

## Original Article

# Effects of control training of scapula on functional recovery of shoulder joint after the operation of rotator cuff injury syndrome

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**Abstract:** Objective: To investigate the effects of control training of scapula on functional recovery of shoulder joint after the operation of rotator cuff injury and pain scores. Methods: Forty patients with rotator cuff injury syndrome admitted in our hospital from January 2014 to December 2015 were randomly divided into control group (20 cases) and observation group (20 cases). The control group was only treated with physical therapy and early immobilizing rehabilitation of shoulder joint, once per two days, ten times as a course, three courses in total and no interval between courses. Besides the above treatment, the observation group received control training of scapula. All patients were assessed for shoulder joint range of motion (ROM) and visual analog scale (VAS) of shoulder joint before and after treatment. Results: Forty patients involved were all qualified for result analysis. Compared with prior treatment, no significant difference was found in VAS score and shoulder joint ROM improvement of patients in the two groups 2 weeks after operation ( $P=0.15$ ); while 4 and 8 weeks after operation, the VAS score and shoulder joint ROM markedly improved ( $P=0.02$ ,  $P=0.01$ ), and the VAS score and shoulder joint ROM improvement in observation group were better than those in control group ( $P=0.02$ ,  $P=0.03$ ). Conclusion: Patients with rotator cuff injury syndrome can effectively relieve their postoperative pain, improve the shoulder joint ROM and motor function of shoulder joint through long-term control training of scapula.

**Keywords:** Control training of scapula, rotator cuff injury, clinical outcome

## Introduction

The shoulder joint that mainly consists of the caput humeri, cavitasglenoidalis, and adjacent muscles, tendons, and joint capsule, is the most active joint of the human body [1]. The rotator cuff (sometimes called a rotary cuff), a sleeve-shaped surrounding humeral head, is composed of the tendons of supraspinatus, infraspinatus, subscapularis and teres minor, which act to stabilize glenohumeral joint, and at the same time, provide the dynamia of shoulder joint movements [2]. The rotator cuff injury is a degenerative disease with age growing, common in middle-aged people over the age of 40; it has the highest incidence of joint disease, and the shoulder impingement syndrome is the main type of rotator cuff injury [3, 4].

The rotator cuff plays a critical role in maintaining the dynamic stability of shoulder joint. Pain and restricted movement of shoulder joint

caused by rotator cuff injuries can seriously affect the quality of daily life of patients. The aim of the present study is to investigate the post-operative clinical outcome of arthroscopic repair of rotator cuff injuries for patients with rotator cuff injury syndrome by using normative control training of scapula after repair of scapula and to make comparative analysis of shoulder joint functional recovery in observation group and control group.

## Materials and methods

### General information

Forty patients who had been treated with arthroscopic repair of rotator cuff injuries in our hospital from January 2014 to December 2015 were selected. Inclusion criteria: All the patients suffered from dysfunction of shoulder joint caused by trauma, covering labor injuries, sports injuries and traffic accidents, with cor-

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**Table 1.** Comparison of general information of patients in the two groups, (n,  $\bar{x} \pm s$ )

Group	n	Gender (n)		Age (year)	Course (year)	Partial thickness damage/ full thickness damage	P value
		Male	Female				
Control group	20	12	8	45.8±11.1	3.75±2.36	12/8	
Observation group	20	11	9	42.7±12.4	3.64±2.57	13/7	0.12

responding clinical signs confirmed by MRI; as for the severity of rotator cuff injuries, patients with partial thickness damage and full thickness damage. Exclusion criteria: Patients with dysfunctional scapula joint, shoulder joint movement disorder caused by central nerve injuries and peripheral nerve injuries, and dysfunctional shoulder joint caused by trauma and upper limb fractures; patients with some other diseases unsuitable for rehabilitation; patients with abnormal mentality unable to cooperate with investigators; patients with other severe systematic disorders. Patients must be approved by Clinical Ethics Committee, signed the informed consent before selected, and then were randomly divided into 2 groups, with 20 cases in each group. There was no statistical difference in age, course, severity of disease ( $P > 0.05$ ) and basic treatment, which was comparable, as shown in **Table 1**.

