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THE EFFECT OF PHYSICAL THERAPY PROGRAMS ON RANGE OF MOTION AND PAIN IN PATIENTS WITH ADHESIVE CAPSULITIS AND MYOFASCIAL PAIN SYNDROME

Actuality. Adhesive capsulitis of the shoulder joint and myofascial pain syndrome are common. Physical therapy plays a key role in their treatment. However, research has focused on one of these conditions, not the combination.

The aim – to investigate and compare the effects of and range mobilization, and mobilization and proprioceptive neuromuscular facilitation, and therapeutic exercises combined with ischemic compression on range of motion and pain among patients with adhesive capsulitis and myofascial pain syndrome in the thoracic region.

Material and methods. The study included 150 patients. Patients were divided into groups: the first outpatient group (OG1, n=50), the second outpatient group (OG2, n=50) and the home program group (HPG, n=50). OG1 participants received procedures of end-range shoulder joint mobilization (five times a week, 3 weeks, performed by a physical therapist) and ischemic compression of myofascial trigger points (daily, performed independently). OG2 participants additionally received proprioceptive neuromuscular facilitation. After the end of the main three-week intervention block, patients OG1 and OG2 were advised to use the affected limb as much as possible in household activities. HPG participants performed therapeutic exercises (twice a day) and ischemic compression of trigger points (daily, performed independently). In HPG, the duration of the physical therapy was 12 weeks. Shoulder joint goniometry and trigger point pain assessment were performed before the intervention, at the beginning of the second and third weeks, at the end of the third week of therapy (in particular, after the end of the main block physical therapy program for OG1 and OG2), and 9 weeks after the start of physical therapy.

Results. The results confirmed the positive dynamics in the groups for all investigated amplitude and trigger point pain indicators. The interventions OG1 and OG2 had advantages compared to the use of therapeutic exercises in combination with ischemic compression already a week after the start of physical therapy. According to the final results, the effectiveness of OG1 therapy did not differ from the effectiveness of OG2 therapy. The advantages of adding proprioceptive neuromuscular facilitation were noted only at the second and third assessments. The final assessment of trigger point pain also confirmed the advantages of the interventions performed in OG1 and OG2.

Conclusions. The comparison of the effectiveness of three treatment programs found that the least dynamic was when using therapeutic exercises with ischemic compression. The benefits of adding proprioceptive neuromuscular facilitation to end-range mobilization with ischemic compression were temporary and were not observed at the final assessment. The use of end-range mobilization with ischemic can be considered the optimal option. The dynamics of the indicators were significant in all groups.

Key words: rehabilitation, manual therapy, exercises, musculoskeletal system, shoulder joint, activity, ergotherapy.

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ВПЛИВ ПРОГРАМ ФІЗИЧНОЇ ТЕРАПІЇ НА ДІАПАЗОН РУХІВ ТА БІЛЬ У ПАЦІЄНТІВ З АДГЕЗИВНИМ КАПСУЛІТОМ ТА МІОФАСЦІАЛЬНИМ БОЛЬОВИМ СИНДРОМОМ

Актуальність. Адгезивний капсуліт плечового суглобу та міофасціальний больовий синдромом широко розповсюджені. Фізична терапія відіграє ключову роль у їх лікуванні. Проте дослідження фокусуються на одному із цих станів, а не на їх поєднанні.

Мета дослідження – дослідити та порівняти вплив кінцевоамплітудної мобілізації, кінцевоамплітудної мобілізації та пропріоцептивної нейром'язової фасилітації, терапевтичних вправ, комбінованих з ішемічною компресією на амплітуду руху та біль серед пацієнтів з адгезивним капсулітом плечового суглобу та міофасціальним больовим синдромом у грудному відділі.

