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აღმოჩენილ სტატიის გამოცდილი შეესაბამება სტატიის არ გამოცდილში.
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No 6 (339) 2023

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Abstract.

Aim: The aim of the study was to evaluate the treatment outcomes in patients who underwent arthroscopic repair of large and massive rotator cuff tears and underwent rehabilitation at different stages of the recovery process.

Materials and methods: The clinical study group consisted of 88 patients, with an age range of 47 to 68 years (mean age 52.7±9.5 years). All patients underwent a double-row repair of the rotator cuff tendons and tenodesis or tenotomy of the long head of the biceps tendon under arthroscopic guidance. The results were assessed using the Constant Shoulder Score and the Oxford Shoulder Score scales at 6 and 12 months after the surgery.

Study design: A total of 88 patients were selected, with 50 patients in the main group (MG) who had a 6-week immobilization period. The control group (CG) consisted of 38 patients who had a shortened immobilization period of 3-4 weeks due to patient preference or recommendations from other rehabilitation centers where patients underwent rehabilitation. Shoulder immobilization was performed using a standard sling with a triangular pillow and a 15° abduction angle in the shoulder joint. Following the surgeon's recommendation, all patients were offered a rehabilitation program consisting of three periods: immobilization (0-6 weeks), functional (6-12 weeks), and training (>12 weeks) periods.

Results: Comparative analysis of the treatment results using the Oxford Shoulder Score scale showed that significantly better results were obtained in the MG patients (41.5±2.1 points) compared to the CG patients (34.2±3.6 points) at 12,2±1.2 months (p<0.05). Comparative analysis of the treatment results using the Oxford Shoulder Score scale at 12,2±1.3 months showed that there were no statistically significant differences between the MG and CG results (MG – 44.5±2.2 and CG – 42.4±3, p>0.05). Similarly, according to the Constant Shoulder Score scale, better results were observed in the MG both at 6 months and 12 months after the surgery (excellent in 82% of MG vs 36.8% in CG, good in 18% of MG vs 57.9% in CG, respectively).

Conclusion: Thus, in the short term, early activation of the operated joint leads to delayed healing of the operated tissues and worsening of joint function, as confirmed by the comparative analysis of the examined groups. Significant advantages of prolonged immobilization (at least 6 weeks) were found in short-term observation (up to 6 months), and no differences in functional outcomes were observed in the long term during the follow-up at 12 months.

Key words. Rehabilitation, tears of the rotator cuff of the shoulder, surgical treatment.

Introduction.

Injuries to the rotator cuff of the shoulder are characterized by the development of a symptom complex involving a range of movements and positions that cause pain in the shoulder joint area. This pain is associated with the loss of the rotators' guiding function during abduction and rotation, as well as the fibrosis of the capsuloligamentous apparatus of the shoulder joint [1,2]. This not only impairs the function of the shoulder joint but also leads to persistent pain syndrome and can result in the development of degenerative shoulder arthritis [3,4].

Injuries to the rotator cuff of the shoulder are characterized by the loss of anatomical integrity of the skeletal muscles: supraspinatus, infraspinatus, teres minor, and subscapularis muscles [1,4-6]. The main clinical manifestations of rotator cuff injuries are the absence or impairment of active elevation of the upper limb accompanied by persistent pain syndrome in the shoulder joint region. The lack of movement leads to the development of contracture and limited range of motion in the shoulder joint. Insufficient function of the rotator cuff results in impingement of the greater tuberosity of the humerus against the acromion during elevation, which is associated with pain [4,6]. Another factor contributing to the pain syndrome is the retraction of the multi-innervated capsule of the shoulder joint and its impingement in the subacromial space during shoulder elevation [1,4,5].

The main functional problem of the shoulder joint in this pathology is the impairment of the shoulder-scapular rhythm. An anatomical defect of the rotator cuff has been shown to cause functional deficiency in the elevation of the upper limb [7]. Surgical treatment of the rotator cuff is aimed at overcoming this functional impairment of the shoulder joint, along with reducing persistent pain syndrome. The surgical management of patients with this pathology includes repairing the injured structures of the rotator cuff with transosseous fixation to the greater tuberosity of the humerus, myolysis, and tenolysis [4,5,8,9], suturing of the rotator tendons [3,6,9-11], shoulder joint arthrolysis, closure of defects in the rotator cuff through transposition of other shoulder and scapular muscles to the greater tuberosity [2,6,10], decompressive procedures of the subacromial space, including anterior acromioplasty [4,9,10], and others. Unsatisfactory results of conservative treatment [3,9,11,12] underscore the importance of analyzing the surgical treatment of the rotator cuff and determining indications and developing an algorithm for physiotherapeutic interventions for such patients in the postoperative stage.