### Methods

Patients in the two groups were successfully performed with arthroscopic repair of rotator cuff injuries by surgeons from the same group. Pain education was carried out in the two groups before operation. There was no statistical difference in patients' mastery degree on pain education and the total score of awareness of pain control after operation; the routine post-operative therapies were the same. Patients in the two groups were treated with routine rehabilitation the next day after operation, once per two days, ten times as a course, and three courses in total.

There were three stages of routine rehabilitation. The first stage (0~3th week): The injured shoulder should be protected by shoulder con-dole belt in a comfortable suspension position, without weight and excessive force. Otherwise, it will affect the function of tissue healing. Protection time depended on pain and muscle strength. The second stage (7~12th week): 1. Accompanied with motion training, such as shoulder ladder, pulley, etc. 2. Use sticks to do exercises like flexion, extension, external rota-

tion when the patient stood, all three times/d, five to ten per times. 3. Continue to carry out contracting practice of shoulder muscles. 4. Correct postures; maintaining good habits and postures in the daily life was as important as rehabilitation training. The third stage (after 12th week): In this stage, the rotator cuff was basically healed, final pull and strength practice were needed in addition to the previous actions.

The observation group was additionally performed with control training of scapula [5], and the details were as follows.

*Passive motion of scapula:* The therapist was on the left side of supine patient, holding the scapula of patient with right palm and gradually pushed the scapula upward. The patient's scapula was fixed by fingers of the therapist at the same time. Then, external rotation of the scapula was realized by ulnar deviation through therapist's wrists. Repeat each movement ten times for twice every time.

*Squeezing the scapulothoracic joint:* The therapist was on the left side of supine patient, holding the scapula of patient with right palm and gradually pushed the scapula upward, at the same time, his left hand supported the affected side of the pectoralis major, then both hands squeezed slowly with force relatively for over 15 s until the tension of spastic muscle around the shoulder joint relatively declined.

*Stimulus induced training of muscles around the scapula:* Subscapularis and pectoralis major were gently massaged to decrease spasm before training, then, the superior trapezius muscle, infraspinatus and teres minor were strongly stimulated through point-pressing and squeezing to induce muscle contraction. Repeat each movement three to five minutes for each time.

*Active motion of scapula:* The injured side of patient was left. The patient was in sitting position with both his upper extremities separately

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**Table 2.** Comparison of VAS and shoulder joint ROM of patients in the two groups

Group	VAS (score)	Flexion (°)	Extension (°)	Adduction (°)	External rotation (°)
<b>Control group</b>					
Before treatment	6.30±1.1	43.2±11.70	11.70±3.2	28.1±5.6	12.8±4.2
Two weeks after treatment	6.1±1.3	48.2±12.5	12.1±2.6	30.1±4.3	13.1±3.9
Four weeks after treatment	4.5±0.7 <sup>a</sup>	65.2±7.5 <sup>a</sup>	14.5±2.9 <sup>a</sup>	33.5±3.3 <sup>a</sup>	25.7±5.1 <sup>a,b</sup>
Eight weeks after treatment	2.6±0.5 <sup>a,b</sup>	101.7±13.4 <sup>a,b</sup>	26.7±3.4 <sup>a,b</sup>	56.8±6.7 <sup>a,b</sup>	43.4±10.8 <sup>a,b,c</sup>
<b>Observation group</b>					
Before treatment	6.20±0.8	41.3±10.9	11.4±4.2	27.6±6.2	12.3±3.7
Two weeks after treatment	6.3±1.1	50.4±9.1	12.3±2.1	29.5±4.9	13.4±4.1
Four weeks after treatment	3.8±0.9 <sup>a,c</sup>	72.4±9.1 <sup>a,c</sup>	17.5±3.1 <sup>a,c</sup>	48.5±3.9 <sup>a,c</sup>	35.7±6.4 <sup>a,b,c</sup>
Eight weeks after treatment	1.6±0.40 <sup>a,b,c</sup>	135.4±19.5 <sup>a,b,c</sup>	38.4±5.8 <sup>a,b,c</sup>	73.4±11.8 <sup>a,b,c</sup>	35.7±6.4 <sup>a,b,c</sup>

Note: Compared with before treatment, <sup>a</sup>P<0.05; compared with four weeks after treatment, <sup>b</sup>P<0.05; compared with the control group, <sup>c</sup>P<0.05.

placed at the side of his body, then was asked to initiatively shrug. The therapist was standing behind the patient with his left hand holding the affected lateral side of patient. When the patient's motion was weak, the therapist helped him to lift upward for completing the action. Or the therapist may place his left hand on the patient's affected side of shoulder, right hand on the uninjured side, the scapular muscle was gently beaten and lifted up by the therapist's left hand while the patient was shrugging, meanwhile, the right shoulder was pushed downward by therapist's right hand to induce the affected side for completing the shrug. Ten times as a set, repeat each movement one to two sets each time.

