ASSESSMENT OF THE EFFECTIVENESS OF SURGICAL TREATMENT OF PATIENTS WITH MASSIVE TEARS OF THE ROTATOR CUFF TENDONS USING ARTHROSCOPICALLY ASSISTED TRANSPOSITION OF THE LATISSIMUS DORSI TENDON

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ABSTRACT

Rotator cuff tears are one of the most common musculoskeletal injuries and account for about 20 %. Massive rotator cuff tears account for up to 40 % of all tears. There is no single approach in the treatment of patients with massive rotator cuff tears. We have developed a new method of surgical treatment of these patients – arthroscopically assisted transposition of the latissimus dorsi tendon using 1/2 of the tendon of the long peroneal muscle.

The aim of the study. *To assess the effectiveness of surgical treatment of patients with massive rotator cuff tears who had arthroscopically assisted transposition of the latissimus dorsi tendon using an autograft of a 1/2 of the tendon of the long peroneal muscle.*

Materials and methods. *The study included 15 patients with Patte stage III and Thomazeau grade 2–3 massive rotator cuff tears, who had arthroscopically assisted transposition of the latissimus dorsi tendon using 1/2 of the tendon of the long peroneal muscle.*

Results. *The article presents the long-term results of surgical treatment of patients using the developed method. The following criteria were evaluated: average age; time since injury; duration of surgery. Functional outcome was assessed using the ASES (American Shoulder and Elbow Surgeons) scale. Taking into account the indicators on the ASES functional scale 1 year after surgical treatment, the following results were obtained: excellent – in 14 (93.3 %) patients, satisfactory – in 1 (6.7 %) patient.*

Conclusion. *The developed method allows us to restore the function of the shoulder joint as early as it possible, to reduce the severity of the pain syndrome and to improve the quality of life of patients.*

Key words: *transposition of the latissimus dorsi tendon, massive ruptures of the rotator cuff, tendon of the long peroneal muscle*

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ОЦЕНКА ЭФФЕКТИВНОСТИ ХИРУРГИЧЕСКОГО ЛЕЧЕНИЯ ПАЦИЕНТОВ С МАССИВНЫМИ РАЗРЫВАМИ СУХОЖИЛИЙ ВРАЩАТЕЛЬНОЙ МАНЖЕТЫ ПЛЕЧА С ИСПОЛЬЗОВАНИЕМ АРТРОСКОПИЧЕСКИ-АССИСТИРОВАННОЙ ТРАНСПОЗИЦИИ СУХОЖИЛИЯ ШИРОЧАЙШЕЙ МЫШЦЫ СПИНЫ

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РЕЗЮМЕ

Разрывы вращательной манжеты плеча входят в число наиболее распространённых травм опорно-двигательного аппарата: их частота составляет около 20 %. Доля массивных разрывов вращательной манжеты среди всех разрывов достигает 40 %. Единого подхода в лечении пациентов с массивными разрывами вращательной манжеты плечевого сустава (МРВМПС) на сегодняшний день не существует. Нами разработан новый способ хирургического лечения такой категории пациентов: артроскопически-ассистированная транспозиция сухожилия широчайшей мышцы спины с использованием 1/2 сухожилия длинной малоберцовой мышцы.

Цель исследования. *Оценить эффективность хирургического лечения пациентов с массивными разрывами вращательной манжеты плечевого сустава, которым выполнена артроскопически-ассистированная транспозиция сухожилия широчайшей мышцы спины с использованием аутотрансплантата 1/2 сухожилия длинной малоберцовой мышцы.*

Материалы и методы. *В исследование включено 15 пациентов с МРВМПС III стадии по Patte и 2–3-й степени по Thomazeau, которым выполнена артроскопически-ассистированная транспозиция сухожилия широчайшей мышцы спины с использованием 1/2 сухожилия длинной малоберцовой мышцы.*

Результаты. *В статье представлены отдалённые результаты хирургического лечения пациентов по разработанному способу. Оценивались следующие критерии: средний возраст; давность с момента травмы; длительность операции. Функциональный результат оценивался по шкале ASES (American Shoulder and Elbow Surgeons). Учитывая показатели по функциональной шкале ASES через 1 год после оперативного лечения, получены следующие результаты: отличные – в 14 (93,3 %) случаях, удовлетворительные – в 1 (6,7 %).*

Заключение. *Разработанный способ позволяет в более ранние сроки восстановить функцию плечевого сустава, уменьшить выраженность болевого синдрома и улучшить качество жизни пациентов.*

Ключевые слова: *транспозиция сухожилия широчайшей мышцы спины, массивные разрывы вращательной манжеты плеча, сухожилие длинной малоберцовой мышцы*