Aim. The aim of the study is to evaluate the treatment outcomes of patients who underwent arthroscopic repair of large and massive tears of the rotator cuff of the shoulder and underwent rehabilitation at various stages of the recovery process.
Materials and methods.

The clinical study group consisted of 88 patients, ranging in age from 47 to 68 years (mean age 52.7±9.5 years). All patients underwent double-row repair of the rotator cuff tendons and tenodesis or tenotomy of the long head of the biceps tendon under arthroscopic control. The results were assessed using the Constant Shoulder Score and the Oxford Shoulder Score scales at 6 and 12 months after the rotator cuff repair. The evaluation according to the Oxford Shoulder Score scale was based on the following criteria: maximum score of 48, minimum score of 0. Scores ranging from 0 to 19 were considered unsatisfactory, 20-29 points were considered satisfactory, 30-39 points were considered good, and 40-48 points were considered excellent. The Constant Shoulder Score was used to assess both shoulder joints. The maximum score was 100, and the minimum score was 8. The scores of the affected and healthy upper limbs were compared. A difference of more than 30 points was considered unsatisfactory, 21-30 points were considered satisfactory, 11-20 points were considered good, and less than 11 points were considered excellent.

Statistical analysis of the research materials was performed using the MedStat software, employing descriptive statistical methods to calculate quantitative indicators in the study groups, such as mean values (M) and standard error of the mean (m). Qualitative indicators were presented as frequencies and their percentage ratios. The statistical significance of differences was determined using parametric and non-parametric methods. For independent groups of quantitative variables, the t-test was used. Differences were considered statistically significant at p<0.05 for all types of analysis.

Study design.

Shoulder immobilization was performed using a standard sling with a wedge-shaped pillow and a shoulder abduction angle of 15°. The clinical study group consisted of 88 patients, with 50 patients in the main group who underwent a 6-week immobilization period. The control group comprised 38 patients who underwent a 3-4-week immobilization period. The reduction in the immobilization period in the control group was due to the following factors:

- Patient's own desire to shorten the immobilization period.
- Recommendations from other rehabilitation centers where postoperative patients underwent rehabilitation.
- Since the physiotherapy program was individually prescribed to each patient, and some patients independently decided to start earlier than the recommended 6 weeks, reducing the duration of wearing the immobilization sling.

Results.

Based on the recommendation of the operating surgeon, patients were offered a rehabilitation program in the postoperative period, consisting of three stages: immobilization period (0-6 weeks), functional period (6-12 weeks), and training period (> 12 weeks).

The immobilization period (0-6 weeks). After the repair of the rotator cuff tendons under arthroscopic control, patients were placed in a standard soft immobilizing sling with an abduction angle of 15° or 45°, depending on the extent of tendon retraction observed during the surgery. Patients were allowed

finger movements and movements at the wrist joint. Passive elbow joint movements (flexion and extension) were performed once a day to prevent elbow joint contracture in patients after rotator cuff repair under arthroscopic control. All patients were prohibited from any movements in the shoulder joint and sudden movements in the operated limb. Anti-inflammatory therapy involved the administration of moderate therapeutic doses of non-steroidal anti-inflammatory drugs orally or intramuscularly. Analgesics were prescribed as needed.

Cold therapy included the use of gel cold packs or a local hypothermia device. Postoperative wound management followed standard procedures, and drains (if used) were removed 24-48 hours after the surgery. The goals during this period were to ensure that there were no painful sensations during or after the exercises. The recommended exercises included:

- Passive external rotation of the shoulder while lying on the back (Figure 1).
- Passive shoulder flexion while lying on the back (Figure 2).
- Shoulder shrugs.
- Elbow flexion/extension (Figure 3).

The functional period began 6 weeks after the surgery with the removal of the immobilization dressing and continued until full restoration of shoulder joint range of motion (typically up to 12 weeks after the surgery). Passive, active-assisted, and active range of motion exercises were performed for the shoulder joint.

Block trainers, rehabilitation equipment, and strength training devices were utilized.

For patients who underwent arthroscopic repair of the rotator cuff under arthroscopic control, during the first two weeks of the functional period, the dressing was removed only during exercises, and the patients remained in the dressing the rest of the time. Patients who underwent immobilization with the shoulder abducted at 45 degrees continued immobilization with the shoulder abducted at 15 degrees.

