

THE IMPLEMENT OF PHYSICAL THERAPY ON THE PSYCHO-EMOTIONAL STATE OF THE INDIVIDUALS AFTER THE GUNSHOT WOUND OF THE UPPER LIMB VPLYV FYZIKÁLNEJ TERAPIE NA PSYCHOEMOCIONÁLNY STAV OSÔB PO STRELNÝCH PORANENIACH HORNEJ KONČATINY

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ABSTRACT

Theoretical background: Unfortunately, as a result of hostilities in Ukraine, there is an increase of the number of victims with combat injuries of the upper limbs.

Objective: To evaluate the effectiveness of the developed program for the using of physical therapy (PT), based on the principles of the International Classification of Functioning (ICF), for people after gunshot wounds of the upper limbs (GWUL).

Research sample and method: The study involved 68 men who were physically trained professional military personnel with multiple GWUL, who were divided into an experimental group (EG, n = 34) and a control group (CG, n = 34). Patients of EG group were rehabilitated according to the developed PT program. CG patients – according to the standard program of the medical facility. The duration of the PT was 3 months. The research was conducted before and after the PT course. Visual analogue scale ratings (VAS), The Hamilton Anxiety Rating Scale (HARS) and Patient Health Questionnaire (PHQ-9) was used for comprehensive examination of patients in both groups.

Results: It was found that after PT, the pain intensity indicators ($p < 0.01$), manifestations of anxiety ($p < 0.05$) and depression ($p < 0.01$) were significantly better in patients from EG than in CG group.

Conclusions: The application of the developed PT program, based on the principles of the ICF, reduces the intensity of pain in the wounded limb and improves psycho-emotional state of servicemen with GWUL and can be used in specialized institutions to improve the recovery results of this category of patients.

Key words: Upper limb. Gunshot wounds. Physiotherapeutic intervention. Biopsychosocial approach. Psychoemotional state.

ABSTRAKT

Teoretické východiská: V dôsledku vojnových konfliktov na Ukrajine bohužiaľ narastá počet obetí s bojovými poraneniami horných končatín.

Ciele: Zhodnotiť účinnosť vypracovaného programu využívania fyzikálnej terapie (FT), založeného na princípoch Medzinárodnej klasifikácie funkčnosti (MKF), pre osoby po strelných poraneniach horných končatín (SPHK).

Výskumná vzorka a metóda: Štúdie sa zúčastnilo 68 mužov, ktorí boli fyzicky vyškolený profesionálny vojenský personál s viacnásobnou SPHK, a boli rozdelení do experimentálnej skupiny (ES, n = 34) a kontrolnej skupiny (KS, n = 34). Pacienti skupiny ES rehabilitovali podľa vypracovaného FT programu, pacienti skupiny KS podľa štandardného programu zdravotníckeho zariadenia. Dĺžka trvania FT bola 3 mesiace. Výskum sa uskutočnil pred a po ukončení kurzu FT. Na komplexné

vyšetrenie pacientov v oboch skupinách sa použila hodnotenie na Vizualnej analógovej škále (VAS), Hamiltonova škála hodnotenia úzkosti (HARS) a dotazník o zdraví pacienta (PHQ-9). *Výsledky:* Zistilo sa, že po FT boli ukazovatele intenzity bolesti ($p < 0,01$), prejavy úzkosti ($p < 0,05$) a depresie ($p < 0,01$) významne lepšie u pacientov zo skupiny ES ako v skupine KS. *Záver:* Aplikácia vypracovaného FT programu, založeného na princípoch MKF, znižuje intenzitu bolesti zranenej končatiny a zlepšuje psycho-emocionálny stav vojakov s SPHK, a môže sa používať v špecializovaných zariadeniach na zlepšenie výsledkov rekonvalescencie tejto kategórie pacientov.

Kľúčové slová: Horná končatina. Strelné poranenia. Fyzioterapeutická intervencia. Biopsychosociálny prístup. Psychoemocionálny stav.

INTRODUCTION

Using of modern weapons during military events in Ukraine was led to the spread of combat injuries of various localization. Currently, the structure of gunshot wounds is dominated by injuries of the musculoskeletal system, in particular combat injuries of the upper limbs, since they are the least protected anatomical parts of the body from the point of view of effective means of protection, they make up 53-70 % of the total number of all injuries both among military people and among the civilian people located in the zone of active hostilities, and lead to a significant loss of functioning of the affected limb of the victims, significantly reducing their independence and quality of life (Burianov et al., 2018; Khomenko et al., 2021).