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Rotator cuff ruptures are among the most common musculoskeletal injuries. Their incidence is 20 % [1]. Rotator cuff pathology is more commonly caused by degenerative processes in the tendons. According to the literature, up to 54 % of ruptures occur in individuals over 60 years of age [2]. The prevalence of rotator cuff massive ruptures (RCMR) comprises 40 % of all cuff ruptures [3]. No single classification of rotator cuff ruptures currently exists. Patients with massive ruptures have complaints of pain and limitation of movement, but they can also be asymptomatic [4]. In large and massive ruptures, there is a change in the biomechanics of the shoulder joint. An antero-superior dislocation of the head of the humerus is formed, and at later stages, progression of osteoarthritis and, as a consequence, atropathy of the shoulder joint. In 20 % of RCMR cases, pseudoparalysis of the upper extremity results [5]. No single approach in the treatment of this pathology currently exists. Nonsurgical therapy is aimed at pain control, but has a short-term effect. Surgical treatment options favoured include: subacromial balloon angioplasty, proximal rotator cuff plasty, musculotendinous transfers and reverse endoprosthesis. According to the literature, however, the complication rate after surgical repair of massive ruptures ranges from 20 to 94 % [6–8].

Considering the literature data, all advantages and disadvantages of the existing methods of treatment of patients with RCMR, a new method of surgical treatment was developed in our clinic: arthroscopic-assisted latissimus dorsi tendon transposition using autograft of the 1/2 of the peroneus longus tendon – and the long-term results of surgical treatment are being summarised.

THE AIM OF THE STUDY

To assess the efficacy of surgical treatment of patients with massive ruptures of the rotator cuff to which an arthroscopically-assisted latissimus dorsi tendon transposition using autograft of a 1/2 of the peroneus longus tendon was performed.

MATERIALS AND METHODS

The clinical study was approved by the local ethical committee of the Irkutsk Scientific Centre of Surgery and Traumatology (Minutes No. 2 dated February 25, 2023). In 2021, 15 patients (10 men and 5 women) who were admitted to the clinic with the diagnosis of chronic massive injury of the tendons of the rotator cuff have undergone surgery on the basis of the traumatology and orthopedics department No. 1 of the Irkutsk Scientific Centre of Surgery and Traumatology. According to magnetic resonance imaging (MRI), all patients had tendon retraction of the supraspinous muscle (stage III according to Patte with fatty atrophy of the supraspinous muscle of the grades 2 and 3 according to Thomazeau). All patients had undergone surgery according to the developed method: atroscopic-assisted latissimus dorsi tendon transposition using autograft by 1/2 of the peroneus longus tendon (patent for invention No. 2779219 C1) [9]. The patients were residents of the Irkutsk region; the mean age was 61.2 ± 6.7 years. In all patients, the cause of rupture was domestic trauma, more often a fall on the hand. The mean time from injury to admission was 3.5 ± 2.6 years.

Inclusion criteria:

- patients with massive ruptures of the rotator cuff (Patte stage III and Thomazeau grade 2–3);
- the age of the patients is 45–70 years;
- patients with recurrent rotator cuff tendon ruptures after surgical treatment – tendon reinsertion.

Exclusion criteria:

- patients with rotator cuff tendon ruptures (Patte stage I–II and Thomazeau grade 1);
- age of patients – over 70 years;
- patients with infectious lesions in the area of surgical intervention;
- upper extremity neurological disorders;
- patients' refusal to undergo surgical intervention.

Surgical treatment was performed as follows. Under anesthesia, the shoulder joint is accessed under aseptic conditions in the patient's side position through standard arthroscopic ports. The condition of the articular cartilage and the degree of retraction of damaged tendons are assessed. The insertion site area on the head of the humerus is refreshed to pinpoint bleeding.

The next step is a mini-access to latissimus dorsi tendon along the posterior axillary line (Fig. 1) and its excision, not reaching 4 cm to the fixation point (Fig. 2).

