

# Therapeutic Exercises for Prevention and Rehabilitation of Sports Shoulder Injuries

## Ćwiczenia terapeutyczne w zapobieganiu i rehabilitacji sportowych urazów barku

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### SUMMARY

**Aim:** To analyze the functional effects of frequently used therapeutic exercises in the rehabilitation of athletes with shoulder injuries and to evaluate the possibility of their use in the prevention of sports shoulder injuries.

**Materials and Methods:** The analysis of scientific literature based on the Web of Science database has been carried out. A computer search for the title "sports shoulder injury" revealed 2428 articles. Later, the search was specified. At the final stage, eight articles were analyzed. The analysis of selected articles suggests that the following exercises are recommended for the prevention and rehabilitation of shoulder injuries: proprioceptive, resistance exercises (e.g., kinesiology tape), passive exercises, exercises for the upper extremities with closed and open kinematic chains, isokinetic, plyometric and specialized sports exercises (depending on the sport). Besides therapeutic exercises, for the prevention of sports injuries of the shoulder, we admit it is appropriate to consider the method of kinesiology taping as a promising means of physical therapy.

**Conclusions:** Among the therapeutic exercises to prevent of sports injuries of the shoulder, we consider promising proprioceptive, isokinetic, exercises with open and closed kinematic chain, exercises with resistance. It is necessary to study the feasibility of using these exercises and develop appropriate preventive measures and recommendations in the training process. It is also high-potential to study the effectiveness of combining therapeutic exercises with other means of physical rehabilitation.

**Key words:** physical therapy, athletes, shoulder impingement syndrome, exercise

**Słowa kluczowe:** fizjoterapia, sportowcy, zespół ciasnoty barku, ćwiczenia fizyczne

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### INTRODUCTION

Sahrmann S. et al. developed a scheme of motor disorders, which was adopted by the American Physical Therapy Association in 2013. This scheme is useful for determining the methods and means of rehabilitation and prognosis of patient recovery because it combines the musculoskeletal system and regulation of muscle contraction with the system of autonomic movement [1, 2]. An analysis of diseases according to the Sahrmann S. scheme revealed that over 1.7 billion people worldwide suffer from diseases of the musculoskeletal system, disorders of which are often connected with long-term pain, functional limitations, loss of activity and deteriorating quality of life [3]. A significant proportion of patients with motor disorders are athletes. The leading cause of musculoskeletal dysfunction of athletes is sports injuries [4]. Sports injuries account

for 3-5 per cent of the total number of injuries and can be received not only by professional athletes but also by amateurs who do not follow safety precautions [5].

Among sports injuries, shoulder complaints are the third most common injuries of the musculoskeletal system after back and neck injuries. Among people with shoulder pain, impingement syndrome is the most common and accounts for 36 per cent of shoulder joint diseases [5, 6]. Houghlum has identified that systematic trauma, abnormal posture, age-related changes, fatigue and vascularization of the shoulder muscles, biomechanical changes, neuromuscular adaptation, and rotator cuff imbalance are the major causes of impingement syndrome [6]. Shoulder Impingement Syndrome (SIS) is a general term that explains the damage to structures in the subacromial space, such as rotator cuff tendinosis, partial rotator cuff rupture, and bursitis [7].

Some systematic reviews have focused on studying the effectiveness of various physiotherapeutic interventions aimed at stabilizing the scapula in impingement syndrome [8]. However, as far as we know, the literature has not sufficiently reviewed the functional effects of the use of therapeutic exercises for their use in the prevention of sports shoulder injuries.

## AIM

To analyze the functional effects of frequently used therapeutic exercises in the rehabilitation of athletes with shoulder injuries and to evaluate the possibility of their use in the prevention of sports shoulder injuries.

## MATERIALS AND METHODS

The analysis of scientific literature based on the Web of Science database has been carried out. A computer search for the title "sports shoulder injury" revealed 2428 articles. A further search was specified: a) articles that were published from 2017 to 2021 – 1059 (from January 1, 2017, to November 25, 2021); b) category «Rehabilitation and sports sciences» – 704; c) article – 579; d) exercise – 129 e) prevention – 51.

The keywords used for the search are illustrated in Fig. 1.

With the help of manual selection, 51 articles were analyzed for the presence of therapeutic exercises, which should be used for rehabilitation and prevention of shoulder impingement syndrome as the most common dysfunction of the shoulder joint. Eight such articles were found [9-16].

