

Rehabilitation Methods for Shoulder Joint Injuries

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Abstract. Shoulder injuries frequently appear in various upper limb-dominated sports, and there will be physical discomfort, pain and stretching during competitions and daily sports training, which brings great distress to athletes in such sports. Therefore, it is necessary to provide relevant guidance for professional athletes and others who are enthusiastic about shoulder injury rehabilitation. This paper mainly discusses the various rehabilitation treatment methods and methods of shoulder joint injury and analyzes the advantages and treatment effects of each method. The results show that exercise training, physical factor therapy, acupuncture and massage therapy have good curative effects on shoulder joint injury, and each has its specialization. For example, exercise training can better restore the patient's shoulder joint mobility, improve the patient's overall physical quality and improve the level of metabolism to a certain extent, and is not subject to a single rehabilitation place in the hospital. Physical factor therapy is effective in relieving shoulder pain and helping the outflow of inflammatory factors, while acupuncture and massage therapy focus on the comprehensive recovery of patients, so that the total clinical effective rate of patients is greatly improved. This paper fills the gap that there is no systematic induction of shoulder rehabilitation in the professional community and can provide guidance for the comprehensive rehabilitation of shoulder joints to a certain extent.

Keywords: Shoulder joint athletic training, Therapeutic ultrasound, Percutaneous peripheral nerve Stimulation, Acupuncture and massage therapy.

1. Introduction

The shoulder joint is the most mobile complex joint in the human body, relying on the dynamic interaction supported by the sensorimotor system to form the acromioclavicular joint, sternoclavicular joint, glenohumeral joint, and scapulothoracic joint[1]. The shoulder joint capsule is thin and loose, so the surrounding muscles and ligaments of the shoulder joint play an indispensable role in fixing the shoulder joint. Shoulder injuries are often caused by improper exertion of the muscles around the shoulder joint, resulting in changes in tendon morphology. Rotator cuff myopathy, shoulder dislocation, and subacromial impingement syndrome caused by acute injury[1]. The global incidence of shoulder pain is as high as 6.2%, and the annual incidence rate in high-income countries is 7.7~62 cases per 1,000 people/year[2]. In the community population, the prevalence is 20.2% in women and 12.5% in men[2]. Acute shoulder dislocation is the most common form of large joint dislocation, with more than 200,000 cases occurring each year and

therefore, the emergency department is presented[3]. Shoulder injuries are more common in ball games dominated by the upper limbs, such as badminton, and the number of studies on shoulder injuries in badminton has been on the rise in recent years. According to reliable data, the incidence of shoulder pain in the Spanish badminton team (n=45) was as high as 47.4%[4]. Continuous, high-intensity upper limb-dominated movements have a significant impact on the shoulder joint. One study showed that after two consecutive badminton matches, the range of motion of the dominant shoulder decreased by 5.8% and the total range of motion of the dominant side decreased by 4.8% [5]. Previous studies have found that shoulder injuries are very detrimental to ball players with upper limb dominance. At present, most of the research on shoulder joint injuries is mainly on surgical treatment and drug treatment, such as rotator cuff myopathy and rotator cuff tear. Frozen shoulder is mostly treated with surgery, while shoulder pain and frozen shoulder are mostly treated with medication. The existing mainstream treatment methods have some limitations, such as a long recovery period and a short analgesic effect. As a novel treatment method, comprehensive treatment, including physical therapy, has gradually become known to the public. However, according to the current analysis, most of the three aspects of shoulder joint exercise training, physical factor therapy and acupuncture and massage therapy are mainly based on case reports of clinical studies, and there is no systematic combination of these approaches, and there is still a certain gap. Therefore, this study provides diagnosis and treatment ideas for shoulder joint injury rehabilitation, such as exercise training, physical therapy and acupuncture and massage therapy.