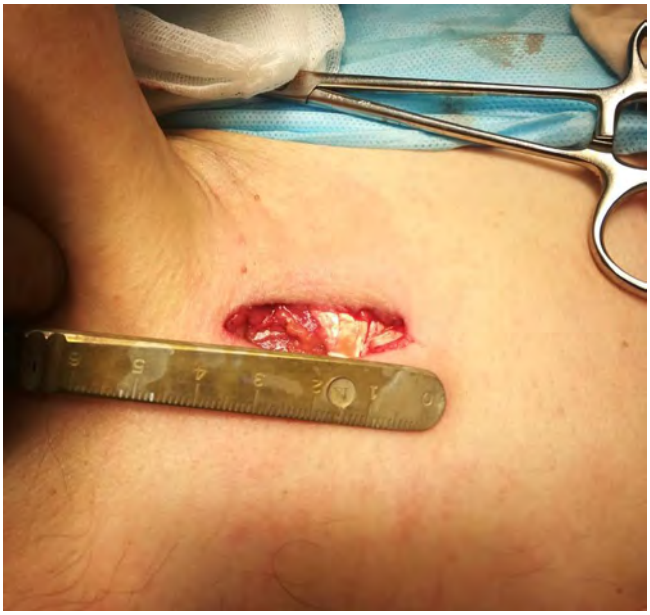

FIG. 1.
Limited incision to access latissimus dorsi tendon

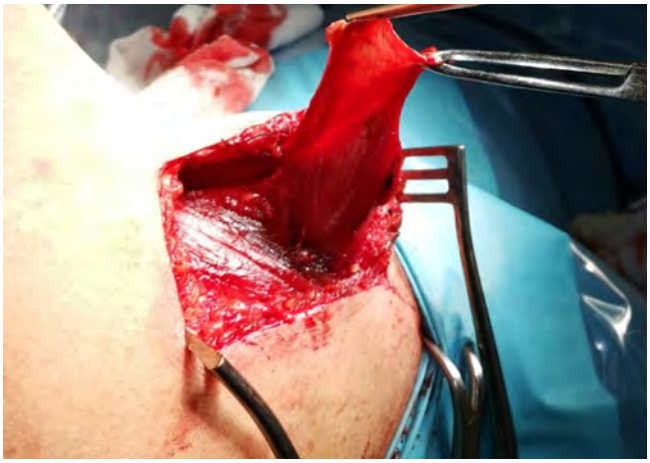

FIG. 2.
Isolation and dissection of the latissimus dorsi tendon from the fixation point

A separate access in the lower third of the tibia is used to take 1/2 of the peroneus longus tendon (Fig. 3).

The fourth stage – lengthening of the tendon of the latissimus longus dorsi by inserting 1/2 of the tendon of the peroneus longus tendon (Fig. 4) and suturing it with a spike suture – thus, a tendon autograft was formed (Fig. 5).

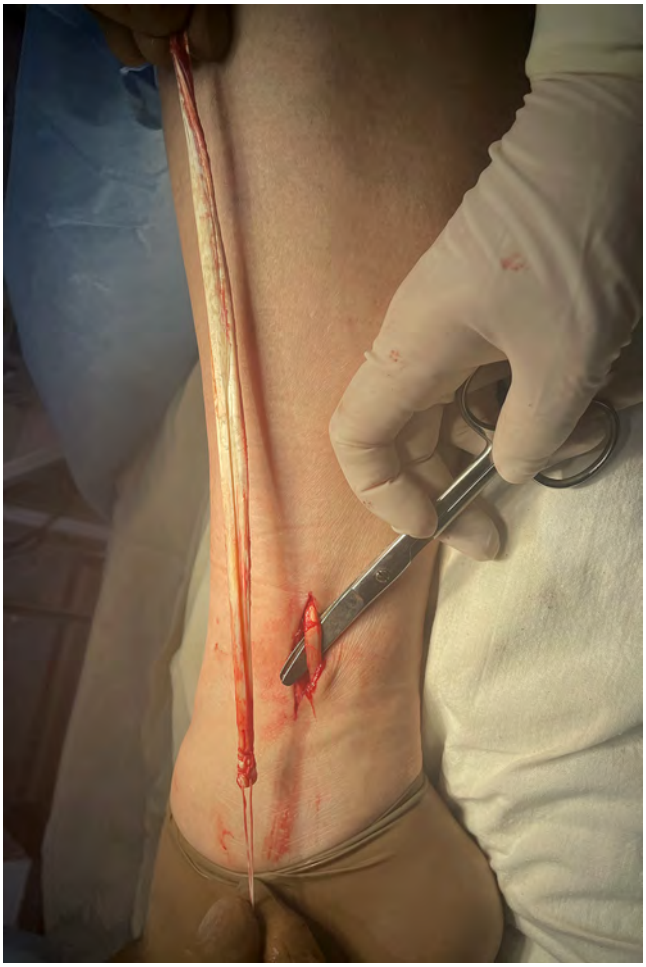

FIG. 3.
Retrieval of 1/2 of long peroneal muscle

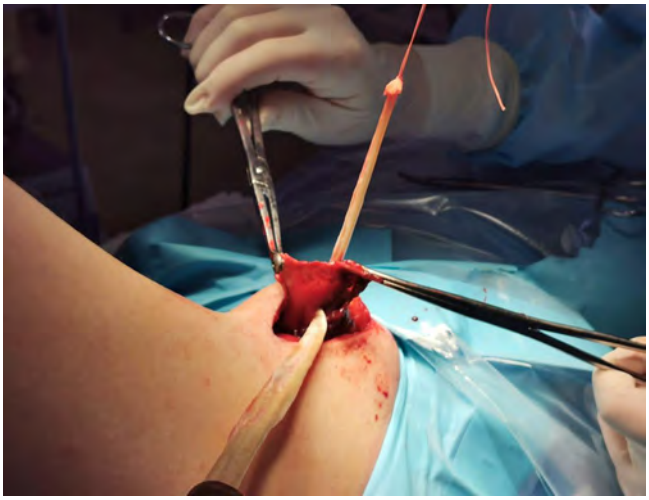

FIG. 4.
Integration of 1/2 of the long peroneal muscle tendon into the latissimus dorsi tendon