Матеріал і методи. У дослідженні взяли участь 150 пацієнтів. Пацієнти були розділені на три групи: перша амбулаторна група (АГ1, n=50), друга амбулаторна група (АГ2, n=50) та група домашньої програми (ГДП, n=50). Учасники АГ1 отримували процедури кінцевоамплітудної мобілізації плечового суглобу (п'ять разів на тиждень, три тижні, виконувалася фізичним терапевтом) та ішемічну компресію міофасціальних тригерних точок (щодня, виконувалася самостійно). Учасники АГ2 додатково отримували пропріоцептивну нейром'язову фасилітацію. Після закінчення основного тритижневого блоку втручання пацієнтам радилося максимально використовувати уражену кінцівку в побутовій активності. Учасники ГДП виконували терапевтичні вправи (двічі на день) та ішемічну компресію тригерних точок (щодня, виконувалася самостійно). У ГДП тривалість програми фізичної терапії становила 12 тижнів. Гоніометрія плечового суглобу та оцінка болю у тригерних точках виконувалися до втручання, на початку другого та третього тижня, у кінці третього тижня терапії (зокрема, після закінчення програми фізичної терапії для АГ1 та АГ2), а також через дев'ять тижнів після початку фізичної терапії.

Результати дослідження. Результати підтвердили позитивну динаміку в групах за всіма дослідженими показниками амплітуди та болю у тригерних точок. Втручання АГ1 та АГ2 мало переваги порівняно з використанням терапевтичних вправ у комбінації з ішемічною компресією уже через тиждень після початку фізичної терапії. Відповідно до заключних результатів, ефективність терапії АГ1 не відрізнялася від ефективності терапії АГ2. Переваги додавання пропріоцептивної нейром'язової фасилітації відзначалися лише під час другого та третього оцінювання. Заключне оцінювання болю у тригерних точках також підтвердило переваги втручання, котрі виконувались у АГ1 та АГ2.

Висновок. Порівняння ефективності трьох програм лікування показало, що найменша динаміка була під час використання терапевтичних вправ з ішемічною компресією. Переваги додавання пропріоцептивної нейром'язової фасилітації до кінцевоамплітудної мобілізації з ішемічною компресією були тимчасовими і не спостерігалися під час заключного оцінювання. Використання кінцевоамплітудної мобілізації з ішемічною компресією можна вважати оптимальним варіантом. Динаміка показників була значимою у всіх групах.

Ключові слова: реабілітація, мануальна терапія, вправи, опорно-рухова система, плечовий суглоб, активність, ерготерапія.

Introduction. Idiopathic adhesive capsulitis (AC), also known as «frozen shoulder», is characterized by a gradual reduction in the range of active and passive movements in the glenohumeral joint (Rangan, et. all, 2020; Teytelbaum, et. all, 2024), accompanied by progressive pain (Fields, et. all, 2019). The prevalence of AC in the general population is 2–5% (Jump, et. all, 2021; Ramirez, 2019; Teytelbaum, et. all, 2024). It most commonly affects middle-aged women (Fields, et. all, 2019; Tedla & Sangadala, 2019). In most cases, AC is idiopathic (Ramirez, 2019), but its association with autoimmune, rheumatoid, and endocrine disorders has been described in the literature (Fields, et. all, 2019; Jump, et. all, 2021; Schiefer, et. all, 2017). AC was previously thought to have a relatively benign course with three phases (pain, stiffness, and recovery; total duration 1–2 years), culminating in full recovery of function without therapeutic intervention. However, recent evidence suggests that permanent functional limitations and disability may occur (Fields, et. all,

2019; Ramirez, 2019). There are also reports of longer phases (Tedla & Sangadala, 2019). Providing an effective and cost-effective treatment plan remains a challenge in the management of AC (Teytelbaum, et. all, 2024).

A critical review of clinical guidelines highlights the significant variability in recommendations and the need for standardization of criteria for the diagnosis and treatment of AC (Salamh, et. all, 2025). There is no single universally accepted standard for the treatment of AC. Therapeutic approaches are divided into conservative and surgical (Fields, et. all, 2019; Ramirez, 2019). Conservative treatments include physical therapy (PT), the use of nonsteroidal anti-inflammatory drugs and other medications, and intra-articular corticosteroid injections. Among conservative approaches, PT is the most common and recommended by specialists (Tedla & Sangadala, 2019). Recent randomized trials confirm the role of modern conservative strategies in the treatment of AC (Teytelbaum, et. all, 2024; Amjad & Asghar, 2025).