Being in a dangerous combat environment, all military people without exception feel a stress experience (Mozgovyi, 2017; Kolesnichenko, 2018). A research of the best practices in the organization of physical recovery in the armies of the leading NATO member countries (the USA, Germany and France) shows that after exposure of physical and mental stress which were received during hostilities, the military need psycho-emotional relief, despite of the sufficient stress resistance of the most military-

professionals and their improvement of qualities, on which the effectiveness of modern military professional (combat) activity depends.

Determining psycho-traumatic factors of combat activity include such factors as a perceived threat to one's life, injuries, pain, and disability (Pustovyi, 2017).

After observing suffering, death, fear and pain in the combat zone, soldiers reassess their values, it is difficult for them to adapt to peaceful life, in particular, their sleep experience disturbances, a sense of fear and depression appear, they may feel anger, resentment, despair and frustration that affects for all areas of their life (Aleshchenko, 2018; Kolesnichenko, 2018). Of course, getting injured is an additional stress for military. It has been shown that pain in wounded limbs, inability to care for oneself, loss of autonomy and independence are directly related to psychological stress, anxiety and depression, which often leads to anxiety and depressive disorders in combatants (Allami et al., 2017).

Rehabilitation of military with gunshot wounds of the upper limb (GWUL) is a complex process which is aimed at restoring, not only at the functional state of the musculoskeletal system and improving their quality of life, but also to return of their moral and psychological readiness to perform their professional duties (Oderov et al., 2014). Since it is the psychosocial component that is decisive in the formation of the unfavorable prognosis for the recovery of injured upper limbs of military, it is believed that using physical therapy (PT) is focused on a biopsychosocial approach which allows you to focus on the individual characteristics of each patient in each individual case and select PT measures in accordance with his/her needs (Lane et al., 2014; Shestopal et al., 2022).

Currently, the majority of research concerns of the problems of gunshot injury surgery with determination of the severity of polystructural gunshot injury of the upper limb (Burianov et al., 2018; Khomenko et al., 2021), at the same time, scientific research on the problem of developing recovery measures for patients after GWUL by means of PT, which are oriented on a biopsychosocial approach, which is the basis of The International Classification of Functioning (ICF), but there are few of them. Basically, the therapeutic means of PT are aimed at restoring the lost functions of the upper limb, without taking into account interventions which are

aimed at the psychosocial aspect of this injury (Pang et al., 2006; Rhee et al., 2016).

Based on the information above, the development and the implementation of a new set of PT measures which are based on a biopsychosocial approach, in which attention is focused not only on the damage of the upper limb, but also on the psychosocial component of patients with GWUL, and it is extremely relevant.

OBJECTIVE

To assess the effectiveness of the developed program of using PT tools, which is based on the principles of the ICF, on the level of pain, anxiety, and depression in people after GWUL.

RESEARCH SAMPLE

68 men who were physically trained professional military personnel took part in the research after multiple GWUL, the average age is 38.0 ± 2.4 (28.0 – 52.0) years old, who underwent the recovery at the clinic of rehabilitation, occupational pathology and non-traditional methods of treatment of the Military Medical Hospital in Irpin.

The research was approved by the University Ethics Committee (Nu. 4/2020) and was conducted in compliance with the international principles of the Helsinki Declaration of the World Medical Association (World Medical Association, 2013) regarding ethical norms and rules for conducting medical research with human participation. All participants were familiarized with the measurement procedure and signed the informed consent.

METHODOLOGY

All patients with GWUL were randomly divided into two groups – experimental (EG) ($n = 34$) and control (CG) ($n = 34$). EG patients were underwent by restorative treatment according to a developed PT program which is included therapeutic exercises, positioning, a system of progressive exercises using special Thera-band and Artromot simulators, post-isometric relaxation (PIR), therapeutic massage, bimanual therapy, motor activity from modeling the situation, which consisted of training not only everyday life skills, but also activities related to the duties of a serviceman (the ability to put on military equipment, hold weapons, shoot, perform defensive actions, etc.), as well as variable means of PT, in particular, retraining, using visual, sound, and tactile provocation (re-education, mirror therapy) (Table 1).