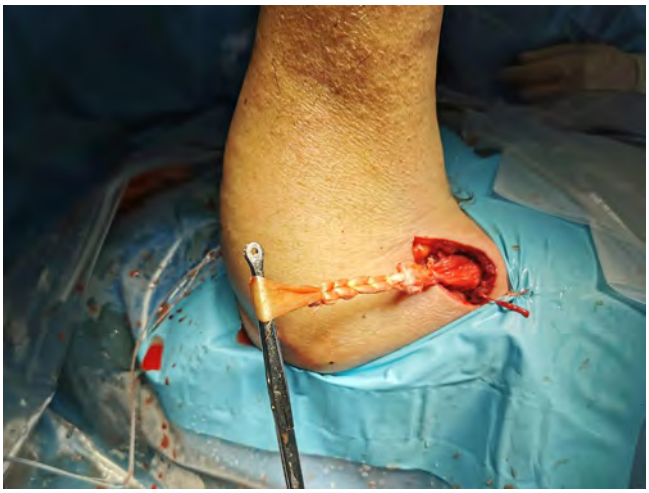

FIG. 5.
Suturing of the prepared autograft

A channel is formed through the posterior arthroscopic port under the posterior portion of the deltoid muscle, through which the free end of the tendon autograft is passed into the subacromial space and its fixation with anchor fixators on the insertion site of the humeral head is performed. The shoulder joint is washed with saline solution, haemostasis is performed, skin sutures and aseptic dressing are applied. The upper extremity is fixed with a 60° abduction splint for 6 weeks. From the day 2 patients start passive exercises of the shoulder joint on an abduction splint. After the cessation of immobilization, the active phase of physical therapy of the shoulder joint begins.

RESULTS

As a result of the analysis of surgical treatment efficiency, the following criteria were evaluated: duration

of surgical intervention; volume of intraoperative blood loss; and length of hospital stay. The level of pain syndrome in the area of surgical intervention was assessed according to the visual analogue scale (VAS). Functional outcomes were assessed using the American Shoulder and Elbow Surgeons' Shoulder Assessment Questionnaire (ASES).

The duration of surgery was 93.6 ± 16.5 min. Intraoperative blood loss was 34.6 ± 28.7 ml. The patients' length of hospital stay was 9.5 ± 3.3 days.

Pain intensity and functional outcome scores were assessed at 3, 6, and 12 months postoperatively. The preoperative pain level in patients was 7.6 ± 0.7 points. Three months after surgical treatment, patients complained of minor pain syndrome at rest, which increased after physical activity. The mean pain scores 3 months after surgery were 2.0 ± 0.9. At 6 months after surgery, the intensity of pain syndrome was 1.3 ± 1.0 points. After 12 months, patients reported a significant reduction or absence of pain syndrome. The mean pain intensity scores were 1.1 ± 1.0 points. Figure 6 summarizes the dynamics of pain syndrome intensity.

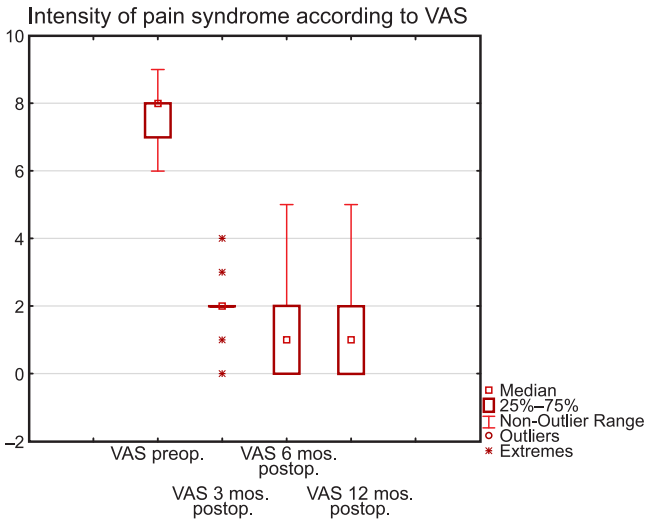

FIG. 6.
Dynamics of pain syndrome intensity

Functional outcomes were assessed using the ASES score. Figure 7 summarizes the results from the ASES evaluation questionnaire.

The mean preoperative functional scores according to the ASES score were 20.6 ± 5.3 points. Functional results 1 year after surgical treatment were 89.2 ± 10.4 points. There was a positive improvement in functional outcomes; Wilcoxon criterion for related groups $p < 0.0004$.