Myofascial pain syndrome (MPS) is a common pathological condition characterized by the formation of trigger points (TPs) in skeletal muscles and fascia (Wu, et. all, 2022; Steen, et. all, 2025). The pathogenesis, diagnostic criteria, and classification of MPS are still under investigation, making it difficult to develop standardized treatment protocols. Although diagnostic tools have improved, MPS often remains under-recognized due to the overlap of symptoms with other pain disorders, such as fibromyalgia, neuropathic pain, and joint disorders. Factors contributing to its onset and maintenance include muscle overload, postural imbalances, systemic conditions, and psychological and behavioral influences (Steen, et. all, 2025). MPS significantly impairs quality of life, emotional well-being, and social and physical functioning (Galasso, et. all, 2020; Roldan & Hu, 2015).

PT plays a key role in the treatment of patients with both AC (Challoumas, et. all, 2020; Rangan, et. all, 2016) and MPS (Barbero, et. all, 2019; Chen, et. all, 2025), similar to its use in other musculoskeletal disorders (Fedorenko, et. all, 2024, 2020) and and pathologies of other systems of the human body (Balazh, et. all, 2020; Vitomskyi, 2020; Vitomskyi, et. all, 2022). Physical therapy programs for AC include active and passive stretching exercises, pendulum exercises, proprioceptive neuromuscular facilitation (PNF) techniques, cold application, shockwave therapy, electrical nerve stimulation, end range mobilization (ERM) (Tedla & Sangadala, 2019; Challoumas, et. all, 2020; Anwar, et. all, 2022). MPS therapy typically involves the use of therapeutic exercises, heat therapy, ultrasound therapy, ischemic compression (IC), massage, and other manual techniques (Barbero, et. all, 2019; Lew, et. all, 2021).

Given the prevalence and significant impact of these pathologies on the functional state of patients, research into the effectiveness of PT in AC and MPS is extremely relevant.

Connection of the study with scientific programs, plans, topics. The work was carried out according to the plan of scientific research work of National University of Physical Education and Sports of Ukraine for 2021–2025 on the topic «Restoration of functional capabilities, activity and participation of people of different nosological, professional and age groups by means of physical therapy», state registration number 0121U107926.

The aim – to investigate and compare the effects of ERM, ERM with PNF, and therapeutic exercises combined with IC on range of motion and pain among patients with AC of the shoulder joint and MPS in the thoracic region.

Materials and methods.

Participants

The study involved 150 patients who were treated at the GI «Institute of Traumatology and Orthopedics of

the National Academy of Medical Sciences of Ukraine». Before PT, patients underwent diagnostic tests and received a consultation from an orthopedic traumatologist.

Ethical consent was provided by the ethics committee of the local institution (protocol No. 2, dated March 30, 2023), in accordance with the Helsinki Declaration. The patients willingly participated in the study, and their voluntary participation was confirmed by their personally signed informed consents.

Inclusion and exclusion criteria are presented in previous scientific works (Rusanov & Vitomskyi, 2023).

Intervention

Patients were divided into three groups: the first outpatient group (OG1, n=50), the second outpatient group (OG2, n=50) and the home program group (HPG, n=50). PT began after examination and consultation with an orthopedic traumatologist. All patients received consultation with a physical therapist.

Participants in OG1 and OG2 received information about the features of ERM and IR during a consultation with a physical therapist, in particular, about the level of pain, the importance of interaction with the physical therapist, and measures to reduce pain during the procedures. OG1 patients received ERM, which was performed by a physical therapist 5 times a week to improve shoulder joint mobility. Mobilization was used in the form of intensive ERM from Maitland grade I to V. The duration of the CAM procedure was 20–25 minutes. A detailed description of the ERM procedure is available in previous studies (Rusanov & Vitomskyi, 2023). The number of procedures could be changed by the physical therapist.

