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## Results of treatment of patients with persistent contracture of the shoulder joint after rotator cuff repair

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*Contracture of the shoulder joint is one of the complications that occurs after rotator cuff repair. The aim of the work is to investigate and compare the results of conservative and surgical treatment of patients with persistent contracture of the shoulder joint 6 months after shoulder rotator cuff repair. Methods. We included 51 patients who had resistant contracture of the shoulder joint of varying grade within 6 months after the operation. Conservative treatment was performed in 27 patients, surgical treatment under arthroscopic control was performed in 24 patients. In our study, we assessed the function of the shoulder using the Constant Shoulder Score and VAS scales before the start of treatment (i.e., 6 months after first surgery) 3 and 6 months after the start of treatment (i. e., 9 and 12 months after first surgery). Results. 3 months after the start of treatment, in the group where surgery was performed, the average functional result according to the Constant Shoulder Score scale was better than in the group where patients were treated conservatively and ranged within  $(16.4 \pm 5.9)$  points, while in the group with conservative treatment the average functional result was  $(28.1 \pm 6.7)$  points ( $p = 0.048$ ). 6 months after rotator cuff repair in the group with conservative treatment the average functional result according to the Constant Shoulder Score scale was  $(23.1 \pm 7.1)$  points, while in the group where surgery was performed it was  $(12.1 \pm 6.3)$  points ( $p = 0.03$ ). Conclusions. Performing arthroscopy with removal of scars from the shoulder joint and subacromial space, selective capsulotomy, subacromial decompression and excision of the coracoid-brachial ligament in patients with resistant contracture of the shoulder joint, which persists 6 months after the rotator cuff repair, provides better average functional results according to the Constant Shoulder Score scale and a lower level of pain syndrome according to the VAS scale in 3 and 6 months after first surgery compared to patients who continued conservative treatment.*

*Одним з ускладнень, яке виникає після шва сухожильків ротаторної манжети плеча, є контрактура плечового суглоба (ПС). Мета. Дослідити та порівняти результати консервативного й оперативного лікування хворих зі стійкою контрактурою плечового суглоба через 6 міс. після шва сухожильків ротаторної манжети плеча. Методи. Включили 51 хворого, які мали стійку контрактуру ПС різного ступеня в терміни 6 міс. після операції. Консервативне лікування проходили 27 осіб, хірургічне — під артроскопічним контролем проведено 24 хворим. У своєму дослідженні ми вивчали функції ПС за шкалами Constant Shoulder Score та ВАШ до початку лікування (тобто через 6 міс. після операції) та через 3 та 6 міс. від початку лікування (9 та 12 міс. після втручання). Результати. Через 3 міс. після початку лікування, у групі де було виконано оперативне втручання, середній функціональний результат за шкалою Constant Shoulder Score кращий і коливався в межах  $(16,4 \pm 5,9)$  бала. Тоді як у групі з консервативним лікуванням середній функціональний результат склав  $(28,1 \pm 6,7)$  бала ( $p = 0,048$ ). Через 6 міс. після операції в групі з консервативним методом середній функціональний результат за шкалою Constant Shoulder Score є  $(23,1 \pm 7,1)$  бала, тоді як в групі, де виконано операцію складав  $(12,1 \pm 6,3)$  бала ( $p = 0,03$ ). Висновки. Виконання артроскопії з видаленням рубців із плечового суглоба та субакроміального простору, селективною капсулотомією, субакроміальною декомпресією та висіченням дзьобо-плечової зв'язки у хворих зі стійкою контрактурою плечового суглоба, яка зберігається через 6 міс. після шва сухожильків ротаторної манжети плеча, має кращі середні функціональні результати за шкалою Constant Shoulder Score і менший рівень больового синдрому за шкалою ВАШ як через 3, так і через 6 міс. після операції порівняно з хворими, які продовжували консервативне лікування. Ключові слова. Плечовий суглоб, ротаторна манжета плеча, стійка контрактура, селективна капсулотомія.*

**Keywords.** Shoulder joint, rotator cuff of the shoulder, persistent contracture, selective capsulotomy

## Introduction

One of the frequent complications that occurs after the suture of the tendons of the rotator cuff of the shoulder (RCS) is contracture of the shoulder joint (SJ). According to the literature, the limitation of movements in the SJ after the suture of the RCS tendons occurs from 4.9 to 32.7 % [1–3].