Considering the ASES functional scale scores 1 year after surgical treatment, the following results were obtained: excellent in 14 (93.3 %) cases. Patients had no complaints of pain and discomfort in the operated shoulder joint or minor pain syndrome after physical activity. The range

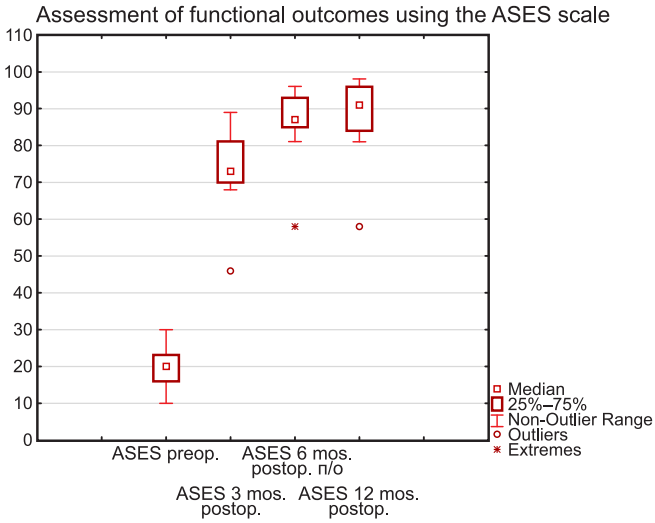

FIG. 7.
Assessment of the functional results according to ASES score

of motion in the shoulder joint: flexion and abduction – in the range of 160–180°. All patients in this group returned to their daily activities, and 3 patients continued to undertake physical activity at an amateur level. Satisfactory results were obtained in 1 (6.7 %) case. 1 patient had moderate pain and limitation of abduction and flexion in the range of 90–100°.

CLINICAL CASE STUDY

Patient M., 56 years old, addressed the diagnostic and counselling department of Irkutsk Scientific Centre of Surgery and Traumatology with complaints of pain and restriction of motion in the right shoulder joint. Past medical history: in 2013, the patient suffered a traumatic dislocation of the right shoulder joint. The dislocation was suppressed at the community clinic. The patient was re-injured in 2017; the injury was domestic – she slipped and fell on her right hand. The patient was admitted to the local clinic with dislocation of the acromial end of the clavicle, ligament grafting was performed. The postoperative period was uneventful. Subsequently, the patient continued to be bothered by pain syndrome with progressive limitation of movement in the right shoulder joint. Nonsurgical therapy: physiotherapy and non-steroidal anti-inflammatory drugs had no positive effect. Considering the clinical examination and MRI findings of the shoulder joint, the patient was diagnosed with a long-standing massive injury of the right rotator cuff tendon. A combined contracture of the right shoulder joint was detected. Surgical treatment has been recommended.

Local status: right upper extremity is involved in locomotor act of walking, not immobilised. The skin of the shoulder joint is of normal colour. There is a 10 cm postoperative scar without signs of inflammation in the projection of the clavicular-acromial articulation. Hypotrophy of the soft tissues of the right shoulder joint

is observed. Palpatory – pain in the area of the supraspinous fossa, pain and weakness when making abduction. Positive Leclerc's symptom, falling arm test, Jobe test. Active movements in the right shoulder joint: 70° abduction, 70° flexion. No neurovascular abnormalities of the right upper extremity were revealed. The preoperative ASES functional score was 20 points.

Preoperative radiographs revealed upper subluxation of the head of the right humerus, grade II osteoarthritis of the right shoulder joint, and grade II osteoarthritis of the clavicular-acromial joint (Fig. 8).

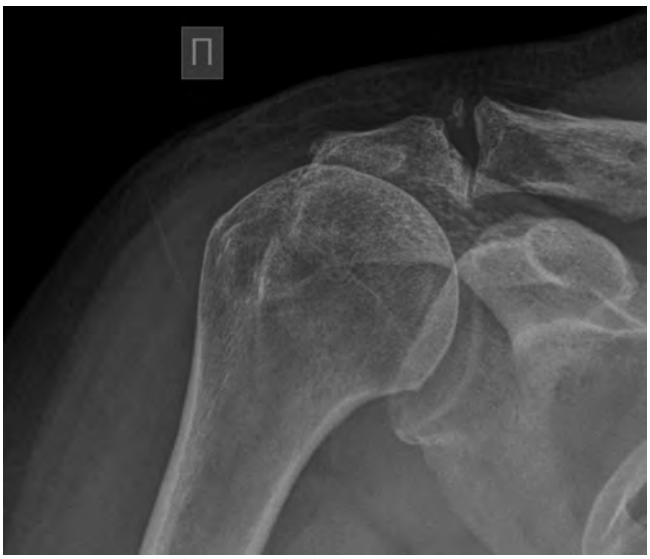

FIG. 8.
Patient M. X-ray of the right shoulder joint before the surgery

MRI of the right shoulder joint revealed subacromial narrowing up to 0.2 cm, rupture of the tendon of the supraspinous muscle with retracted tendon fibres at the glenoid level (Patte stage III). Muscular abdomen of the supraspinous muscle – with signs of atrophy (grade 3 according to Thomazeau) (Fig. 9).