## REVIEW AND DISCUSSION

The analysis of selected articles suggests that the following exercises are recommended for the prevention

and rehabilitation of shoulder injuries: proprioceptive, resistance exercises (e.g., kinesiology tape), passive exercises, exercises for the upper extremities with closed and open kinematic chains, isokinetic, plyometric and specialized sports exercises (depending on the sport) (Table 1) [9-16].

The majority of authors note the importance of considering the pain syndrome, the quality of functional movements in the shoulder, as well as the range of motion.

It should be noted that all selected articles described and explained the specifics of different sports. Therefore, sports exercises that consider the peculiarities of the movements of a particular sport are mandatory in the rehabilitation and prevention of impingement syndrome [17]. This ensures progress in the rehabilitation process and promotes a faster return of the athlete to intensive training [18, 19]. In our opinion, the use of such exercises cannot be considered as prevention, because the prevention of sports injuries of the shoulder should be aimed at internal causes.

In the articles analyzed, proprioceptive exercises were most often used to rehabilitate SIS. These exercises are usually used to train balance, for which stabilometric platform is used, which provides multiple activations of sensory receptors and further integration of these perceptions in the central nervous system [20, 21]. It is generally thought that this leads to a better perception of the position and movement of the joints. Thus, unconscious stabilization of joints during movement based on coordination reflexes is supported [23]. After all, when the proprioceptive system is not stimulated properly, there is a greater risk of falls and sprains [13, 14]. Therefore, we believe that proprioceptive exercises are a necessary element in the prevention of sports injuries. Proprioceptive training has convincing scientific evidence of its effect on the body both at the level of recovery and to prevent injury [9]. These exercises also help increase strength, elasticity, and coordination of muscle contraction. In turn, an important aspect of the application of these exercises is their appropriate use at the beginning of training and with a certain frequency [11, 16].

Plyometric exercises are important for the rehabilitation of athletes, the essence of which is to perform speed-force, explosive movements, which allow to increase muscle strength, as well as to restore/improve the technique of performing certain motor actions. For example, sessions using plyometric exercises may include push-ups, jumps, punches, throws, pushes, and so on [10, 14]. This tool, with skilful use, is indispensable in the late stages of recovery when the main task of rehabilitation is to restore specific activities and sports skills [16]. Given that sports such as basketball, volleyball, handball involve a large number of explosive movements [24, 25], the use of plyometric exercises in the prevention of SIS requires more detailed and evidence-based research. At the same time, it should be noted that the rapid progression of physical activity, technical errors in performing specific explosive movements for each sport, lack of proper recovery time can lead to injuries or unwanted complications [12, 13].

