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COMPLEX PHYSICAL THERAPY OF PATIENTS WITH ADHESIVE CAPSULITIS

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University of East Sarajevo³ (East Sarajevo, Bosnia and Herzegovina),Dnipro State University of Internal Affairs⁴ (Dnipro, Ukraine)**Summary.**

Adhesive capsulitis is predominantly an idiopathic condition and is more common in patients with metabolic disorders.

PS contracture can be of varying degrees of severity, depending on the pathology of the PS with which we are dealing. This condition greatly affects work capacity and quality of life due to the presence of pain, discomfort and limitation of daily life activities.

Prolonged pain syndrome can provoke sleep disorders and depression. Disruption of normal sleep, pain and depression form a pathological closed circle and contribute to the maintenance of the pathological process in the locus morbi.

The development of a comprehensive program of physical therapy for patients with adhesive capsulitis with the use of modern means of recovery, which will reduce the risk of the disease re-emerging, and will also contribute to the faster recovery of the functional capacity of the musculoskeletal system of the patients.

The objective of the study. *The develop and practically substantiate a comprehensive program of therapy for patients with adhesive capsulitis using physical therapy.*

Materials and Research Methods. *The study is based on a comprehensive therapeutic approach for 36 patients diagnosed with adhesive capsulitis in the acute phase of the condition. The assessed parameters included X-ray and computed tomography results, evaluation of range of motion in the shoulder joint, joint-muscle apparatus, and analysis of pain intensity indicators.*

Conclusions. *To improve the condition of patients and optimize the process of treatment and rehabilitation of patients with adhesive capsulitis of the shoulder joint in the acute period, it is advisable to use with the differentiation of means of therapeutic intervention according to the diagnosis of the international classification of functioning, optimization of physiotherapeutic means and special means of physical therapy allowed to shorten the terms of treatment and recovery of patients with adhesive capsulitis.*

It was determined that the best combination of means of therapeutic intervention for patients with adhesive capsulitis is the use of a complex of ideomotor exercises to create the patient's idea of correct movement; correct positioning of the limb during sleep, everyday and professional activity; passive exercises to increase the volume of painless movements (bending, external rotation); restoration of the pattern of typical motor actions and optimization of physiotherapeutic means due to the use of shock wave and TENS therapy significantly improved the effectiveness of their recovery in the short-term and long-term stages of the acute period of rehabilitation.

Keywords: *Adhesive Capsulitis; Range of Motion; Comprehensive Therapy; Joint-Muscle Apparatus; Physical Therapy.*

Introduction

Adhesive capsulitis, or «frozen shoulder,» M75.0 according to ICD-10, is a condition of the shoulder joint characterized by a painful syndrome and progressive contracture of the shoulder joint, leading to restricted passive and active movements, especially during external rotation [1, 2, 3]. Adhesive capsulitis is primarily an idiopathic condition and is more commonly observed in patients with metabolic disorders. The prevalence of adhesive capsulitis in the general population is approximately 2-3 %, predominantly affecting women aged 40-60 years [2, 4, 5]. According to the research of foreign authors, adhesive capsulitis quite often goes away after 1-3 years, but in almost half of the patients it persists [2, 5].

The disease is classified as primary and secondary. Primary adhesive capsulitis of the shoulder is often associated with other diseases and conditions, such as diabetes, and may be the first manifestation. Patients with systemic diseases such as thyroid disease and Parkinson's disease are at increased risk. Secondary may occur after shoulder injuries or immobilization (eg, rotator cuff tendon rupture, subacromial impingement, biceps tenosynovitis, and calcific tendinitis). These patients develop pain due to

shoulder pathology, which leads to reduced range of motion in that shoulder and thus the development of frozen shoulder.

Adhesive capsulitis of the shoulder joint develops in four stages. The first stage can last about three months, during which the patient may experience sharp pain in the end range of motion, as well as at rest. The second is manifested by signs of freezing of the shoulder joint and can last from three to nine months. The patient may feel pain mainly at night, when movements are limited in forward bending, abduction, internal and external rotation. The third is characterized by freezing, which can last from nine to fifteen months. The patient may still experience pain in the end ranges and may experience limited range of motion. The fourth stage of thawing, pain can be reduced with progressive improvement of movements [2, 3, 4, 6].