Following the results of instrumental studies and clinical examination, the patient was considered to undergo arthroscopic-assisted latissimus dorsi tendon transposition using autograft of 1/2 tendon of the peroneus longus tendon. The postoperative period was uneventful. The patient was discharged from the hospital on the day 7 to the outpatient stage with recommendations. The right upper extremity was immobilized with an abduction splint for 6 weeks. During the period from 2 days to 6 weeks, the patient performed a set of passive shoulder exercises. From week 7 postoperatively, the patient started active right shoulder physical therapy and was provided with a course of physiotherapy.

At 3 months after surgery, the patient has a minor pain syndrome – 2 points according to VAS. Right shoulder joint full range of motion: 180° of abduction, 180° of flexion. Functionality was rated at 89 according to the ASES scale (Fig. 11).

Six months after surgery, the patient noted insignificant pain syndrome after physical activity – 1 point according to VAS, full recovery of working efficiency. Functionality was rated at 91 according to the ASES scale (Fig. 12).

After 12 months, the patient has no complaints. Pain syndrome is insignificant after heavy physical activity – 1 point according to VAS. Complete restoration of working efficiency. Functionality is rated at 93 according to the ASES scale. The patient is satisfied with the results of surgical treatment (Fig. 13).

One year after surgery, MRI of the right shoulder joint revealed that the tendon of the supraspinous muscle was not visualized, and a graft of 1/2 of the peroneus longus tendon, fixed with anchors in the head of the humerus, was detected in its projection (Fig. 14).