Table 1 PT measures according to the ICF domains of EG patients with GWUL

Period and goals	At the level of structure and function	At the level of structure and function
The first early postoperative period (2-22 days) Short-term goals: 1. training of everyday life skills and activities related to the duties of a serviceman; 2. improvement of movements for gripping and holding objects for self-service and holding weapons.	1. therapeutic exercises – 10 min; 2. positioning – individual duration; 3. therapeutic massage – 15 min; 4. Artromot simulators – 10 min; 5. PIR – 10 min.	1. moderate motor activity of purposeful actions with modeling of occupations, significant for each patient - individual duration; 2. bimanual therapy – 10 min.
The second late postoperative period (23-45 days) Short-term goals: 1. improving daily living skills and training professional skills military personnel; 2. increase the speed and coordination of movements of the upper limb for dressing the military outfit; 3. training the strength of the muscles of the upper limb to perform protective actions.	1. therapeutic exercises – 15 min; 2. PIR – 10 min; 3. simulator systems Theraband – 10 min; 4. re-education – 10 min.	1. motor activity from modeling the situation – individual duration; 2. bimanual therapy – 10 min.
The third period – restorative (46-66 days) Short-term goals: 1. consolidation of functional independence skills and professional skills military personnel; 2. motivation for independent studies aimed at consolidation and improvement of the results obtained; 3. increase muscle strength and endurance upper limb to be able to perform shooting.	1. therapeutic exercises – 15 min; 2. simulator systems Theraband – 10 min; 3. PNF – 10 min. 4. mirror therapy – 10 min.	1. motor activity from modeling the situation – 15 min; 2. adaptation of the environment – individual duration.

CG patients were undergone by PT according to the standard program of the medical facility which included therapeutic exercises, physiotherapy, kinesiotherapy, simulators Artromot, therapeutic massage. The total duration of the PT was 3 months. Activities were held every day, except on the weekends. Research was conducted before and after the course of PT. The intensity of pain in the wounded upper limb of military was assessed by the Visual

Analogue Scale (VAS). The severity of the anxiety syndrome in individuals with GWUL was assessed using The Hamilton Anxiety Rating Scale (HARS). In order to assess and monitor the severity of depression in individuals with GWUL, the PHQ-9 (Patient Health Questionnaire).

All statistical analyses were conducted by using Statistica 10.0 (StatSoft, USA). Mean \pm standard deviation ($M \pm SD$), median (Me), upper and lower quartiles (25 %; 75 %) were measured. To measure the significance of the difference, Student's t-test

(for dependent groups) was used provided there was a normal distribution of study results. Wilcoxon test (for dependent groups) and Mann-Whitney U test (for independent groups) were used provided the indicators had a distribution other than normal. Correlation analysis was performed using Spearman's correlation coefficient. Statistical significance defined at $p < 0.05$.

RESULTS

It was established that the index of pain syndrome severity according to VAS in patients after GWUL before the start of PT in both EG and CG was 5 (4; 7) points. After PT, a significant decrease of pain intensity was found in both groups. Thus, the magnitude of pain according to VAS in EG and CG was respectively 1 (1; 2) points ($p < 0.01$) and 2 (1; 4) points ($p < 0.05$) (Figure 1).

Table 2 Dynamics of the indicators of anxiety and depression during the process of PT of people with GWUL, the scores, Me (25 %; 75 %)

Indicators	Before intervention		After intervention	
	EG (n = 34)	CG (n = 34)	EG (n = 34)	CG (n = 34)
HARS	33 (28; 41)	35 (28; 41)	5 (0; 10)**#	14 (13; 24)*
PHQ-9	17 (14; 20)	16 (14; 20)	0 (0; 3)**#	5 (2; 8)*

Legend: EG – experimental group, CG – control group, HARS – The Hamilton Anxiety Rating Scale, PHQ-9 – Patient Health Questionnaire, * – $p < 0.05$, ** – $p < 0.01$ compared to the beginning of PT, # – $p < 0.05$ compared to CG.

It was shown that during the initial examination, a high level of HARS anxiety was observed in both groups of patients, namely, in EG and CG of patients, respectively, this indicator was 33 (28; 41) points and 35 (28; 41) points. After PT, a decrease of this indicator was observed in both groups and amounted to 5 (0; 10) ($p < 0.01$) points in EG and 14 (13; 24) ($p < 0.05$) points in CG. In addition to this, a statistically significant difference was observed between the level of anxiety according to the HARS after PT in EG patients compared to CG ($p < 0.05$) (Table 2).

It was found that at the beginning of the course of PT, in patients with GWUL were showed signs of depression of the moderate degree of severity according to the PHQ-9 in both groups of patients. After PT, self-assessment of depression according to the PHQ-9 changed from 17 (14; 20) points to 0 (0; 3) points ($p < 0.01$) in EG, and from 16 (14; 20) points to 5 (2; 8) points ($p < 0.05$) in CG patients. In addition to this, the statistically significant difference was observed between the level of self-assessment of depression according to PHQ-9 after PT in EG of patients compared to CG patients ($p < 0.05$) (Table 2).