2. Athletic training for shoulder injuries

Athletic training is an exercise that activates the muscles around the shoulder joint and restores the range of motion of the shoulder joint. These include stretching to control the shoulder, strength training for the shoulder, internal and external rotation of the shoulder and trunk, load-related training for handball throwing, and comprehensive improvement of the overall motor function of the shoulder [6]. As a result, the comprehensive ability of the patient's shoulder joint can reach a normal level or even improve. Shoulder injuries based on different reasons should also adopt different training methods according to local conditions and also control the frequency and intensity of exercise to avoid secondary injuries caused by excessive exercise training. At present, exercise training is one of the main ways of shoulder rehabilitation, and through exercise training, it can help patients with shoulder joint injuries to restore their range of motion, relieve shoulder pain, and slowly return to daily life. According to a clinical study in the rehabilitation department of a rehabilitation hospital in China, 46 patients with rotator cuff injury were randomly divided into an experimental group and a control group. Both groups were given conventional therapeutic exercise and physical therapy, and the experimental group was supplemented with scapular training exercises. The Constant-Murley scale (CMS), visual analog scale (VAS) and shoulder range of motion (ROM) were used for evaluation[7]. Research data indicate that after 12 weeks of treatment, CMS (pain index 7.39 vs. 5.44; daily activities 8.13 vs. 6.04; range of motion 21.64 vs. 17.05; strength training 6.08 vs. 5.00; total score 42.91 vs. 38.14) and shoulder range of motion (flexion 95.83 vs. 62.13, abduction 89.61 vs. 62.70, extension 20.26 vs. 14.52) all showed improvement, and VAS score (4.87 vs. 3.61) showed a downward trend [7]. The functions of the experimental group were significantly better than those of the control group, and the differences were statistically significant($P<0.05$)[7].

In a clinical study of subacromial impingement syndrome in Danish baseball players, patients with subacromial impingement syndrome (N=30) were assessed by a numeric scale (NRS) [6]. Shoulder pain was relieved after treatment with exercise therapy (warm-up, strength training, ice),

and the NRS score (7.88 → 3.56) was reduced [6]. From this point of view, exercise training has great significance for the recovery of the shoulder joint, which makes up for the disadvantages of expensive and high-risk surgical treatment, and can also avoid the side effects caused by drug treatment. Exercise therapy can effectively affect the range of motion, range of motion, and pain of the shoulder joint. Secondly, exercise training can improve the patient's own physical fitness to a certain extent, increase the level of body metabolism, and is not restricted by the single recovery place of the hospital, which is conducive to the further recovery of the patient.

3. Physical factor treatment of shoulder joint injury

3.1. Percutaneous Peripheral Nerve Stimulation

Percutaneous Peripheral Nerve Stimulation(PPS)is a neuromodulation technique that can be used to relieve pain caused by shoulder injuries [8]. The therapist can deliver an electric current that slowly increases from zero at a frequency of 100 Hz to the target brachial plexus by utilizing an external pulse generator [8]. Electrical currents can alleviate abnormal pain caused by shoulder injuries by stimulating nerve fibers to block the conduction of pain signals and, to some extent, promote the production of endogenous opioid peptides such as endorphins, thereby enhancing the analgesic effect of the central nervous system [8]. A randomized, double-blind clinical trial study showed that PPS was effective in treating joint pain. Percutaneous electrode leads are implanted to target the brachial plexus, and a surface return electrode is placed on the ipsilateral shoulder [8]. The current is delivered at a frequency of 100 Hz and the intensity is slowly increasing from zero, with a median opioid consumption (IQR) of 5 mg in the group given transcutaneous electrode therapy compared with 48 mg in patients given sham therapy: ratio of geometric means (97.5% CI) 0.20, $P < 0.001$ [8]. During the same period, the mean pain intensity was 1.1 in patients given percutaneous electrode therapy versus 3.1 in patients given sham stimulation: a difference (97.5% CI) -1.8, $P < 0.001$ [8]. PPS is effective and precise in relieving pain, has better analgesic effects than opioids commonly used in clinical practice today, and avoids drug addiction [8]. Neuromodulation does not cause proprioceptive or motor deficits and therefore does not affect the rehabilitation process [8].

3.2. Therapeutic ultrasound

Ultrasound, as a non-invasive technique, induces various biological effects, such as increased blood perfusion and accelerated cell necrosis, through both thermal and non-thermal mechanisms [9]. Ultrasound therapy also plays a significant role in the rehabilitation of calcific shoulder tendonitis [9]. Calcific tendonitis is often caused by hydroxyapatite crystals that accumulate at the tendons of the shoulder and gradually accumulate to form calcifications, and most of them are bilaterally symmetrical [9]. In a clinical randomized controlled practice study (N=58), patients with calcific shoulder tendonitis were treated with ultrasound in continuous mode at a frequency of 1 MHz and an intensity of 1.5 W/cm² in a calcified area for 10 minutes [9]. Compared with the placebo group, the treatment group had a more significant decrease in HAQ-DI (69.05% vs. 36.93%, $P=0.007$), a decrease in Change VAS global health (VAS GH) (78.72% vs. 46.78% $P=0.001$), and a more significant increase in grip strength (20.20% vs. 3.47% $P=0.010$) [9]. The increased capillary blood flow from ultrasound therapy contributes to the outflow of inflammatory mediators, which can lead to a reduction in pain. It is also effective in the treatment of calcific tendonitis, and ultrasound therapy may be preferred if significant calcifications are observed during ultrasonography of the

shoulder. In summary, ultrasound therapy, as a safe, analgesic and cost-effective treatment, is a good choice for patients to undergo physical factor rehabilitation.