*Resistance training of scapular muscles:* The therapist was on the left side of supine patient with his right hand holding patient's affected hand (palm to palm) and his left hand placed at the elbow of the affected limb, in order to keep the elbow extension, which means the affected shoulder was at 90° of flexion and the elbow was extended. Then, the patient was asked to push the therapist's right hand upward, at the same time, he would have proper resistance from the therapist, and the therapist's left hand was used to keep the patient's elbow extended. When the upward push became relatively weak, the patient's elbow was helped to lift up, meanwhile, he was told to feel the pushing forcing (remind the patient of correct way to push, so as to avoid the joint injury and dislocation due to dragging articular capsule).

The therapist was on the left side of supine patient with the patient's affected shoulder

abducted to 90° and the elbow extended, then, the therapist's right hand held the patient's affected hand (palm to palm) and his left hand placed at the lower part of the elbow of affected limb for keeping elbow extended. The patient was asked to push the therapist's right hand outward, at the same time, he would have proper resistance from the therapist, and the therapist's left hand was used to keep the patient's elbow extended. When the outward pushing force became relatively weak, the elbow of the patient was held and helped to pull outward, again, the patient was told to feel the pushing forcing (remind the patient of correct way to push, so as to avoid the joint injury and dislocation due to dragging articular capsule injury). Ten times as a set, repeat each movement one to two sets each time.

*Assessment of therapeutic efficacy:* The shoulder joint ROM and pain scores of patients in the two groups were measured before the treatment as well as 2, 4 and 8 weeks after the treatment.

*Shoulder joint ROM:* The shoulder joint ROM was measured by specialists using joint goniometers to decrease the measurement error. The shoulder joint ROM tests include the ROM of shoulder's flexion, extension, adduction and external rotation.

*Pain scores:* Patients in the 2 groups were provided with pain education before operation and there was no statistical difference in the total score of the awareness of pain control for patients in the two groups. VAS was applied to assess the pain intensity of affected part of

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patients: 0 was considered as painless, 1 to 3 as mild pain, 4 to 6 as moderate pain, 7 to 9 as severe pain, 10 as fierce maximal pain.

All the assessments were performed by the same rehabilitation therapist.

### *Statistical treatment*

The assessment results were statistically analyzed by SPSS17.0. Differences of measurement data and enumeration data were compared with t-test and  $\chi^2$  test respectively, and the former was expressed as mean  $\pm$  standard deviation ( $\bar{x} \pm s$ ).  $P < 0.05$  was considered statistically significant.

### **Results**

There was no statistical difference in VAS and shoulder joint ROM of patients in the two groups before treatment ( $P > 0.05$ ); compared with prior treatment, there was no significant improvement of VAS and shoulder joint ROM of patients in the two groups 2 weeks after treatment ( $P > 0.05$ ), however, 4 and 8 weeks after treatment, they presented significant improvement of VAS and shoulder joint ROM ( $P < 0.05$ ), and the shoulder joint ROM in observation group was better improved than that in control group ( $P < 0.05$ ); the VAS in observation group was superior to that in control group ( $P < 0.05$ ). See **Table 2**.