In the pre-arthroscopic era, most shoulder surgeons considered early mobilization of the SJ as the main measure for the prevention of its contracture and therefore, despite the numerous recurrences of RCS tendon injuries, they promoted early and active rehabilitation [1]. With the beginning of the use of arthroscopy, the rehabilitation program became more passive, since the amount of scarring with such a suture of the RCS tendons became significantly smaller, and the long-term results of immobilization of the SJ for 6 or 8 weeks were almost the same. For the practicing surgeon, it is important that immobilization for 6–8 weeks leads to a significantly lower number of recurrences of RCS tendon injuries than immobilization for 3–4 weeks, so most orthopedists deliberately increase the duration of postoperative immobilization, regardless of the possible development of SJ contracture [4–6].

With increasing time after the suture of the RCS tendons, the volume of movements in the SJ is known to also grow, so 3 months after surgery, movement restrictions are detected in 19 % of patients, and 12 months after surgery only in 7 % [7]. Most patients show satisfactory results by undergoing a course of rehabilitation treatment (therapeutic physical education (PE), physiotherapy methods), however, 7 % of patients develop persistent SJ contracture, which requires surgical intervention [8, 9].

A significant number of domestic orthopedists prefer conservative treatment of this group of patients or performing corrections under anesthesia, despite the dubious results, which subsequently leads to overloading of certain areas of the articular cartilage during the development of movements, the development of omarthrosis and arthrosis of the clavicular-acromial joint with a deterioration in the quality of life. Besides, important and unresolved is the choice of the timing of the transition from conservative to surgical treatment of this group of patients.

*Purpose:* to investigate and compare the results of conservative and surgical treatment of patients with persistent contracture of the shoulder joint 6 months after suture of the tendons of the rotator cuff of the shoulder.

## Material and methods

From 2013 to 2023, at the Clinic of Reconstructive and Restorative Surgery of the Upper Limb of the State Establishment “National Institute of Traumatology and Orthopedics of the National Academy of Medical Sciences of Ukraine” (Kyiv) and Ivano-Frankivsk Regional Clinical Hospital, we treated 94 patients with SJ contracture after suture of the RCS tendons. We included 51 patients in the study who had persistent SJ contracture of varying degrees within 6 months after surgery (suture of the RCS tendons under arthroscopic control). Conservative treatment was performed in 27 patients, surgical treatment was carried out under arthroscopic control in 24 patients (Fig. 1).

The patients' age ranged from 35 to 65 years. Mean age —  $(47.9 \pm 19.1)$  years. In all patients, MRI was performed 6 months after surgery, no recurrence of RCS tendon rupture was detected.

The Bioethics Commission of the State Establishment “NITO of the NAMS of Ukraine” reviewed the materials of the study and considered it appropriate to recommend it for publication (Protocol No. 5 dated 11.09.2024). The clinical study was performed in compliance with the requirements and provisions of the Helsinki Declaration on Human Rights, the Constitution and the Fundamentals of Ukrainian Legislation on Health Care, all patients gave informed consent to participate.

The study group was divided into 2 subgroups depending on the treatment performed:

– 1 — conservative, which included exercise therapy, physiotherapy methods (phonophoresis with anti-inflammatory ointments and magnetotherapy for 20 sessions), two distension intra-articular injections with prolonged glucocorticoids with an interval of 2–3 weeks. All exercise therapy tasks were divided into independent and those performed with a rehabilitation specialist. In turn, independent exercises were divided into 3 levels: performed by the patient independently for 10 minutes every hour and ended 2 hours before night sleep; the patient performed independently in the exercise therapy room once a day during outpatient treatment and 2 times a day during inpatient treatment (the important point was the speed of changing the position of the limb, which should not exceed  $30^\circ$  per second); exercises aimed at restoring the synchronous interaction of muscles and neuromuscular balance of the muscles of synergists PNF Diagonals (a continuation of classes after performing exercises of the 1st and 2nd levels). Exercises with a rehabilitation specialist were performed by patients

after reaching 90° flexion in the SJ once a day after the last set of exercises in the gym, provided they were normally tolerated.

The level of pain during exercise therapy did not exceed 5 points on the VAS scale.

