the gradual reintegration of the athlete into daily activities and sports. We continue with range of motion, strengthening, and motor control exercises tailored to improving the joint's condition and functionality. Additionally, we incorporate resistance exercises adjusted to the individual's progress and injury severity to ensure optimal recovery. Surgical intervention is recommended for athletes exclusively when conservative treatment has proven unsuccessful.

Table 1: Recommendations for the use of physiotherapeutic methods and techniques in the treatment of RC injuries in athletes based on the results of the latest research

Physiotherapy Method	Effectiveness	Recommendations
Kinesiotherapy	Effective	Kinesiotherapy is recommended in all phases of rehabilitation for athletes with acute and chronic rotator cuff (RC) injury and impingement syndrome. The focus is on pendulum and stretching exercises, range of motion (ROM) exercises, resistance training, strengthening exercises, and motor control exercises. Each phase represents progression from the previous phase, with activities becoming increasingly intensive and demanding.
Mobilization	Effective	Mobilization is recommended for impingement syndrome and, along with passive joint mobilization, is used to achieve normal kinematics and improve range of motion (ROM).
Kinesiology Taping	Effective	Kinesiology taping is recommended for impingement syndrome to improve proprioception and joint movement control.

Rigid Taping	Possibly effective	Due to the lack of evidence on effectiveness, rigid taping is not recommended, except for short-term pain reduction and increased joint functionality in athletes with tendinopathy.
Thermotherapy	Effective	Thermotherapy is recommended after the acute inflammation subsides, using moist heat therapy to increase local circulation and improve soft tissue extensibility, in combination with range of motion (ROM) and stretching techniques.
Myofascial Trigger Point Therapy by Dry Needling	Effective	Dry needling therapy is recommended for impingement syndrome to relieve pain and increase joint functionality.
Shockwave Therapy	Possibly effective	Due to insufficient evidence, shockwave therapy is not recommended, except for patients with tendinopathy with or without partial tear who do not respond to other conservative treatments.
Laser Therapy	Effective	Laser therapy is recommended for subacromial impingement syndrome and RC injuries of grades 1 and 2 for pain relief, inflammation management, and increased joint functionality.
Ultrasound Therapy	Effective	Ultrasound therapy is recommended for subacromial impingement syndrome and RC injuries of grades 1 and 2 to alleviate pain and improve joint functionality.

CONCLUSION

Rotator cuff (RC) injuries are increasingly common among athletes, largely due to the high demands placed on the shoulder joint, particularly in sports involving repetitive overhead arm movements. These movements, characterized by abduction combined with external rotation (ER), often negatively impact the supraspinatus muscle, owing to its anatomical structure and function. Acute RC injuries in elite athletes typically result from direct trauma, such as falls on an outstretched arm, while chronic injuries stem from overuse and repetitive microtrauma. To enhance throwing velocity, athletes often develop increased ER in the glenohumeral (GH) joint, which can lead to adaptive changes in soft tissue and bone. Such injuries can significantly affect an athlete's career, limiting their ability to compete. RC injuries can vary in severity, ranging from contusions and tendinopathies to partial or complete tears. Diagnosis is based on a thorough clinical examination that includes a detailed history, inspection, palpation, assessment of active and passive range of motion, evaluation of muscle strength, and diagnostic imaging. The type of injury and its mechanism are key factors in determining the clinical approach, with particular attention to the position of the arm at the time of injury. Magnetic resonance imaging (MRI) is the preferred diagnostic imaging method, but ultrasound (US) imaging can also be used. To accurately assess the function of specific RC muscles, clinical provocation tests are commonly employed. In this article, we have successfully demonstrated the effectiveness of physiotherapy treatment in RC injury in athletes and found that a considerable number of physiotherapeutic methods and techniques are effective. What is needed is an understanding of the biomechanics of the individual's sport and an active focus on the potential consequences and development of pathology with specific preventative physiotherapy programs. The primary goals of physiotherapy include reducing pain and inflammation, restoring mobility in the GH joint, and enhancing stability, strength, and neuromuscular control, while identifying any dysfunctions in the kinematic chain. The physiotherapy treatment program should progress through several phases, which are adapted according to the intensity of pain and the degree of injury. Attention must be paid to

common concomitant pathologies in athletes. Treatment is conservative and includes a comprehensive rehabilitation program, anti-inflammatory drugs and corticosteroid injections. Effective physiotherapeutic methods and techniques for treating RC injuries in athletes include kinesiotherapy, joint mobilization, kinesiology tape therapy, thermotherapy, dry needling, laser therapy and ultrasound. In the early stages of rehabilitation, therapy focuses on reducing pain, inflammation, and swelling, while restoring normal range of motion. If pain or swelling is present, cryotherapy is recommended before starting treatment. For athletes with tendinopathy, with or without partial tears, who have not responded to traditional conservative methods, we recommend deep shockwave therapy as an effective alternative. Kinesiotherapy is recommended in all phases of rehabilitation. Kinesiotherapy includes pendulum and stretching exercises, exercises to increase flexibility, counter-resistance exercises, strengthening exercises and motor control exercises. Kinesiology taping is advised to enhance proprioception and improve joint control. We recommend surgical intervention only for athletes who have not achieved success with well-structured and consistent conservative treatment. Further research is necessary to establish a precise treatment protocol for RC injuries in athletes, one that accounts for the specific demands of the sport, the severity of symptoms, concurrent pathologies, and the timing within the athlete's season. High-quality studies involving larger sample sizes and long-term objective measurements are needed to develop definitive treatment guidelines. In clinical practice, we recommend the use of physiotherapy methods and techniques that are supported by latest research.

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