The strongest correlations were found between the intensity of pain the VAS and HARS indicators “Tension” (feeling of tense, trembling, feeling anxious, inability to relax) ($\rho = 0.58$, $p < 0.01$), “Somatic muscle symptoms” (pain, twitching, tension, clonic convulsions, teeth grinding, broken voice, increased muscle tone) ($\rho = 0.67$, $p < 0.01$), “Somatic sensory symptoms” (ringing in the ears, blurred vision, hot and cold flashes, feeling weak, tingling) ($\rho = 0.64$, $p < 0.01$), and “Insomnia” (difficulty falling asleep, interrupted sleep that does not bring rest, feeling broken and weak when waking up, nightmares) ($\rho = 0.7$, $p < 0.01$). Also, correlations were also found between the intensity of pain the VAS and PHQ-9 indicators “Difficulty of concentrating” (for example, focus on reading a newspaper or watching television) ($\rho = 0.56$, $p < 0.01$) and “Your

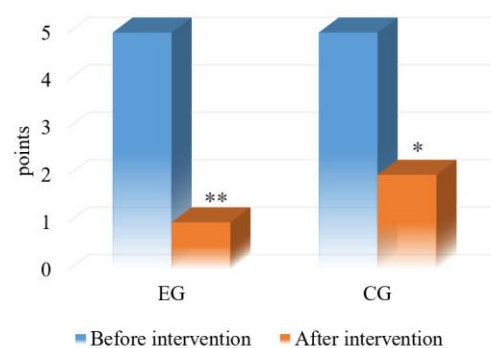


Figure 1 The dynamics of indicators of the expressiveness of the pain syndrome according to VAS in the process of PT of people with GWUL scores, Me (25 %; 75 %); Legend: EG – experimental group, CG – control group, * – $p < 0.05$, ** – $p < 0.01$ compared to the beginning of PT.

movements or speech were so slow that others could notice this. Or, conversely, you were so fussy or excited that you moved more than usual” ($\rho = 0.54$, $p < 0.01$).

DISCUSSION

As a result of the hostilities in Ukraine, which continue until now, there is an increase of the number of victims with various degrees and localization of gunshot wounds, which, in its turn, requires an improvement in the approach not only to restoring the health of military with the consequences of gunshot wounds, but also to the earliest possible return to their work capacity and combat readiness to performance of their professional duties.

Especially the important place during the PT process is occupied by the psycho-emotional state of patients after injury. As a usual, patients who have been in the combat zone cannot concentrate, work without a mood, often pay their attention to external signs of physical diseases, which are signs of anxiety and depression. Covery et al. (2010) were showed that behavioral approaches which promote self-efficacy are effective for patients with upper limb injuries and contribute to the reduction of the pain levels, to the improvement of grip strength of

the affected limb and the disappearance of depressed mood. The formation in people who were injured in the result of the hostilities, the rational attitude to trauma, the development of motivation for active participation in the rehabilitation process and assistance in adaptation to new life realities, certainly affect on the favorable prognosis of recovery and improve the psycho-emotional condition of the patients (Shevchuk et al., 2018; Shestopal et al., 2022a).

In this research, the effectiveness of the developed program of PT tools which was based on the principles of the ICF and was evaluated on the level of pain, anxiety, and depression in people with GWUL, compared to the standard approach used in the medical institution.

The methods and the means of PT which we used during the work, were distributed according to the domains of the ICF (Mcdougall et al., 2010; World Health Organization, 2024), which made it possible to choose the PT measures in accordance with the individual problems and needs of the each patient (Marunych et al., 2006).

It is known that the long-term pain syndrome after the injury has the impact not only on the functional capabilities of patients, in particular on limiting the range of movements in the joints, but also on the quality of their lives. According to Hall et al. (2013) pain, have been fulfilled its primary protective and informational role in the human body, becomes the centre of constant excitation of the central nervous system and, as a result, the reason of physical and psychoemotional exhaustion of the body.

In our research, before the beginning of the PT in EG and CG, patients with GWUL had “moderate pain” according to the VAS. Analyzing the degree of expressiveness of the pain syndrome according to the VAS after the using of PT, we noted an essential decrease of pain in both EG and in the CG groups. Thus, in EG, the pain intensity indicator decreased by 5 times ($p < 0.01$) compared to CG, where this indicator decreased by 2.5 times ($p < 0.05$), although no patient determined the complete absence of pain.