Almost all injuries and diseases of the shoulder joint (SJ) are accompanied by a restriction of both active and passive movements – SJ contracture [2, 3, 4, 6]. The severity of SJ contracture can vary depending on the pathology of the SJ involved. Often, after traumatic SJ contracture, changes in the SJ capsule accompany it. Therefore, in English literature, we encounter concepts such as secondary adhesive capsulitis and post-traumatic stress syndrome of the SJ [2, 3, 4, 6].

This condition significantly impacts workability and the quality of life due to pain, discomfort, and limitations in daily activities. It is also important to emphasize the existing complex connection between structural formations of the shoulder joint and other systems of the body, which lead to the development of a reflexogenic pain syndrome.

Persistent pain syndrome can trigger the onset of sleep disorders and depression. Disruptions in normal sleep, pain, and depression create a pathological cycle and maintain the pathological process in the locus morbi. Unfortunately, according to recent studies, priority in the treatment of adhesive capsulitis is given to traditional therapy. This includes nonsteroidal anti-inflammatory drugs, short-term oral corticosteroids, various therapeutic exercises and manual therapies, preformed physical agents (including heat, electrical current), intra-articular corticosteroid injections, physiotherapy, acupuncture, and hydrodilatation [7, 8].

The majority of conservative methods represent with the physical therapy (PT), which plays a significant role in improving the quality of life, functioning, and activity of patients with musculoskeletal disorders [1, 2, 3, 4, 5, 7, 8]. The issues of conservative treatment for idiopathic adhesive capsulitis are well-known and covered in numerous works by both Ukrainian and English-speaking authors [2, 3, 7, 8, 9].

Additionally, patients quite often encounter the problem of secondary adhesive capsulitis, associated with soft tissue pathology of the shoulder joint, consequences of prolonged immobilization, or surgical interventions [9, 10].

Histological studies of the shoulder joint capsule, which is the main cause of contracture and pain syndrome, indicate its hypertrophy due to increased collagen, starting from the 2nd stage. There is a significant increase in fibroblasts, which, due to cytokine regulation disturbances, have an activated phenotype and can differentiate in various directions.

In our opinion, it is appropriate to develop a comprehensive program of physical therapy for patients with adhesive capsulitis with the use of modern means of recovery.

The objective of the work is to develop and practically substantiate a comprehensive program of therapy for patients with adhesive capsulitis using physical therapy.

Materials and Methods of the study. We examined 36 female patients aged 38 to 46 years (mean age – 42.11 ± 3.89), diagnosed with primary unilateral adhesive capsulitis of the shoulder joint. Complete information about the study was provided to all patients, and their consent was obtained through written agreement.

The research was conducted between 2022 and 2023 at the Physical Therapy Center «Olympic» in Kyiv and at the Department of Physical Rehabilitation and Sports Medicine of Bogomolets National Medical University.

The following data were analysed: to confirm the diagnosis – MRI and X-rays; to determine the range of motion in the shoulder joint – goniometry in frontal, sagittal, and horizontal planes (flexion, extension, abduction, adduction, internal and external rotation); to assess the muscle-joint apparatus – provocative tests such as the Apley Scarf Test – scarf wearing test, Active Compression Test – O'Brien test, and Lift-off test. To determine the pain syndrome in patients, the Visual Analog Scale for Pain (VAS) was used.

All the data obtained in the study were processed using mathematical statistics with the STATISTICA 10.0 program. The data are expressed as the mean value \pm standard deviation (SD). Fisher's test was applied for the normal distribution of the study variables. In case of non-normal distribution, logarithmic transformation was performed. Two-sided repeated measurements in STATISTICA 10.0 were used to compare the obtained indicators between the beginning and the end of the study. The significance of the observed changes was determined by the Wilcoxon criterion for non-parametric data, and the reliability coefficient of the results was set at $p < 0.05$.