In addition, OG2 patients received PNF procedures. The first PNF technique used involved performing diagonal spiral movements against the resistance of the physical therapist several times through the full range of motion. The facilitation of flexion, abduction, and external rotation of the shoulder was performed by performing the PNF flexion pattern for the upper limb with the elbow straight D2F using the contract-relax technique. PNF for the internal rotators and for shoulder abduction, namely the hold-relax technique, was performed in the supine and sitting positions, respectively.

In OG1 and OG2, the planned duration of the physical therapy program was 3 weeks. After that, patients were advised to use the affected limb as much as possible in daily activities.

During the consultation, the participants of the HPG received information about the features of therapeutic exercises and IC. In addition, the physical therapist performed a demonstration and evaluated the patient's trial performance of the exercises. Patients received informa-

tion sheets with a description of the exercises and photographs. The patients performed the therapeutic exercises independently. The complex included pendulum exercises (7–10 minutes) and stretching exercises (15–20 minutes) for the shoulder joint. The exercises were performed twice a day. The planned consultation of HPG patients by a physical therapist took place at the beginning of the 2nd and 3rd weeks of PT, as well as at the end of the 3rd week. During the consultations, the physical therapist received information from the patients about their practice of performing exercises and IC, provided additional explanations, and assessed the dynamics. If necessary, the patients clarified the information about their physical therapy. A detailed description of the therapeutic exercises is available in previous studies (Rusanov, et. all, 2023). In the HPG, the duration of the PT program was 9 weeks.

Patients in all groups were advised to perform all activities, including household activities, with the maximum possible range of motion in the shoulder joint.

For TPs therapy, all patients performed IC independently. During the first consultation, the physical therapist determined the localization and compiled a map of active and latent TPs. This map was given to the patient. The patient was instructed on the techniques and methods of influencing TPs of different localization. A detailed description of IC is available in previous studies (Rusanov & Vitomskyi, 2023). It should be noted that IC of one point lasted 30 seconds. Several compressions could occur at one point. Pain should be of medium or above average level. IC was performed daily for 15–20 minutes.

Testing methods

Shoulder joint goniometry and assessment of pain in the TPs were performed before the intervention, at the beginning of the second and third weeks, at the end of the third week of therapy (after the completion of the main block of physical therapy programs of groups OG1 and OG2), and 9 weeks after the start of PT. Active amplitude was measured. The goniometer was positioned according to methodological recommendations (Clarkson, 2013). Initially, external and internal rotation in patients was measured in the supine position with the shoulder abducted at 15° and a small pillow or folded towel under the elbow. Later, the abduction angle was increased according to the patient's capabilities.

Pain in TPs was assessed on a numerical scale from 0 («no pain») to 10 («worst pain») (Markman, et. all, 2020) with a pressure of 2.5 kg×cm² using a digital VTSYIQI strain gauge. The highest pain score among TPs was recorded.

Statistical analysis

The results were processed using mathematical statistics. SPSS Statistics 21 was used. The median (Me) and

upper and lower quartiles (25%; 75%), mean value and standard deviation ($\bar{x}\pm SD$) were calculated. Compliance with the law of normal distribution was checked by the Shapiro-Wilk test. One-way analysis of variance (if the indicator conforms to the law of normal distribution) and the Kruskal-Wallis test (with Dunn's posterior test) were used to compare the results of groups. Friedman's two-way analysis of variance with post-hoc analysis to compare the results of several measurements in one group.