### **Discussion**

A rotator cuff injury is not only a common degenerative joint disease of shoulder, but also one of the common clinical diseases. Studies have reported that the rotator cuff injury in normal people is up to 41% [5], with an extremely high disability rate. The rotator cuff plays an important role in supporting, stabilizing and maintaining the normal fulcrum of the caput humeri and the cavitasglenoidalis. The main manifestations of patients with rotator cuff injuries were pain and limited activities of shoulder joint. At present, the arthroscopic suture, the most widely used repair of rotator cuff injuries, is adopted by many scholars and has achieved satisfactory outcomes. However, if patients pay no attention to regular rehabilitation exercises, they will probably suffer from shoulder joint stiffness or even reoperation, no matter which operation they have underwent. Therefore, a number of literatures have empha-

sized the important role of proper rehabilitation training of scapula in shoulder joint function after the repair of rotator cuff injuries. Liu et al. performed functional exercise of shoulder joint on patients who had dysfunctional problems after receiving the arthroscopic repair of rotator cuff injuries, and the results showed that after the arthroscopic repair, the shoulder function will be recovered as soon as possible with effective rehabilitation therapies [6, 7]; Jeanie et al. performed muscle strength training 2 and 6 weeks after operation respectively on patients who had received the operation of shoulder injury, especially on those with rotator cuff calcifying tendinitis, under the circumstances of not adding pain of shoulder owing to the muscle strength training [8]. The study of Escamilla et al. showed that providing standard and individual early rehabilitation training of shoulder joint for patients can promote effective recovery of shoulder function [9]. Tsuruie et al. suggested that the muscle training around the shoulder joint, especially around the rotator cuff muscles, can bring good treatment outcomes for improving the stability of glenohumeral joint, the shoulder joint ROM, as well as for the patients with glenoid labrum tears [10]. The study of Shen et al. has shown that the injured scapular joint, which was immobilized, must be treated with rehabilitation training for repairing the muscles around the scapula [11]. Kim et al. suggested that the control training of scapula had therapeutic significance on improving the function of upper extremities of hemiplegic patients and alleviating the pain in their shoulders [12, 13]. Our study revealed that, after adding the control training of scapula to the routine rehabilitation training in the observation group, the patients in this group were significantly better improved in the pain of shoulder joint, daily life, and the shoulder joint ROM assessment 4 and 8 weeks after the treatment than that in control group of the same period.

Some studies have shown that, compared to the control group, there was no significant difference in adduction scores of shoulder activities after rehabilitation for 6 weeks [12], but in this study, the adduction scores after rehabilitation for 4 weeks markedly improved, which may be due to the different evaluation criteria or be possible that most of the patients with rotator cuff injuries present something wrong with the supraspinatus, therefore, conservative

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therapeutic regimen and limited adduction exercises of shoulder joint were required; however, in this study, the control training of scapula was required as much as possible under the circumstance of not causing an increase in the degree of scapula pain, to result in earlier recovered activity functions and it may be also one of the advantages of this method.

It was found that, compared with prior treatment, there was no improvement of VAS pain score in control group and observation group two weeks after the treatment, and even greater pain score in observation group, which means that the early rehabilitation training will add the pain sensation to patients who had received the rotator cuff operation, and this may also indicate that the control training of scapula shouldn't be performed on patients when they had the early rehabilitation training after the arthroscopic repair, in this way they can avoid increasing their pain. Keener et al. also proposed that the passive motion of early rehabilitation after the rotator cuff repair unable to promise to get the ROM earlier or alleviate the pain, but it had no negative influence on the healing of rotator cuff [14-17]. Lee et al. believed that dividing the rehabilitation into different stages was better in promoting the recovery of shoulder joint function and relieving the physical pain of patients who had received the operation of traumatic rotator cuff injuries [18-20].

In conclusion, the location of scapula and the shoulder joint movements play a critical role in the shoulder joint function. In the early rehabilitation of patients with rotator cuff injury syndrome, especially for patients with shoulder joint movement disorders, they should start with the movements of the scapula [21]. The result of this study suggests that the post-operative early control training of scapula is needed to maintain the shoulder joint ROM and further extend, so as to promote the recovery of rotator cuff injuries, which is of great significance to the early rehabilitation of patients with rotator cuff injury syndrome. It is because that there are various forms of rehabilitation training after the arthroscopic repair of rotator cuff, and no obvious improvement of scapula control training in the early post-operative pain, besides, the early exercises after the arthroscopic repair of rotator cuff is not mandatory, so, during the

post-operative rehabilitation process, therapist should firstly classify the etiology of rotator cuff injuries and analyze the main cause of dysfunctional activities of shoulder joint, then make targeted comprehensive rehabilitation plan based on the etiology and adjust the plan timely to ensure patients' compliance.

### Disclosure of conflict of interest

None.

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