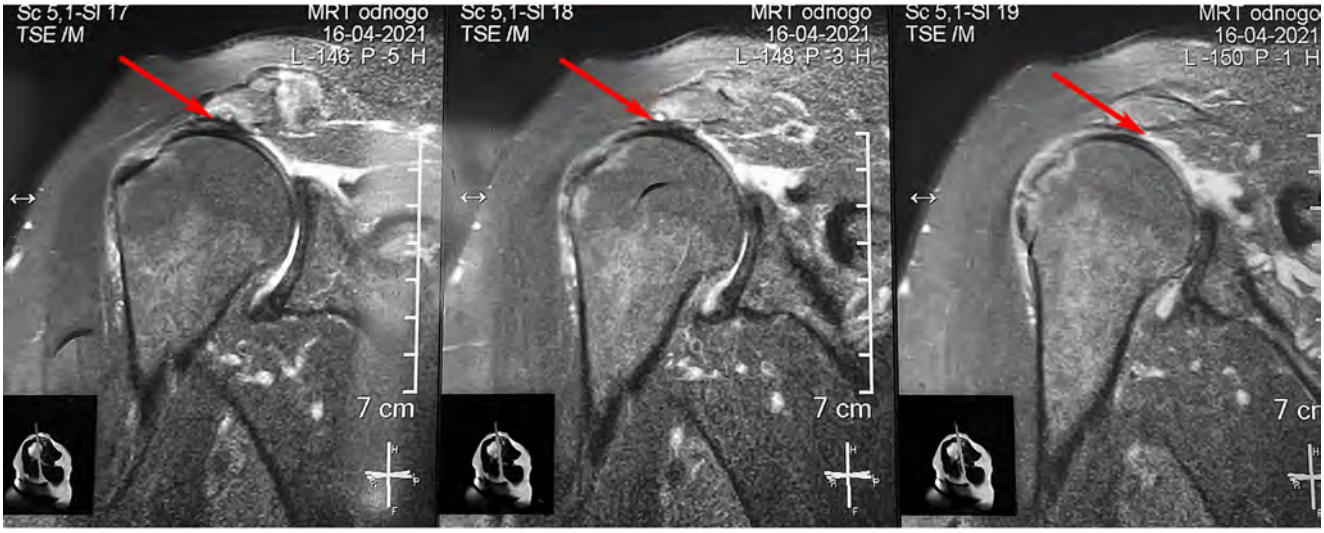

FIG. 9.
Patient M. MRI of the right shoulder joint before the surgery

FIG. 10.
Patient M. Functional result before the surgery

FIG. 11.
Patient M. Functional result in 3 months after the surgery

FIG. 12.
Patient M. Functional result 6 months after the surgery

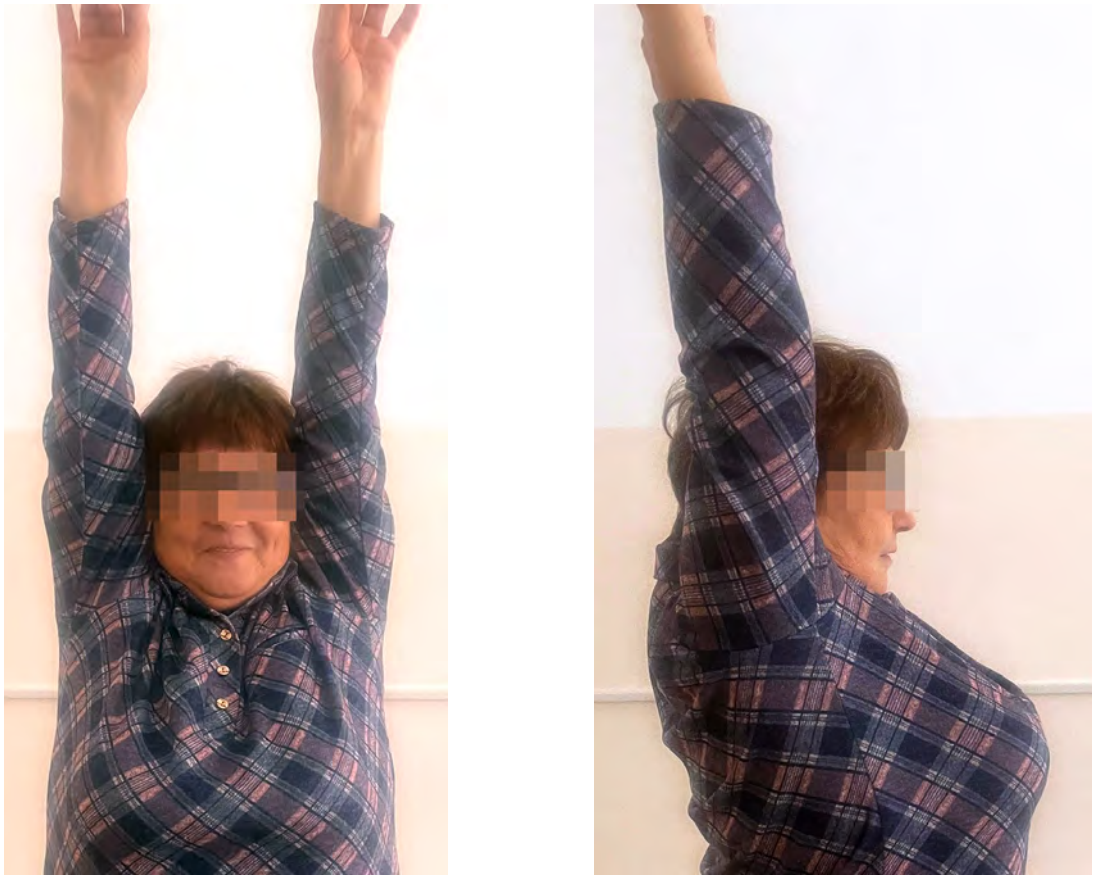

FIG. 13.
Patient M. Functional result 12 months after the surgery

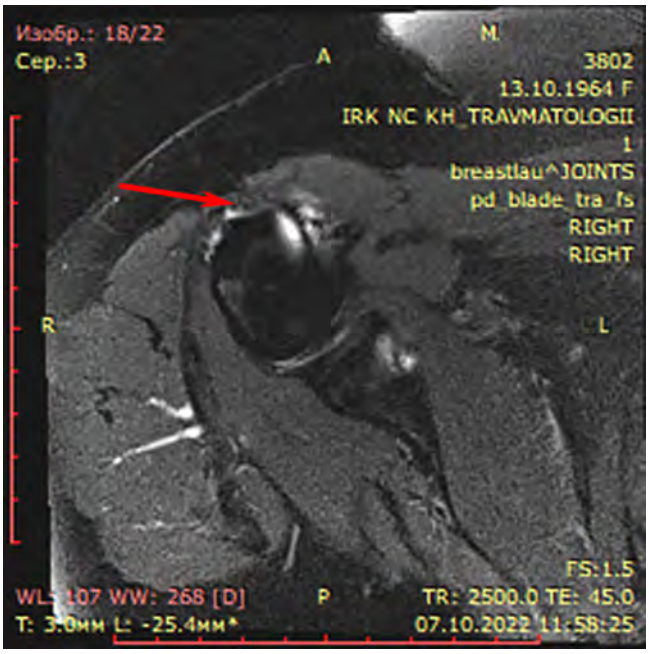

FIG. 14.
Patient M. MRI of the right shoulder joint 12 months after the surgery

DISCUSSION

The most common surgical treatment options for RCMR, according to the literature, can be considered to be subacromial balloon angioplasty, proximal rotator cuff plasty, musculotendinous transfers, namely latissimus dorsi tendon transposition, and reverse endoprosthesis. The essence of subacromial balloon angioplasty is the introduction of a balloon spacer into the subacromial space, which is subsequently filled with physiological solution. This device is designed to increase the acromion-shoulder interval, lower the humeral head and thereby eliminate secondary subluxation. Studies prove that the subacromial spacer is destroyed within 12 months [10, 11]. Much attention is currently being paid to such a surgical treatment option as proximal rotator cuff plasty. Defects are substituted with both allografts and autografts. The fasciae latae muscle is more often used as autografts. R.W. Jordan et al. conducted a systematic review of the literature of reconstruction of the upper part of the rotator cuff with the fasciae latae muscle and cell-free dermal collagen matrix. 9 studies were included in the review. Five studies reported about transplantation of the fasciae latae muscle, and 4 studies focused on cell-free dermal collagen matrix. The average follow-up time ranged from 10.9 to 42.4 months. The results were assessed using X-ray techniques. Dermal matrix failure was observed from 5.5 to 55 % of cases, fasciae latae muscle failure was 4.2–36.1 % [8]. When the articular cartilage of the humeral head is preserved, muscle-tendon transfers are one of the surgical treatment options for RCMR. The most common is the transfer of latissimus dorsi tendon. In 1998, C. Gerber et al. were the first to propose and perform latissimus dorsi tendon transposition to the head of the humerus in cases of massive ruptures of the rotator cuff. The results of treatment of 16 patients with tendon defects of the supraspinous and infraspinatus muscles, secondary subluxation of the head of the humerus, and limitation of abduction and flexion were analyzed. Biomechanically, the essence of the surgery was to change the force vector to relegate the head of the humerus and restore the biomechanics of the joint. Positive treatment results were reported in 80 % of cases [12]. K.P. Shea et al. conducted a systematic literature review between 1992 and 2010 to determine the outcomes of latissimus dorsi tendon transposition. Ten studies were analysed; mean follow-up was 45.5 months. Functional scores improved from 45.9 to 73.2 points. There was an improvement in flexion from 101.9° to 130.7° postoperatively. The overall reported complication incidence was 9.5 %, including infectious complications, neuropathy, ruptures of transferred tendons, haematomas, and wound discrepancies [13]. Currently, latissimus dorsi tendon transposition using the arthroscopic technique has become more common in the