Research results and their discussion. Among OG1, the $\bar{x}\pm SD$ values for the age indicator were 55.12±7.88 years, and for OG2 and HPG groups, 56.94±7.75 years and 54.5±8.65 years, respectively. Levene's criterion confirmed the homogeneity of variance in the age results ($p=0.742$). The results of the one-way analysis of variance did not confirm the presence of a significant difference between the groups in terms of age ($F=1.225$; $p=0.297$). The Me (25%; 75%) values for this indicator were 54 (50; 59.5) years, 57 (50.75; 63.25) years and 53.5 (47; 59) years. The groups did not differ statistically in the duration of symptoms: OG1 – 6 (6; 7) months, OG2 – 7 (6; 8) months, HPG – 7 (6; 8) months ($\chi^2=3.339$; $p=0.188$). The values of $\bar{x}\pm SD$ for this indicator were 6.66±1.87 months, 7.12±1.65 months and 6.9±1.62 months, respectively. The proportion of women was higher in the groups: OG1 – 70%, OG2 – 76%, HPG – 72%.

According to the results of statistical analysis, the distribution of patients by gender was the same in the groups ($\chi^2=0.656$; $p=0.842$). Left-sided localization of the lesion was in 66% of OG1, 62% of OG2 and 70% of HPG. According to the results of statistical analysis, the distribution of patients by localization was the same in the groups ($\chi^2=0.713$; $p=0.700$). The proportions of patients with the affected dominant upper limb were statistically the same: OG1 – 68%, OG2 – 64%, HPG – 70% ($\chi^2=0.424$; $p=0.810$). An equal proportion of group participants received a nonsteroidal anti-inflammatory drug: OG1 – 4%, OG2 – 4%, HPG – 2% ($\chi^2=0.414$; $p=0.813$).

The number of sessions with a physical therapist did not differ between OG1 and OG2 ($Z=-0.319$; $p=0.749$). In OG1, one patient received thirteen ERM sessions, two fourteen sessions, two – sixteen, one – seventeen sessions, and the majority (88%) fifteen sessions. In OG2, one patient received fourteen ERM sessions, two – sixteen, and the majority (94%) fifteen sessions.

The results of statistical analysis of the active amplitude of movements in the shoulder joint at the first measurement did not establish any differences between the groups (table 1). The second and third measurements established a difference between OG1 and OG2 (in favor of OG2) in terms of rotation indicators, as well as better indicators in OG1 and OG2 compared to HPG in terms

of all amplitude indicators. In addition, at the beginning of the third week, OG2 had better abduction indicators compared to OG1. The fourth measurement also confirmed the advantages of OG1 and OG2 over HPG in terms of all indicators, but the difference between OG1 and OG2 was no longer observed. The results of the comparison of the final assessment of amplitudes were similar. The study of dynamics in groups using Friedman's two-factor analysis of variance established significant changes in all amplitude indicators ($p < 0.001$).

Comparison of the initial results of the pain index in TPs using the Kruskal-Wallis test did not establish a statistically significant difference between the groups (Table 2). According to the results of the comparison of the indicators of the third measurement (at the beginning of the third week), OG1 and OG2 did not differ ($Z = 2.392$; $p = 0.050$). At the same time, the results of the HPG were not worse than OG1 ($Z = -0.305$; $p = 1.000$), but were worse than OG2 ($Z = -2.697$; $p = 0.021$). The results of the statistical analysis of the values of the fourth measurement using the Kruskal-Wallis test confirmed the presence of a statistically significant difference between the groups. Dunn's test for pairwise

comparison of groups established that the results of OG1 and OG2 did not differ ($Z = 2.180$; $p = 0.088$). At the same time, the results of HPG were not worse than in OG1 ($Z = -1.912$; $p = 0.168$), but were worse than in OG2 ($Z = -3.890$; $p < 0.001$).

Comparison of the results of the final measurement established a statistically significant difference between the groups, and pairwise comparison of the groups established that the results of OG1 and OG2 did not differ ($Z = 0.194$; $p = 1.000$). At the same time, the results of the HPG were worse than in OG1 ($Z = -7.692$; $p < 0.001$) and OG2 ($Z = -7.887$; $p < 0.001$). The study of dynamics in the groups using two-factor Friedman's analysis of variance established significant changes in the pain index in TT ($p < 0.001$).