4. Acupuncture and massage therapy for shoulder injuries

Acupuncture and massage therapy are ways for therapists to stimulate specific acupuncture points and dredge meridians to restore patients' range of motion, shoulder joint function and self-care ability, and can also relieve pain to a certain extent. Before the massage, the therapist first ensures that the temperature and humidity are suitable, asks the patient to sit upright, uses the palm root kneading method to massage and relax the muscles around the patient's shoulder joint, and then fully relaxes the muscles and then clicks on the specific acupuncture points of the patient. After the tapping is over, the shoulder joint on the affected side is partially relaxed again, the shoulder skin heat is increased by rubbing, then the distal to the proximal end of the affected limb is rubbed, and finally, the palm massage is performed from the shoulder and neck of the affected side to the distal end of the upper limb to unblock the patient's meridians [10]. Patients were divided into two groups of 44 men and women in a statistically balanced group [10]. The control group used menstrual massage [10]. In the observation group, on the basis of the menstrual massage treatment in the control group, the patients were instructed to perform slow shoulder exercises, such as abduction and extension, and the acupuncture needles were removed after 20 minutes [10]. The total clinical effective rate of the observation group was higher than that of the control group, and the difference was statistically significant (95.45% vs. 77.27%) ($P < 0.05$). In summary, acupuncture and massage therapy are beneficial for the repair of shoulder injuries [10]. Stimulation of the mounds and ruins on the affected side and the two acupoints of Zhaohai has a better effect on shoulder joint rehabilitation. However, acupuncture and massage therapy are great tests of the therapist's accurate control of the body's acupuncture points and the therapist's understanding and application of TCM knowledge, and may cause secondary damage due to incomplete needle disinfection, so special attention should be paid to these potential risks when using acupuncture and massage therapy.

5. Suggestion

According to current research, although exercise therapy can better restore the range of motion of the shoulder joint, there is still room for improvement. The paper focuses on virtual VR technology, and uses VR technology to assist patients in standardizing and rationalizing the intensity of exercise training movements, to improve the fun of training and the accuracy of patient movements. In addition, using AI technology in the patient's exercise training to help him customize the personalized exercise training plan, to further accelerate the rehabilitation process and improve the patient's comprehensive exercise ability, and combine the comprehensive rehabilitation technology of physical factor therapy to maximize the efficacy. There is also room for improvement in acupuncture and massage therapy, and in the future, which can focus on the combination of medical imaging technology and acupuncture and massage therapy. For example, under the guidance of ultrasound, the blood vessels around key acupuncture points are accurately avoided to reduce the risk of acupuncture point deviation, and the standard of needle disinfection is strictly controlled to avoid secondary injury to patients caused by improper needle disinfection. On this basis, a guiding guide for shoulder acupuncture rehabilitation was established, and the principles of acupoint extraction and acupuncture for different types of injuries were clarified, to reduce the risk of operation and expand the applicable population. At the same time, a large database of the shoulder injury rehabilitation population was established to analyze the directional characteristics and

distribution types of the shoulder joint injury population. Tertiary prevention is very worthy of attention, timely detection and intervention after the disease, and the adoption of correct, accurate and personalized diagnosis and treatment methods, to maximize the efficacy, minimize side effects, and achieve multi-faceted and multi-angle systematic comprehensive rehabilitation.

6. Conclusion

Current studies have shown that exercise training, physical factor therapy and acupuncture and massage therapy have a positive effect on the comprehensive rehabilitation of the shoulder joint. Exercise training is aimed at the range of motion of the shoulder joint, and the effect is good, which can improve the overall physical fitness of patients to a certain extent. In the treatment of physical factors, PPS can improve the shoulder pain of patients and fill the deficiency of drug treatment dependence. Ultrasound therapy can also improve shoulder pain by increasing biological effects, which is affordable and cost-effective. Acupuncture therapy is more comprehensive than the treatment. Since there is no systematic review in this field, this paper fills the gap in this area and can give therapists technical guidance on comprehensive shoulder joint rehabilitation to a certain extent. However, although a large number of studies have confirmed the benefits of exercise therapy, physical therapy and acupuncture therapy, it is still necessary to specify personalized treatment plans according to the patient's condition in clinical studies. There are still limitations, such as a small sample size and an insufficient research mechanism in this study. Future studies need to further expand the sample size and establish a large database on the efficacy of shoulder rehabilitation. To a certain extent, combined with comprehensive medical knowledge such as imaging and pathology, different therapies and their efficacy are analyzed. Accurately locate the cause of the patient and adopt personalized and targeted rehabilitation methods according to different patients.

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