literature. Its main advantage is the preservation of the acromiohumeral muscle. In the postoperative period, patients retain muscle strength, which contributes to faster rehabilitation. Patients also experience less pain syndrome in the postoperative period when using minimally invasive technique in comparison with open surgical intervention technique [14]. Muscle-tendon transfers can be considered the technique of choice for young and active patients. The risk of iatrogenic damage to the neurovascular bundle during tendon excision from the crest of the humerus remains high, however, as well as high risks of graft detachment both after primary transposition and after revision intervention. According to the literature, the clinical failure incidence after latissimus dorsi tendon transposition stands at 36 % [15]. Another treatment option for massive ruptures of the rotator cuff tendons is reverse shoulder arthroplasty. Common indications for endoprosthesis are pain and "pseudoparalysis" of the shoulder joint, which develops against the background of massive ruptures of the rotator cuff [16]. According to the authors, endoprosthesis is not suitable for the treatment of young and active patients because of functional limitations, as well as because of the rapid wear of the endoprosthesis and, consequently, the need for repeated revision surgery [17].

Modern scientific literature analysis reveals that there are no unified approach and algorithm for the treatment of patients with massive ruptures of the rotator cuff. Each treatment method has its own pros and cons. In severe cases of RCMR, when there is maximum diastasis between the end of the damaged tendon of the supraspinous muscle and its attachment area (Patte stage III), the muscle itself is in fatty involution (Thomazeau grade 2–3) and becomes unable to fulfil its function. The surgical treatment method suggested by this study makes it possible to replace the function of the supraspinous tendon with the function of the latissimus dorsi. Access to the tendon is minimal (5.0–7.0 cm), thus reducing the risk of one of the complications of this surgery – damage to the neurovascu-

lar bundle – by excising the tendon of the latissimus dorsi before reaching the neurovascular bundle. Half of the peroneus longus tendon is used as the graft, minimizing damage in the donor area and reducing the risk of graft lysis in the area where the graft is used. Lengthening the tendon of the latissimus dorsi with a graft allows to reduce the tension of the muscle and, consequently, to reduce the probability of failure of its new attachment on the head of the humerus. As a result of the latissimus dorsi transfer, the head of the humerus is lowered and the biomechanics of the shoulder joint is restored. The use of arthroscopic technique reduces the traumatic nature of surgical intervention. The autograft also provides an opportunity to cover the entire insertion area of the humeral head and thereby further eliminate subacromial impingement syndrome.

CONCLUSIONS

The developed method of arthroscopic-assisted latissimus dorsi tendon transposition using 1/2 of the peroneus longus tendon allows to restore the function of the shoulder joint earlier, reduce the severity of pain syndrome and improve the quality of life of patients.

Conflict of interest

The authors of this article declare no conflicts of interest.

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