– 2 — arthroscopy of the shoulder joint with removal of scars from the shoulder joint and subacromial space, selective shoulder joint capsulotomy with dissection of the middle and lower acromioclavicular ligaments, subacromial decompression and excision of the scapulohumeral ligament (Fig. 1). Subsequently, from the third day after surgery, patients began exercise therapy similarly to group 1. A month after the intervention, treatment was supplemented with physiotherapeutic methods and distension intra-articular injections similarly to group 1.

General characteristics of the groups are given in Table 1.

In our study, we assessed shoulder joint functions using the Constant Shoulder Score and VAS scales before treatment (i.e. 6 months after surgery) and 3 and 6 months after the start (i.e. 9 and 12 months after surgery). According to the Constant Shoulder Score scale, the maximum number of points is 100, the minimum is 8. The diseased and healthy upper limbs were compared. A difference of more than 30 points was considered an unsatisfactory result, 21–30 points — satisfactory, 11–20 points — good and less than 11 points – excellent [1].

The inclusion criteria for the study were as follows:

1) persistent contracture of the shoulder joint 6 months after the suture of the RCS tendons;

2) age from 35 to 65 years;

3) the absence of other diseases of the shoulder joint, which we determined both clinically and using additional research methods (radiography, MRI);

4) implementation of the standard protocol of surgical intervention and rehabilitation program;

5) examination of the patient 3 and 6 months after the start of treatment (i. e. 9 and 12 months after surgery);

6) surgical intervention by one specialist.

All patients independently filled out the Constant Shoulder Score and VAS forms. The patient performed the dynamometer test until pain appeared. The control of the correctness of all Constant Shoulder Score tests was entrusted to one doctor who was an assistant during the operation.

Statistical data processing was carried out using the STATISTICA 12.0 software package. Descriptive statistics methods were used, the data were presented as the sample mean and its standard deviation ( $M \pm SD$ ) in the case of a normal distribution and as the median and quartiles (Me [25Q–75Q]) in the case of a distribution other than normal. To

Table 1  
Main characteristics of the study groups before surgery

Characteristics	group 1 (n=27)	group 2 (n=24)	p
Age	44.5 ± 18.1	40.1 ± 12.9	0.03*
Sex: m/f	12 (23.5 %) / 15 (29.4 %)	8 (15.7 %) / 16 (31.4 %)	0.04**
Shoulder abduction angle, (°)	83.6 ± 21.3	79.3 ± 21.1	0.07*
Shoulder flexion angle, (°)	107.8 ± 29.1	90.0 ± 20.6	0.05*
Shoulder external rotation angle, (°)	11.2 ± 9.5	12.8 ± 12.1	0.01*
Mean VAS score before treatment	4.7 ± 2.9	4.9 ± 2.2	0.01***
Mean Constant Shoulder Score before treatment	38.6 ± 15.9	40.7 ± 11.1	0.05***

Notes: \* — Student's t-test; \*\* —  $\chi^2$  test; \*\*\* — Mann-Whitney test.

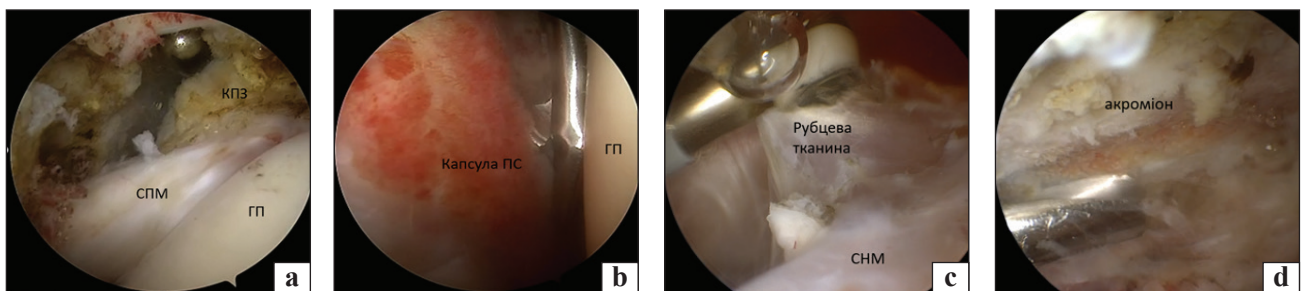


Figure. Stages of revision surgery: a) dissection of the coracobrachial ligament (CL); b) dissection of the shoulder joint capsule; c) removal of scars from the subacromial space; d) subacromial decompression. HH — humeral head, SST — supraspinatus tendon