Results of the study

To confirm the diagnosis, X-ray and the computed tomography results of 36 patients (100 %) in an acute phase of unilateral adhesive capsulitis, were studied.

In patients with adhesive capsulitis of the shoulder joint, ICF disorders were detected: at the level of structures that were related to the structure of the body: s7201 joint of the shoulder girdle, s7203 ligaments and fascia of the shoulder girdle; functions that were caused by pain and lack of mobility – b28014 pain in the upper limb, b28016 pain in the joints, b7100 mobility of one joint; violation of the main type of activity – d4150 maintaining a lying position, d4452 stretching, d5400 dressing, d5401 removing clothes, secondary violations of activity – d2303 controlling the level of own activity, d4300 lifting, d5100 washing parts of the body, d5101 washing the whole body, d5202 wiping and drying, d6201 cleaning for daily needs, d6402 cleaning of living space, d6501 care of housing and household items.

The analysis of the range of motion in the shoulder joint revealed a significant decrease in the amplitude of movements in the frontal and sagittal planes (Table 1).

Table 1

Analysis of Range of Motion in the Shoulder Joint in Patients with Adhesive Capsulitis in the Acute Phase of the Disease

Parameter	Standard, degrees	M \pm m	% deviation from standard
Flexion	160-180°	86.88 \pm 8.09	45.71 %
Extension	50-60°	19.44 \pm 2.39	61.12 %
Abduction	180°	74.55 \pm 4.51	58.58 %
Adduction	30°	4.88 \pm 2.79	83.73 %
External rotation	50°	15 \pm 1.55	70.0 %
Internal rotation	80-95°	34.44 \pm 3.38	56.95 %
Forward Horizontal Bending	130°	69.11 \pm 4.34	46.83 %
Backward Horizontal Bending	45°	9.44 \pm 2.049	79.02 %

Note: % standard deviation was calculated regarding the lowest parameter

Thus, the analysis indicates a significant reduction in the amplitude of movements due to the inflammation in the shoulder joint. Specifically, the lowest indicators were determined for shoulder adduction (deviation from standard – 83.73 %) during horizontal flexion towards the back (deviation 79.02 %), and external rotation (deviation 70.0 %). There was observed a markedly reduced amplitude during extension (deviation 61.12 %), abduction (deviation –58.58 %), and internal rotation (deviation 56.95 %).

Less than 50 % of the patients experienced reduction in the amplitude of movements during flexion and forward horizontal bending (45.71 % and 46.83 %, respectively). The decreased range of motion hinders patients from performing typical movements in the sagittal, frontal, and horizontal planes, negatively affecting their professional activities and complicating basic self-care.

The results of the «Lift-off test» indicated weakness in the subscapularis muscle and an increase in pain on the VAS scale, reaching up to 9 points in 100 % of the patients. Additionally, only 1 patient (2.77 %) was able to partially perform the physical therapist's task and maintain the arm in an abducted position for up to 1 second.

Similar data were obtained during the «Apley Scarf Test,» which allows the identification of muscle weakness in 91.6 % of the patients (33 patients). All 36 patients reported an increase in the pain syndrome by 1-2 points on the VAS scale. The test result was evaluated as positive.

The results of the «O'Brien test» also turned out to be positive for 100 % of the patients. In addition to an increase in pain sensations by 1-2 points on the VAS scale in all patients, they all noted the shooting pain in the acromion area.

Upon analysing pain sensations using the VAS, it was determined that 72.22 % of the patients (26 patients) had a very intense pain syndrome (7-8 points on the VAS scale), while 27.78 % (10 patients) experienced severe pain (5-6 points). Unfortunately, none of the patients reported moderate or mild pain or, in general, reported absence of painful sensations.

Additionally, all patients subjectively indicated that the pain became intolerable during the «Lift-off test» and «Apley Scarf test», in the acromion area, and shooting pains in the shoulder joint area were experienced during the «O'Brien test».

After conducting this study to justify the feasibility of using the developed physical therapy program and improving the rehabilitation process, the patients were divided into two groups, with 18 patients in each (control and experimental).