![Figure 1. Passive external rotation of the shoulder while lying on the back.](image1)

![Figure 2. Passive shoulder flexion while lying down.](image2)
The goals of this period were:
Protect the repaired tissues.
Improve range of motion in the shoulder joint.
Initiate muscle activation.

Certain restrictions were recommended, including: DO NOT:
☐ Lift heavy objects.
☐ Hold onto handrails with the operated arm.
☐ Perform abrupt movements.
☐ Abduct the shoulder more than allowed in the dressing.

The following exercises were prescribed:
- Pendulum exercise
- Passive external rotation of the shoulder while lying on the back
- Passive external rotation of the shoulder while standing
- Passive flexion of the shoulder while lying on the back
- Flexion of the shoulder while sitting or standing
- Passive internal rotation of the shoulder
- Wall stretches
- Strength exercises with an additional weight of 0.5-3 kg (to be performed once a day) (Figure 4).
- Pronation/supination of the forearm with resistance
- Flexion/extension of the wrist with resistance
- Isometric internal and external rotation in neutral position.

The training period (starting from the 12th week after surgery)
Goals:
1. Restore full range of motion.
2. Regain muscle strength.

Timelines required for return to professional sports: The main criterion is achieving full range of motion, strength, absence of pain, and swelling. Swimming, tennis - 6-8 months.

Exercises:
3. Stretching (perform 1 time per day, 3 times per week)
4. Exercises for passive internal rotation of the shoulder
5. Wall stretches
6. Strength exercises with additional weight of 0.5-3 kg (perform 1 time per day, 3 times per week)
7. Shoulder extension while lying down
8. Shoulder and scapular abduction while lying down (Y-type), (Figure 5)
9. External and internal rotation with the use of resistance bands
10. External rotation with a resistance band (W-type)
11. Diagonal resistance band pull from top to bottom.

Comparative analysis of treatment results using the Oxford Shoulder Score showed that at 6.2±1.2 months, significantly better results were obtained in the main group (41.5±2.1 points) compared to the control group (34.2±3.6 points) (p<0.05). Comparative analysis of treatment results using the Oxford Shoulder Score at 12.2±1.3 months showed no significant difference between the main group (44.5±2.2 points) and the control group (42.4±3.9 points) (p>0.05). Thus, in the short-term perspective, it was observed that early activation of the operated joint leads to delayed healing of the operated tissues and deterioration of joint functioning, which is confirmed by the comparative analysis of the examined groups. In the long-term analysis of treatment results, it was observed that at 12 months, the results of both groups did not show significant differences, indicating that the functional capabilities of the patients were at the same level (Figure 6).

The comparative analysis of treatment results using the Constant Shoulder Score scale at 6 and 12 months after the surgical intervention showed that patients in the main group, where immobilization lasted for 6 weeks, had slightly better outcomes compared to patients in the control group, where immobilization lasted for 4 weeks (p<0.05). After 6 months, an excellent result was achieved by 80% of patients in the main group and 57.9% in the control group, while only 26.4% of patients in the control group achieved the same. A good result was obtained by 18% in the main group and 57.9% in the control group, while the satisfactory result was observed in 2% of the main group and 15.7% in the control group. These differences may be attributed to the disruption of tendon-bone healing processes in elderly patients who initiated early activation of the operated limb (Figure 7 & Figure 8). A similar trend was maintained during the follow-up at 12 months, with 82% of patients in the main group achieving an excellent result compared to 36.8% in the control group. A good result was obtained by 18% in the main group and 57.9% in the control group, while the satisfactory result was absent in
the main group and present in 5.3% of patients in the control group.

Thus, based on our observations, prolonging the immobilization period of the shoulder joint contributes to better fusion between the tendon and bone, thereby improving treatment outcomes. Early loading on the shoulder joint after repair of large and massive rotator cuff tendon tears is not always appropriate and rational, especially in older patients.

Discussion.

In the study by Keener J.D., Galatz L.M. [13], which compared the clinical outcomes and healing rates of tendons after arthroscopic rotator cuff reconstruction using two different rehabilitation protocols (n=124, patients were randomized to either a traditional early motion rehabilitation program or an immobilization group with a delayed range of motion for six weeks), it was found that active elevation and external rotation were better in the traditional rehabilitation group at 3 months. There were no significant differences in functional measures, active motion, and shoulder strength between the rehabilitation groups at 12 and 24 months.