compare the results, the Student’s test (for comparing two groups under the condition of a normal distribution of indicators) and the Mann–Whitney test (for comparing two or more groups during the analysis of values that demonstrated a distribution other than normal) were used. The differences in the distribution of the two samples were assessed using the  $\chi^2$  test. Quantitative data are presented as n (%). The calculation of  $M \pm SD$  under the condition of a non-parametric distribution of indicators was used to compare the results obtained by us. The differences between the indicators were considered significant in  $p < 0.05$ .

**Results**

Tables 2 and 3 show the average results before the start of treatment (i. e. 6 months after surgery) in patients of the 2 groups and 3 and 6 months after surgery. As can be seen from Table 2, before the start of treatment, the average indicators of SJ function according to the Constant Shoulder Score scale in the two groups differed slightly and fluctuated within 38–40 points (the difference in points between healthy and impaired SJ). 3 months after the start of treatment, in group 2 the average functional result according to the Constant Shoulder Score scale was slightly better than in group 1 and fluctuated within  $(16.4 \pm 5.9)$  points, while in group 1 the average functional result was  $(28.1 \pm 6.7)$  points ( $p = 0.048$ ). 6 months after surgery in group 1, the average functional result on the Constant Shoulder Score scale was  $(23.1 \pm 7.1)$  points, while in group 2 it was  $(12.1 \pm 6.3)$  points ( $p = 0.03$ ).

According to the VAS scale, we obtained the results shown in Table 3. Before the start of treatment, the average pain syndrome scores of patients in groups 1 and 2 on the VAS scale differed slightly and ranged from  $(4.1 \pm 1.9)$  to  $(4.9 \pm 2.2)$  points. 3 months after the start of treatment, in group 2 the average VAS score was better than in group 1 and ranged from  $(2.4 \pm 0.9)$  points. 6 months after surgery, the average VAS score in group 2 was also better than in group 1 and ranged from  $(1.5 \pm 1.3)$  points ( $p = 0.051$ ).

Thus, patients from group 2 had better average functional results according to the Constant Shoulder Score scale and lower level of pain syndrome according to the VAS scale both 3 and 6 months after surgery.

The average indicators of external rotation in patients of the 2 groups 3 and 6 months after the start of treatment are presented in Table 4.

As can be seen from Table 4, the surgical intervention that we performed in group 2 gives a significant average increase in external rotation of the SJ from  $12.8^\circ \pm 9.1^\circ$  before the operation to  $39.2^\circ \pm 12.8^\circ$  in 3 months and  $51.2^\circ \pm 11.2^\circ$  in 6 months. After statistical processing of the data and comparison of the two groups in 3 months —  $p = 0.01$  and in 6 months —  $p = 0.04$ . Thus, surgical intervention gives a statistically significant increase in external rotation of the SJ in patients.

**Discussion**

Any surgical intervention on the SJ with subsequent immobilization leads to the formation of SJ contracture [1, 9, 10]. Most of such SJ contractures in the process of patients performing the rehabilitation program significantly decrease or disappear within 2–4 months. However, in some patients, the limitation of passive and active movements remains such that it requires the continuation of the rehabilitation program or the use of other, more radical treatment options: redress under anesthesia, open or arthroscopic release of the SJ [4, 11].

Table 3

**Average visual analogue pain scale scores in patients in groups 1 and 2 at different observation periods**

Patient examination periods	Group 1 (points)	Group 2 (points)	p
Before treatment	$4.1 \pm 1.9$	$4.2 \pm 2.2$	0.014***
3 months after intervention	$3.5 \pm 1.5$	$2.4 \pm 0.9$	0.020***
6 months after intervention	$2.8 \pm 1.2$	$1.5 \pm 1.3$	0.051***

Note. \*\*\* — Mann–Whitney test.