The treatment and rehabilitation for patients in both groups lasted for 3 weeks.

The control group of patients was offered traditional therapy and a rehabilitation program according to the clinical protocol. Patients were prescribed non-steroid anti-inflammatory drugs and intra-articular injections using glucocorticoids. The rehabilitation program included physiotherapeutic procedures (ultrasound phonophoresis) and a set of special exercises to stretch the joint capsule.

Additionally, patients in the main group received shock wave therapy (ShockMaster 300 device) instead of ultrasound phonophoresis, with a total of 7 sessions every

other day. In the rehabilitation program for these patients, along with a set of special exercises (with a pendulum, passive forward limb elevation, passive external rotation, and active assisted range of motion in extension, horizontal adduction, and internal rotation) to stretch the joint capsule, the following were added: complex ideomotor exercises to create a mental image of correct movement; educating patients on proper limb positioning during sleep, daily, and professional activities; passive exercises to increase the pain-free range of motion (flexion, external rotation); restoration of the pattern of typical motor actions.

Great attention was paid to the education of patients with adhesive capsulitis of the shoulder joint regarding the explanation of the natural course of the disease, with the aim of further reducing their possible fears about the course of the disease, teaching self-limiting activity modification to stimulate a functional, painless range of motion, dosage of stretching intensity according to the current course of the disease (visual analog pain scale <6/10).

The patients started the classes in the acute period with short-term (1-5 seconds) motor exercises, which were supposed to be relatively painless. These were exercises for stretching the pectoral muscles and the back of the shoulder, pendulum type performed for flexion, abduction and circular motion. Stretching was performed smoothly until pain sensations of no more than 4-5 points on the VAS appeared, since aggressive stretching beyond the pain threshold can lead to worse results, especially in the early stage of the disease. A forward shoulder position has been recommended to be avoided as this may cause loss of glenohumeral flexion and abduction.

After three weeks of comprehensive therapy, a follow-up comparative analysis of both groups was conducted. We found a significant improvement in the range of motion parameters for the main group (Figure 1).

Patients in the main group showed significant improvements in all parameters. The most notable changes were observed in the following: flexion – 62.86 %; extension, abduction, and adduction, external rotation – over 100 %; internal rotation – 93.12 %; forward horizontal bending – 53.66 %, and backward horizontal bending – over 100 %.

Noteworthy, the difference in the range of motion indicators in the shoulder joint in the sagittal, frontal, and horizontal planes is significantly higher in patients in the main group compared to the control group ($p < 0.05$). Patients in the control group showed the best improvements in flexion (24.86 %), abduction (60.29 %), external rotation (43.3 %), and forward horizontal bending (20.38 %).

Upon re-administering provocative tests to assess the joint-muscle apparatus in 15 patients (88.8 %) in the main group, the results were negative. This means that patients reported a complete absence of increased pain and did not feel muscle weakness. Three patients (11.2 %) noted a slight increase in pain sensations but mentioned that it did not hinder them from performing the test. In the control group, only 15 patients (52.77 %) reported a reduction in pain sensations, while 13 patients (47.23 %) mentioned that the pain remained at the same level. Additionally, all patients in the control group complained of muscle weakness during the tests (Figure 2).