The study by Sheps D.M., Silveira A. (Level of Evidence 1) [14] compared the effects of early mobilization (EM) with...
standard rehabilitation (SR) during the first 24 months after arthroscopic rotator cuff repair (n=206). The early mobilization group (n=103) discontinued sling use and performed painless active motion activity for the first 6 weeks, while the standard rehabilitation group (n=103) wore a sling without active motion for 6 weeks.

At 6 weeks post-surgery, the EM participants had significantly better flexion and abduction (p < 0.03) compared to the SR participants; no other group differences were noted. No group differences in range of motion at 6 weeks and beyond (p > 0.08), pain (p > 0.06), strength (p = 0.35), or HRQOL (p > 0.20) were observed at 24 months. Among 52 patients (30% EM; 33% SR) who underwent ultrasound examination at 12 months postsurgery, full-thickness tears were found (p > 0.8).

Thus, our study results complement the findings of Keener JD, Galatz LM (2014) regarding faster restoration of functional capabilities of the operated limb with longer immobilization of the shoulder joint in short-term follow-up (3-6 months). However, in the long-term perspective, both our results and the results of Sheps DM, Silveira A. (2019) and Keener JD (2014) showed no differences in the restoration of active range of motion and quality of life in patients (p > 0.05).

Conclusion.

Arthroscopic full-thickness repair of small and medium-sized rotator cuff tears leads to a reliable improvement in clinical results and a high degree of tendon integrity using the double-row plastic technique in elderly patients. Significant advantages in long-term immobilization (at least 6 weeks) were found during short-term observation (up to 6 months), and later during re-examination after 12 months. no differences in functional results are observed.

Conflict of interest.

There is no conflict of interest.

REFERENCES

Anнотация. Анализ результатов оперативного лечения и ранней реабилитации пациентов с массивными разрывами сухожилий ротаторной манжеты плеча
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Цель исследования – оценить результаты лечения больных, которым выполнен артроскопический шов больших и массивных разрывов сухожилий ротаторной манжеты плеча и проведена реабилитация на разных этапах восстановительного лечения.
Материал и методы исследования. Клиническая группа обследования составляла 88 больных, возраст пациентов – от 47 до 68 лет (средний возраст 52,7±9,5 лет). Всем больным был выполнен двухрядный шов сухожилий ротаторной манжеты плеча и тенодез или тенотомия сухожилия длинной головки бицепса плеча под артроскопическим контролем. Результаты оценивались по шкале Constant Shoulder Score и по шкале Oxford Shoulder Score через 6 и 12 мес после операции.
Дизайн исследования. Было отобрано 88 больных, из них 50 больных составили основную группу (ОГ), у которых иммобилизационный период длился 6 недель. 38 больных составили контрольную группу (КГ), у которых иммобилизационный период был сокращен до 3-4 недель в результате желания пациента или рекомендаций других реабилитационных центров, где пациенты проходили реабилитационное восстановление. Иммобилизация плечевого сустава проводилась в стандартной повязке с клиновидной подушкой и уголом отведения в плечевом
суставе 15°. По рекомендации оперирующего хирурга в послеоперационном периоде всем пациентам была предложена программа реабилитационных вмешательств, состоящая из 3 периодов: иммобилизационного (0–6 недель), функционального (6–12 недель), тренировочного (>12 недель).

Результаты исследования. Сравнительный анализ результатов лечения по шкале Oxford Shoulder Score показал, что через 6,2±1,2 месяцев достоверно лучшие результаты были получены у пациентов ОГ (41,5±2,1 балла) в отличие от пациентов КГ (34,2±3,6 баллов), (при р<0,05). Сравнительный анализ результатов лечения по шкале Oxford Shoulder Score через 12,2±1,3 месяца показал, что результаты в ОГ и КГ уже не имели статистически значимых различий (ОГ - 44,5±2,2, и КГ 42,4±3 (р >0,05)). Аналогично, по шкале Constant Shoulder Score лучший результат отмечен в ОГ как через 6 мес, так и через 12 мес после операции (отличный у 82% ОГ против 36,8 % в КГ, хороший у 18% ОГ против 57,9% в КГ, соответственно).

Выводы. Таким образом, в краткосрочной перспективе отмечено, что ранняя активизация прооперированного сустава приводит к замедлению заживления прооперированных тканей и ухудшению функционирования сустава, что подтверждает сравнительный анализ обследованных групп. Достоверные преимущества в длительной иммобилизации (не менее 6 недель) выявлены при краткосрочном наблюдении (до 6 мес), в дальнейшем при повторном обследовании через 12 мес. отличий относительно функциональных результатов не наблюдается.

Ключевые слова: реабилитация, разрывы ротаторной манжеты плеча, оперативное лечение