It is shown that means of PT restore not only the physical, but also the mental state of the person, thereby allowing to improve significantly all components of the moral and psychological readiness of military people (Badiuk et al., 2016).

In our research, during assessing the severity of the anxiety syndrome, it was shown that individuals

with GWUL had high levels of anxiety according to the HARS at the baseline in both groups, with the majority of patients who had symptoms or aspects of consistent anxiety with severe depression. After the PT in EG, the 78 % patients did not have any symptoms of anxiety according to the HARS, in 23 % of patients the condition was characterized as “borderline”. In CG, despite of the positive dynamics, in the majority of patients (97 %) after the PT course, anxious symptoms of varying degrees of expressiveness were still observed, which corresponded to the assessment of “mild depression” by PHQ-9.

In addition to this, when assessing the manifestations of depression, we were showed that people with GWUL before the start of the PT course mostly had depressive manifestations of the average degree of severity according to the PHQ-9. The proposed PT program which contributed the improvement of the psycho-emotional state according to the PHQ-9 of patients in both groups. Thus, in EG patients manifested a complete absence of depression according to the PHQ-9, in contrast to CG, where “mild depression” was still observed according to the PHQ-9. Moreover, after the PT course, the patients noted that they had positive thoughts, self-confidence, improved sleep, which, in turn, affected the development of motivation for active participation in the PT process and help in adapting them to the new realities of the life situations.

Thus, the obtained results of the research of both groups indicate that after the PT in patients with GWUL, the intensity of pain in the injured limb decreased, as well as the psycho-emotional state of patients significantly improved, but in EG group these changes were significantly better than in CG group.

It should be noted that there are currently few researches in the modern scientific literature on determining the effectiveness of PT programs which are focused on the biopsychosocial approach, which is the basis of ICF, for patients with upper limb injuries in modern scientific literature, in contrast to researches which are related to military people or craniocerebral injuries of the lower limb injuries (Grin et al., 2018; Cristofori et al., 2024). Basically, the scientific researches of various authors substantiate the feasibility of using PT means for patients with the consequences of gunshot wounds and describe the methods that can be effective in implementing the recovery of this category of patients.

So, Kruk et al. (2022) emphasize that combination of rationally selected means of PT, taking into account the individual characteristics of each patient, will provide an opportunity to gradually, in the appropriate period, restoring of the lost functions and the level of physical performance of military people. Salaida et al. (2023) indicate that during the physical and psychological rehabilitation of military people, measures should be implemented and aimed at improving the physical condition of the victim and eliminating his/her psycho-emotional problems in order to help patients fully reintegrate into the family and society. Stevelink et al. (2015) indicate the positive impact of the complex PT for the recovering of military people with post-traumatic stress disorders after the injury.

At the same time, in the USA, which is been experiencing in two decades of continuous military action, the media and stalwarts with the personal ties to the army are expressing the serious public and professional concern about the mental health of the veterans and military people. Inoue et al. (2023) review the assessment and the treatment of the psychiatric disorders, including post-traumatic stress disorder, depression, suicide, and using the substance in military people and veterans, with a primary focus on diagnosing military people and identifying the risk of specific factors in these groups of the people, but unfortunately, the role of PT in this research is not highlighted. The authors emphasize that all treatments and interventions should involve the patient and, if appropriate, the family as a part of the interprofessional team, such as social support plays a crucial role in the pathogenesis and in the treatment of these disorders. Using the interdisciplinary approach will lead to the better outcome for the patient.

Based on the fact that in connection with the duration of the military events in Ukraine, unfortunately, a further increase of the frequency of receiving various injuries of the musculoskeletal system, including the combat injuries of the upper limbs, is expected in the near future, the comprehensive PT program, which is based on the principles of the ICF and is focused on the biopsychosocial approach, is the important component of the treatment, which will reduce the limitations of life activities, lead to the maximum possible recovery of the functional deficits and improve the psycho-emotional state of the military person, which in turn, will lead to the

fastest possible return of thematic patients to the implementation of their professional duties.

CONCLUSION

The developed program of PT measures, based on the principles of the ICF, is more effective in terms of its characteristics for the course of recovery without pain syndromes and improvement of the psycho-emotional state of people with GWUL in comparison with the standard program. And it can be used in the special medical institution by its medical workers, physical therapists with the aim of further improvement of complex PT programs, taking into account and implementing the latest achievements and methods in the renewed treatment of this category of patients.

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