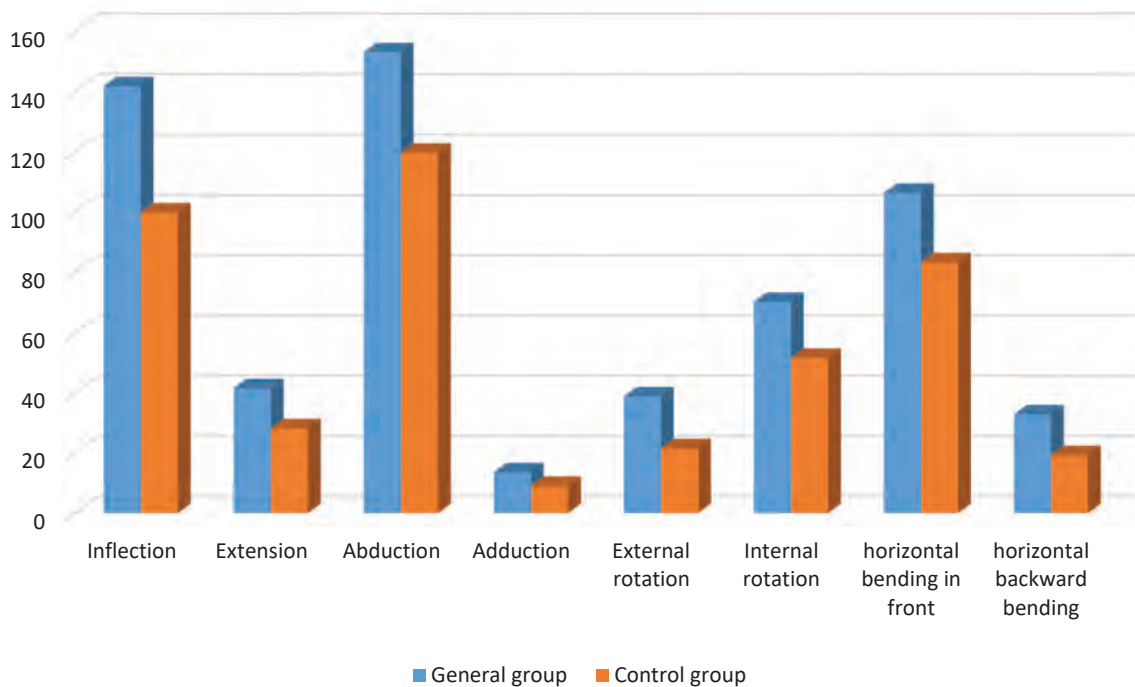


Fig. 1. Analysis of changes in the range of motion amplitudes in patients of the main and control groups at the end of the study.

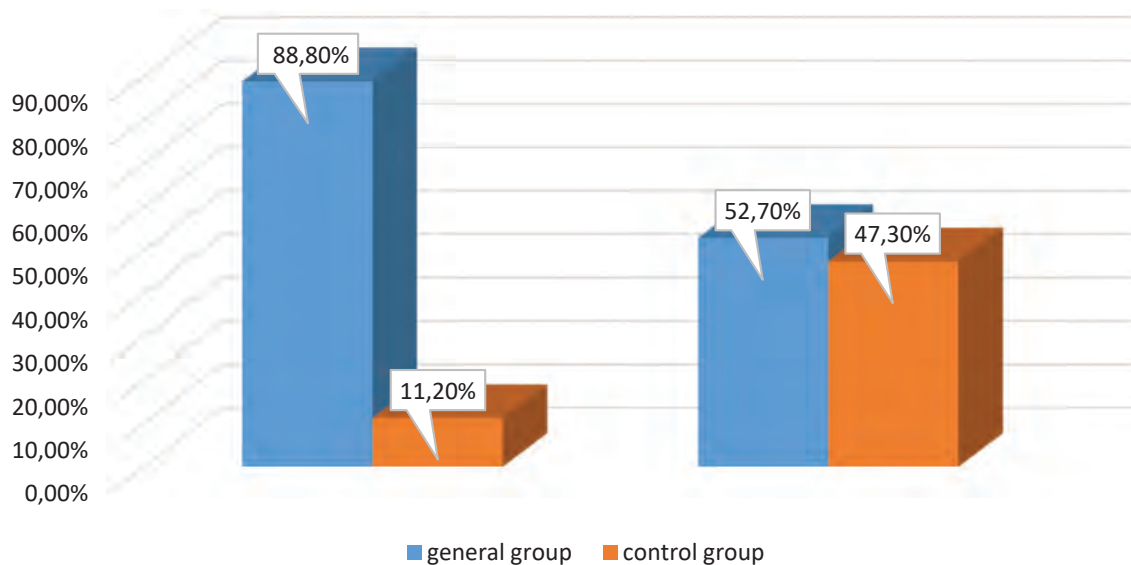


Fig. 2. Comparative analysis of the results of provocative tests in patients of the main and control groups at the end of the study.