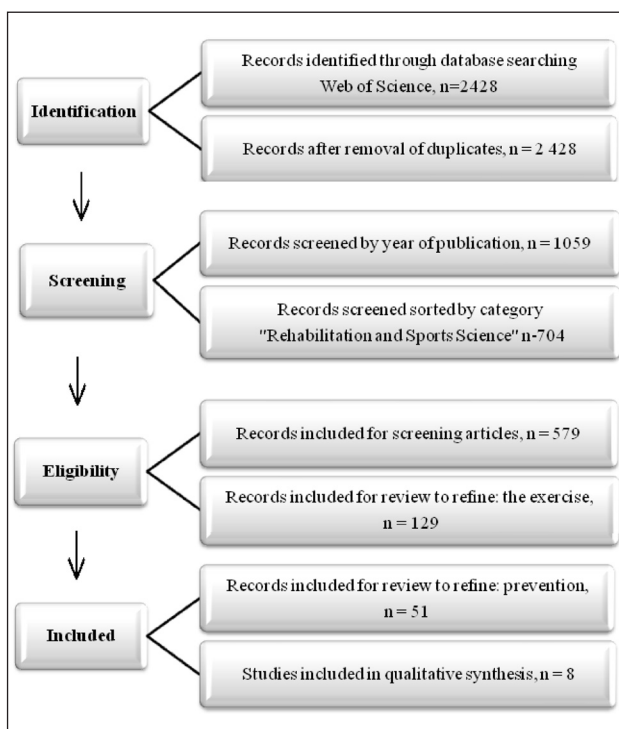


Figure 1. Flow diagram of study selection

**Table 1.** Analysis of the use of therapeutic exercises in the rehabilitation of shoulder impingement syndrome

Article Exercises	Proprioceptive exercises	Resistance exercises (e.g., kinesiology tape)	Passive exercises	Exercises for the upper extremities with closed and open kinematic chains	Isokinetic exercises	Plyometric exercises	Specialized sports exercises
Sekiguchi T, Hagiwara Y, Momma H et al. [9]	*			*			*
Wright AA, Hegedus EJ, Tarara DT et al. [10]				*	*	*	*
Roddy E, Zwierska I, Hay EM et al. [11]	*	*					*
Nejati P, Ghahremaninia A, Naderi F et al. [12]	*	*			*	*	*
Turgut E, Duzgun I, Baltaci G. [13]	*	*			*	*	*
Hotta GH, Santos AL, McQuade KJ et al. [14]	*			*	*	*	*
Andersson SH, Bahr R, Olsen MJ. [15]	*			*	*		*
Andersson SH, Bahr R, Clarsen B et al. [16]	*		*			*	*

Isokinetic exercises are one of the types of strength training. It uses specialized simulators that allow maintaining a constant speed no matter how much effort the patient go through. The idea of this type of exercise is to achieve the highest degree of muscle contraction [8, 27]. It was found that the use of isokinetic exercises in sports rehabilitation has a significant effect on the prevention, diagnosis and rehabilitation of sports injuries [10, 28]. Isokinetic exercises avoid excessive load on the damaged joint and at the same time provide the maximum dynamic load on the involved muscle in the entire range of motion [12, 15]. Given these benefits, these exercises are appropriate for use in rehabilitation in impingement syndrome of the shoulder and are most effective in the prevention of this disease [14].

Exercises with open and closed kinematic chains are also often used in the rehabilitation of shoulder exercises. Exercises with an open kinematic chain are used to increase acceleration, decrease resistance, increase in distraction and rotation of force, improve functional activity, reduce or eliminate axial load and use external rotary load [17, 24]. The closed kinematic chain includes increased compressive load on the joints, increases congruence and stability, reduces acceleration, stimulates proprioception, improves dynamic stability, restores neuromuscular control, activates functional muscle groups and determines movement in several joints [14, 15]. These characteristics of the functional

state of the muscles allow us to consider exercises with open and closed kinematic chains as promising in the prevention of sports injuries of the shoulder.

To strengthen the shoulder joint, resistance exercises are employed. These can be exercises using elastic kinesiological tape. First, the exercises are aimed at strengthening the rotator cuff of the shoulder, which ensures the stability of the shoulder joint during movement [11, 22]. In addition, exercises with a ribbon are aimed at strengthening the extensor muscles, in such exercises, the elastic band is used as a weight [12]. All resistance exercises are aimed at increasing the stability of the shoulder while moving, so it is important to include them in the prevention of sports injuries of the shoulder [13].

Some authors in their studies highlighted the feasibility of using passive exercises, which were used only during the exacerbation of the pathological process [30]. Therefore, such exercises are not used for SIS prevention.

In addition to therapeutic exercises, for the prevention of sports injuries of the shoulder, we admit it is appropriate to consider the method of kinesiology taping as a promising means of physical therapy. Since 1988, this method has gained international recognition at the Olympic Games in Seoul, and in 1995 the method of kinesiology taping was introduced in some protocols for medical care and rehabilitation. Therefore, we can say that taping in sports has long proven itself as an effective method to eliminate pain

and injury during intense work. When using kinesiology tape, the load is redistributed to the problem areas of muscles and joints, certain muscle groups are relaxed and the optimal functional state of the joint is maintained [24, 29]. However, there is evidence of deterioration in muscle function because of improper use of kinesiology taping and/or ignoring contraindications to its use [26, 28].

## CONCLUSIONS

Therapeutic exercises for impingement syndrome of the shoulder are used in all rehabilitation programs, are highly effective, especially in the rehabilitation of athletes. Among the therapeutic exercises preventing SIS and shoulder exercises, we consider proprioceptive, isometric, exercises with open and closed kinematic chain, and exercises with resistance. It is necessary to study in detail the feasibility of using these exercises and develop appropriate preventive measures and recommendations in the training process. It is also prospective to study the effectiveness of combining therapeutic exercises with other means of physical rehabilitation.

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The Authors declare no conflict of interest

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Info



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