Discussion. The results indicate positive dynamics in the three groups for all studied amplitude and pain indicators in TPs. According to the obtained results, the use of ERM in combination with IC or the use of ERM and PNF in combination with IC had advantages compared to the use of therapeutic exercises in combination with IC already a week after the start of PT. At the same time, according to the final results, the effectiveness of using

Table 1

The value of Me (25%; 75%) of the passive amplitude of movement in the shoulder joint

Evaluation period	Groups			Criterion*	P
	OG1 (n=50)	OG2 (n=50)	HPG (n=50)		
Abduction					
Initial measurement	49 (34,5; 60)	49 (33,75; 59,25)	51 (44,75; 55,25)	2,310	0,315
Beginning of the second week	73 (59,75; 79,25)	78 (65,75; 84)	62,5 (54,75; 69)	32,145	<0,001
Beginning of the third week	94,5 (89,5; 100,75)	101 (95,75; 105)	73 (66,75; 78,25)	96,415	<0,001
End of the third week	110 (105; 114,25)	112 (109; 115)	89,5 (84; 96)	98,969	<0,001
Final	110 (105; 110)	110 (107; 114)	96 (92,75; 101)	80,497	<0,001
Flexion					
Initial measurement	61 (53,75; 69,25)	59 (51,75; 67,25)	65 (59,25; 73)	1,579	0,454
Beginning of the second week	95,5 (84,25; 100,25)	102 (88,5; 105,25)	75 (68,25; 82,25)	30,470	<0,001
Beginning of the third week	155 (144,75; 160)	155 (140,5; 160)	92,5 (85,75; 101)	83,464	<0,001
End of the third week	173 (170; 175)	171 (168; 172,25)	120 (95; 125)	97,617	<0,001
Final	172 (170; 175)	170 (167,75; 172,25)	125 (104; 137)	96,301	<0,001
Internal rotation					
Initial measurement	13 (11; 17,25)	14 (11,75; 18)	14 (12; 18)	1,996	0,369
Beginning of the second week	26 (23; 31)	30 (28; 33,75)	23 (20,75; 25)	44,386	<0,001
Beginning of the third week	46,5 (43; 51)	55 (51; 58)	31 (28; 34)	100,253	<0,001
End of the third week	90 (83; 90)	88 (84; 88)	43,5 (41; 45)	104,980	<0,001
Final	90 (80; 90)	85 (80,75; 86)	51,5 (49; 54)	94,875	<0,001
External rotation					
Initial measurement	15 (12; 17,25)	16 (13; 18,25)	15 (13; 18)	1,982	0,371
Beginning of the second week	25 (23; 30)	29 (27; 34,25)	22 (19,75; 25)	49,249	<0,001
Beginning of the third week	47 (41,75; 52)	56 (50,75; 60,25)	31 (29; 34)	99,333	<0,001
End of the third week	90 (83,75; 90)	88 (83,25; 90)	45 (43; 46,25)	102,777	<0,001
Final	90 (80; 90)	85 (80; 87,25)	51 (48,75; 54)	94,512	<0,001

Note. * Kruskal-Wallis test (based on χ^2 tables)

Indicators of Me (25%;75%) trigger point pain, score

Evaluation period	Groups			Criterion*	P
	OG1 (n=50)	OG2 (n=50)	HPG (n=50)		
Initial measurement	9 (9; 9)	9 (8; 9)	9 (9; 9)	3,776	0,151
Beginning of the second week	8 (7; 8)	7 (7; 8)	8 (7; 8)	7,228	0,027
Beginning of the third week	6 (5; 6)	5 (5; 6)	6 (5; 6)	8,725	0,013
End of the third week	3 (2; 4)	2 (2; 3,25)	3 (3; 5)	15,352	<0,001
Final	1,5 (1; 2)	2 (1; 2)	3 (3; 4)	80,941	<0,001

Note. * Kruskal-Wallis test (based on χ^2 tables)

ERM in combination with IR did not differ from the use of ERM and PNF in combination with IC. The advantages of adding PNF were noted only at the second and third assessments. Thus, the use of ERM and IC is a rational option for choosing among the rearranged PT options. The final pain assessment in TPs also confirmed the benefits of the interventions performed in OG1 and OG2.