The analysis of the control and main group dynamics of pain sensations in the everyday motor and professional activities showed significant positive changes in the main group. At the same time, patients in the control group also reported a reduction in the intensity of pain, which was not statistically significant (Figure 3).

In the main group, 11 patients (61.11 %) reported absence of pain; 4 patients (22.22 %) mentioned mild pain that they could ignore; 3 patients (16.67 %) noted moderate pain, but it did not hinder their activities. None experienced severe or intolerable pain that interfered with concentration and basic needs.

In the control group, none reported absence of pain or mild pain. On the contrary, 4 patients (22.22 %) complained

of moderate pain that hindered their concentration; 10 patients (55.55 %) experienced severe pain, interfering with the satisfaction of basic needs, and 3 patients (16.67 %) indicated that their condition remained unchanged, with a sensation of intolerable pain.

Thus, the proposed comprehensive therapy program with differentiation of means of therapeutic intervention according to the diagnosis of the international classification of functioning, optimization of physiotherapeutic means and special means of physical therapy made it possible to shorten the terms of treatment and recovery of patients with adhesive capsulitis.

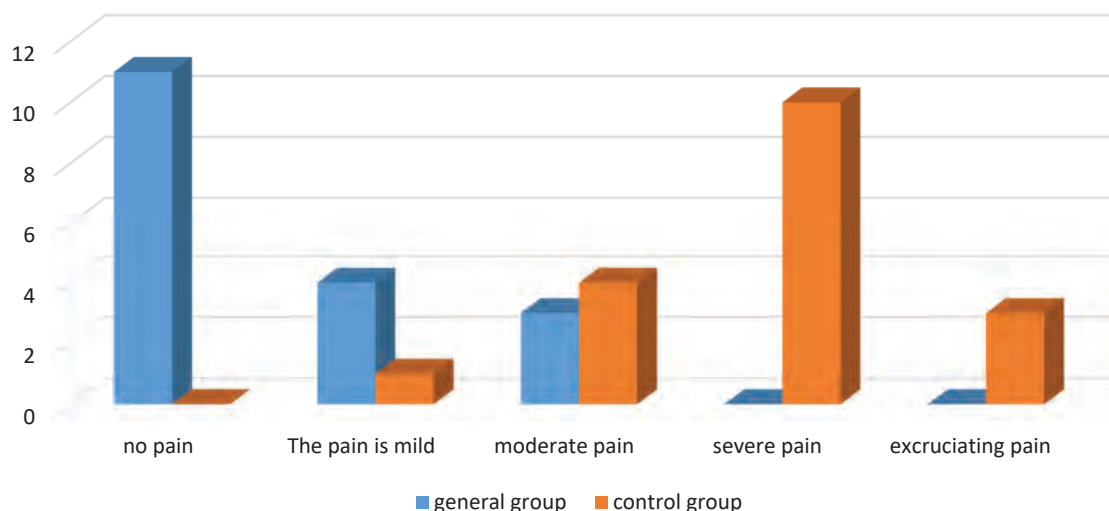


Fig. 3. Analysis of pain sensations in patients of the main and control groups after the study, using the VAS (Visual Analog Scale).

Discussion: A systematic analysis of scientific literary sources on the recovery of patients with AK showed a large number of works with an emphasis on physical therapy to reduce pain sensations: laser therapy, TENS therapy, cryotherapy, ultrasound therapy; therapeutic exercises to improve mobility in PS, immobilization techniques (Mulligan, Maitlanda), proprioceptive neurofacilitation and kinesiотaping [11-17].

A significant part of the authors in their works emphasize the effectiveness and importance of the use of hardware physiotherapy with the aim of reducing pain sensations, namely low-radiation laser therapy, which, thanks to the biostimulating effect, reduces the pain threshold [12, 14].

Ultrasound therapy, according to Page M. J., Green S., [11] helps to improve trophic processes in PS, reduces pain for a significant period of time. In many articles, the authors recommend using transcutaneous electrical nerve stimulation (TENS) in combination with other means of physical therapy to reduce the severity of pain, but there is no evidence of a positive effect of this procedure [11, 12, 14].