Table 2

**Average Constant Shoulder Score scores in patients of groups 1 and 2 at different observation periods**

Patient examination periods	Group 1 (points)	Group 2 (points)	p
Before treatment	$38.6 \pm 15.9$	$40.7 \pm 11.1$	0.054***
3 months after intervention	$28.1 \pm 6.7$	$16.4 \pm 5.9$	0.048***
6 months after intervention	$23.1 \pm 7.1$	$12.1 \pm 6.3$	0.030***

Note. \*\*\* — Mann–Whitney test.

Table 4

**Average external rotation rates in patients of groups 1 and 2 at different observation periods**

Patient examination periods	Group 1 (°)	Group 2 (°)	p
Before treatment	$11.4 \pm 8.5$	$12.8 \pm 9.1$	0.03*
3 months after intervention	$29.5 \pm 20.5$	$39.2 \pm 12.8$	0.01*
6 months after intervention	$28.8 \pm 21.2$	$51.2 \pm 11.2$	0.04*

Note. \* — Student's test.

**Table 5**  
**Distribution of patients with postoperative persistent contractures of the SJ depending on the surgical intervention performed**

Intervention	Number of patients, (%)
МОС перелому ПЕМП	56 (29.60)
MOS of clavicle fracture	1 (0.53)
MOS of scapula fracture	12 (6.30)
Open reduction of anterior dislocation of the shoulder	1 (0.53)
Open reduction of posterior dislocation of the shoulder	9 (4.70)
Debridement of RCS tendon	9 (4.70)
Suture of RCS tendon	46 (24.30)
Suture of RCS tendon (2 or more)	48 (25.40)
Refixation of scapular labrum (SLAP)	0
Refixation of scapular labrum (SLAP) (Bankart without shoulder dislocation)	6 (3.17)
Tenodesis of the long head of the biceps tendon (in Pulley injury)	1 (0.53)
Total	189 (100)

Table 5 presents our data on the formation of persistent SJ contracture depending on the surgical intervention performed.

As can be seen from Table 5, the largest number of patients who had postoperative SJ contracture was after MOC ПЕМ of the humerus — 56 (29.6 %), which is probably associated with the severity of the injury (two or more fragments), the presence of a metal fixator (incorrect placement) and a large number of postoperative scars. In second place were patients with complete and massive ruptures of the RCS tendons — 46 (24.3 %) and 48 (25.4 %), respectively. Other soft tissue injuries of the SJ had very low rates of SJ contracture formation.

The main cause of postoperative contracture of the shoulder joint is the formation of intra-articular and extra-articular scars, thickening of the shoulder joint capsule [11, 12]. The degree of postoperative scarring depends on many factors, the main of which are the presence of shoulder joint contracture before surgery, the method of surgical intervention (open or arthroscopic), and the option of postoperative rehabilitation [8, 12].

It should be remembered that postoperative shoulder joint contracture is much worse treated conservatively than post-traumatic or movement restriction due to idiopathic adhesive capsulitis [13–15]. That is why surgical treatment of persistent postoperative

shoulder joint contracture using arthroscopic techniques should be used more often.

Studying the English-language literature, we came to the conclusion that most authors analyze the nature of SJ contracture in patients with various injuries of the RCS tendons [6, 7], conduct research on the impact of redress in patients with SJ contracture who underwent RCS tendon suture [11], study the risk factors for the development of SJ contracture [8, 9], however, there are not enough publications devoted to the tactics of treatment of persistent postoperative SJ contracture. Our work is a continuation of the research of Ch. A. Rockwood and is a combination of surgical treatment of RCS tendon injuries and idiopathic adhesive capsulitis.

We consider the development of an algorithm for the transition from conservative rehabilitation to surgical treatment of patients with persistent SJ contracture after various surgical interventions on the SJ to be a promising direction of our research.

## Conclusions

Performing arthroscopy with removal of scars from the shoulder joint and subacromial space, selective capsulotomy, subacromial decompression and excision of the scapulohumeral ligament in patients with persistent contracture of the shoulder joint, which persists 6 months after the suture of the tendons of the shoulder rotator cuff, has better average functional results according to the Constant Shoulder Score scale and a lower level of pain syndrome according to the VAS scale both 3 and 6 months after surgery compared to patients who continued conservative treatment.

**Conflict of interest.** The authors declare the absence of a conflict of interest.

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## RESULTS OF TREATMENT OF PATIENTS WITH PERSISTENT CONTRACTURE OF THE SHOULDER JOINT AFTER ROTATOR CUFF REPAIR

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