The results obtained are consistent with previous ones regarding the effectiveness of ERM, PNF, and IC.

In particular, the study by A. Anitha et al. (2020) was devoted to studying the effectiveness of adding ERM to the traditional treatment of patients with AK (interference therapy and free exercises (pendulum exercises, toe walking, towel stretching, stick exercises). Patients received 12 sessions over 2 weeks. The researchers found advantages in amplitude indicators in the group receiving ERM.

S.S. Maarouf et al. (2021) compared the effectiveness of mobilization (ERM and scapular mobilization) and passive stretching exercises. Both groups showed improvements in all ranges of motion. In particular, in the mobilization group, the flexion range increased from 97° to 154.75°, and in the exercise group, from 96° to 135.75°. It should be noted that all patients received 12 sessions over 6 weeks, and levels 3 or 4 were used for mobilization.

The results obtained are consistent with those reported in the study by G.Y. Kumar et al. (2015). The authors demonstrated that the addition of mobilization (level 3–4) and scapular stabilization exercises to the standard therapy program enhances the clinical efficacy of AC therapy. The standard therapy in this study included Codman exercises, the «finger step», as well as strength and stretching exercises, which were performed according to the patient's pain tolerance and in a comfortable position. The treatment course lasted 4 weeks (20 sessions). A statistically significant increase in the amplitude of external rotation was recorded in the mobilization group – from 14.53° to 34°, while in the control group this indicator increased from 14.8° to 23.07°. The

difference found emphasizes the importance of including high-level mobilizations in rehabilitation programs for AK patients.

S. N. Ansari et al. (2012) found that the combination of ERM with ultrasound was superior to the combination of passive stretching with cryotherapy on shoulder pain. In a previous study Vermeulen et al. (2000), the effectiveness of ERM, performed twice a week for 3 months in patients with AC, was found to be, in particular, that the mean active abduction amplitude increased from 91° to 151° and external rotation from 13° to 31°.

An analysis of the effectiveness of ERM (Maitland technique, Vermeulen approach, scapular mobilization) compared with standard intervention (active exercises, stretching, passive mobilization in the middle range of motion) in AC was conducted in a study by J.L. Yang et al. (2012). The authors found that the use of ERM demonstrated greater effectiveness in terms of functional recovery and range of motion at the 4th and 8th weeks of treatment, provided that the therapy was performed twice a week.

A systematic review of the effectiveness of PNF techniques by J.S. Tedla and D.R. Sangadala (2019) found that PNF was associated with greater reductions in pain and disability, as well as increased range of motion and improved function compared with standard interventions. The meta-analysis confirmed not only the significant clinical effect of PNF but also its superiority over traditional PT in reducing pain in AC, increasing external rotation and abduction.

Regarding the effectiveness of IR, previous studies have shown its positive effect on latent myofascial trigger points in the rhomboid muscles, in particular on the pain threshold when pressed (Fahmy, et. all, 2021). The clinical effect of IR in individuals with myofascial trigger points in the upper trapezius muscle was studied in the work of M. Ziaieifar et al. (2019). A significant reduction in pain intensity was recorded in both the short and medium term.

The obtained results of the effectiveness of interventions in OG1 (ERM and IC), and OG2 (ERM, PNF and IC) and HPG (therapeutic exercises and IC) are consist-

ent with the conclusions of previous studies and complement them. It should be noted that when comparing the results, the intensity of ERM and IC should be taken into account.

Conclusion. A comparison of the effectiveness of three treatment programs for patients with AK and

MPS found that the least dynamic was when using therapeutic exercises with IC. The benefits of adding PNF to ERM with IC were temporary and were not observed at the final assessment. The use of ERM and IC can be considered the optimal option. The dynamics of the indicators were significant in all groups.

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