According to Alsubheen S. A., Nazari G., the Mulligan soft tissue immobilization technique is the most effective in the acute stage of AK, compared to the Maitland method and therapeutic exercises aimed at passive and active stretching. According to the results of the studies, the Mulligan technique allowed to quickly reduce the severity of pain sensations, its short-term effect and use in combination with corticosteroid injections were its disadvantages [13].

Most researchers in their works emphasize the importance of a multidisciplinary approach in the management of patients with AK and the involvement of a traumatologist and rehabilitation specialists in the selection of treatment and rehabilitation of patients with this pathology. An important component of the management of a patient with AK is his education, explanation of the etiology, pathogenesis of the disease, symptoms, this helps minimize the patient's fear of functional limitations and reduces fears. Common conservative treatments

for AK include nonsteroidal anti-inflammatory drugs, glucocorticoids, and physical therapy. However, many traumatologists are limited to prescribing drugs to relieve pain and inflammation [15].

Thus, according to Kostopoulos D., Rizopoulos K., soft tissue mobilization and deep tissue massage can benefit patients with AK. Cyriax massage can improve trophic processes and reduce muscle spasms, instrumental soft tissue mobilization (IASTM), namely the Graston Technique, which is used for this pathology, is becoming more and more popular in the practice of physical therapy. IASTM is reported to provide strong afferent stimulation and collagen reorganization, as well as increased microcirculation. Often in patients with AK, limitations of the inferior humeral capsule and pectoral fascia are present, IASTM may help improve fibroblast proliferation and promote normal collagen alignment, although no studies have evaluated the results of IASTM in patients with AK [17].

Although no studies have been published regarding the effectiveness of kinesiотaping for AK, Jain T. K., Sharma N. K. it may be useful in reducing pain and providing tactile cues through proprioceptive and afferent mechanisms. Patients with AK often exhibit poor scapular posture and biomechanics, kinesiо taping applications can provide postural cues and promote proper scapular motion [12].

Simons D. G. Travell J. in their work describe myofascial trigger points, foci of increased tension in the muscles around the shoulder joint in patients with AK. In particular, the subscapularis muscle is called the «frozen shoulder» muscle, because trigger points in it cause limitations in shoulder elevation and external rotation. The Spray and Stretch technique for the subscapularis and back muscles can be effective in reducing trigger point irritation, pain and gradually lengthening tight muscles.

The issue of the use of shock wave therapy in combination with therapeutic exercises of various intensities for patients with AK is not sufficiently discussed in the literature and requires analysis, detailing and clarification.

Therefore, a complex program of physical therapy for patients with AK has been developed using shock wave therapy, a complex of ideomotor exercises to create the patient's idea of correct movement; correct positioning of the limb during sleep, everyday and professional activity; passive exercises to increase the volume of painless movements (bending, external rotation); restoration of the pattern of typical motor actions significantly improved the efficiency of their restoration in both short-term and long-term stages.

Conclusions

To improve the condition of patients and optimize the process of treatment and rehabilitation of patients with adhesive capsulitis of the shoulder joint in the acute period, it is advisable to use with the differentiation of means of therapeutic intervention according to the diagnosis of the international classification of functioning, optimization of physiotherapeutic means and special means of physical therapy allowed to shorten the terms of treatment and recovery of patients.

It was determined that the best combination of means of therapeutic intervention for patients with adhesive capsulitis is the use of a complex of ideomotor exercises to create the

patient's idea of correct movement; correct positioning of the limb during sleep, everyday and professional activity; passive exercises to increase the volume of painless movements (bending, external rotation); restoration of the pattern of typical motor actions and optimization of physiotherapeutic means due to the use of shock wave and TENS therapy significantly improved the effectiveness of their recovery in the short-term and long-term stages of the acute period of rehabilitation.

Perspectives for Future Research: The development of an individual physical therapy program for patients in the long-term rehabilitation period based on the differentiation of physical therapy methods depending on the type of professional activity.

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Conflict of Interest: None.

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