THE SPECIFITY OF USING PHYSICAL THERAPY OF THE PATIENTS AFTER GUNSHOT WOUNDS OF THE UPPER LIMB
VLASTNOSTI APLIKÁCIE FYZIOTERAPIE U OSÔB PO STRELNÝCH PORANENIACH HORNEJ KONČATINY

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ABSTRACT
Theoretical background: The development of the algorithm of physical therapy (pt) measures, which are aimed at the fastest possible recoving of the functions of the upper limbs of servicemen and their return to the normal lifestyle and for their professional duties is very important.
Objective: To evaluate the effectiveness of the developed algorithm of PT measures for patients with gunshot wound of the upper limb (GWUL).
Research sample and method: 76 men were involved in the research with GWUL, who were divided into two groups: patients who were undergoing rehabilitation according to the developed algorithm of complex PT, formed the main group; control group - patients who underwent a standard set of PT. Clinical and instrumental methods, dynamometry, FIM (Functional Independence Measure), military questionnaire, Hamilton's alarm scale were used.
Results: It is established that the developed algorithm of PT measures in servicemen with GWUL allowed to strengthen the strength of the muscles of the upper limb, improve mobility and activity of the patients in everyday`s life, increase its independence, which, in turn, had a positive impact on the mental state of these patients.
Conclusions: Using the developed algorithm of the application of PT measures significantly improved the recovering of patients with GWUL and was more effective than the standard approach. Application of the algorithm of measures of PT of persons with GWUL on the basis of ICF, allowed to reveal positive changes of the functional condition of the upper limb and quality of life of servicemen.

Key words: Gunshot wounds. Upper limb. Physical therapy. Military men

ABSTRAKT
Východiská: Veľmi dôležitý je vývoj algoritmu fyzikálnoterapeutických (PT) opatrení, ktoré sú zamerané na čo najrýchlejšie obnovenie funkcií horných končatín vojakov a ich návrat do normálneho životného štýlu a pre výkon ich profesijných povinností.
Cieľ: Zhodnotiť účinnosť vyvinutého algoritmu PT opatrení u pacientov so strelným poranením hornej končatiny (GWUL).
Výskumná vzorka a metóda: Do výskumu s GWUL bolo zapojených 76 mužov, ktorí boli rozdelení do dvoch skupín: hlavnú skupinu tvorili pacienti, ktorí podstupovali rehabilitáciu podľa vyvinutého algoritmu komplexnej PT; kontrolná skupina - pacienti, ktorí podstúpili štandardný súbor PT. Boli použité klinické a inštrumentálne metódy, dynamometria, FIM (Functional Independence Measure), vojenský dotazník, Hamiltonova škála alarmu.
Výsledky: Zistilo sa, že vyvinutý algoritmus PT opatrení u vojakov s GWUL umožnil posilniť silu svalov hornej končatiny, zlepšiť mobilitu a aktivitu pacientov v každodennom živote, zvýšiť ich nezávislosť, čo zase, mala pozitívny vplyv na psychický stav týchto pacientov.
Závery: Použitie vyvinutého algoritmu aplikácie PT opatrení výrazne zlepšilo zotavenie pacientov s GWUL a bolo efektívnejšie ako štandardný prístup. Aplikácia algoritmu merania PT osôb s GWUL na základe ICF umožnila odhaliť pozitívne zmeny funkčného stavu hornej končatiny a kvality života vojakov.

Kľúčové slová: Strelné poranenia. Horná končatina. Fyzioterapia. Vojaci

INTRODUCTION

Despite all attempts to peacefully resolve the situation in the east of Ukraine, hostilities in the region continue to this day, leading to the increase of the number of casualties with varying degrees and localization of gunshot wounds. The increase of combat injuries, in turn, requires improved approaches to treatment and rehabilitation not only to restore the health of servicemen with gunshot wounds, but also to restore their ability to work and combat readiness as soon as possible to perform and achieve military objectives during the hostilities.

Using the modern weapons during prolonged hostilities in most armies cause the severity of gunshot wounds, including limbs, which prevail compared to injuries to the abdomen, chest, head, and there are the least protected areas, due to the widespread use of individual and effective means of the protection (helmets, bulletproof vests, etc.) (Tsema et al., 2016; Burianov et al., 2018). In the structure of modern combat injuries, gunshot wounds extremities account for 53 – 72 % of the total number of all injuries (Belmont et al., 2016; Zarutskyi et al., 2016; Burianov et al., 2018; Meade et al., 2021; Moriscot et al., 2021), among which,

according to research by various authors, from 15 % to 52 % are the upper limbs (Schoenfeld et al., 2013; Strafun et al., 2017; Gaida et al., 2018; Mitchell et al., 2019; Bäckman et al., 2020; Horoshko et al., 2021). In addition, the frequency of major types of injuries that lead to injury of the limb segment, depending on the intensity of hostilities and the types of weapons used in the east of Ukraine is constantly changing and averages 33.5 – 70.3 % of shrapnel, 12.2 – 50.8 % of explosive and 9.1 – 15.6 % of bullet wounds (Khomenko et al., 2021).

There are few researches of the development of measures to recover patients after gunshot wounds of the upper limb (GWUL) using means of physical therapy (PT) and they are singled. The main goal of the therapy is recovering the structure and the function of the upper limb, the activity and the participation of patients after a gunshot wound of the upper limb is not always used in the recovering process, which does not correspond to the current model of the International Classification of Functioning, Disability and Health (ICF), which helps to study various aspects of rehabilitation and create your own models (Buylova, 2013; Dereka, 2020).

The effectiveness of the recovering process largely depends on a full and accurate assessment of the results of rehabilitation. Despite of the presence in foreign practice a large number of general and specific questionnaires to assess the quality of life, we could not find data on the availability of validated Ukrainian-language versions of specific questionnaires. This necessitates validated tools for assessing the quality of life of the thematic contingent.

According to the information which was mentioned above, the development of the new algorithm of PT measures based on a comprehensive, interdisciplinary approach to the individual needs of each patient with this pathology, taking into account the principles of ICF and aimed at recovering the functions of the upper limbs and their return to normal life are extremely relevant.

OBJECTIVE

To evaluate the effectiveness of the developed algorithm of PT measures for patients after GWUL.

RESEARCH SAMPLE

76 patients were involved in the research after surgery, they were diagnosed GWUL, the mean age is 33.8 ± 6.7 (18.0 – 52.0) years old, who underwent rehabilitation treatment at the rehabilitation department of the military hospital in Irpin.

Participants of the research signed an informed consent form. The research was approved by the University Ethics Committee (№ 2/2017) and was conducted in accordance with the international principles of the Helsinki Declaration of the World Medical Association (2013) and in accordance with the Law of Ukraine “Fundamentals of Ukrainian Health Care Legislation ” (1992) on ethical norms and rules of medical research with human participation.

METHODOLOGY

Patients were divided into two groups: patients who underwent rehabilitation treatment according to the developed algorithm of complex PT for the upper limb, formed the main group (MG), n = 38 and control group (CG), n = 38 – patients who underwent a set of rehabilitation measures according to the methods of the medical institution.

The duration of treatment was 3 months. The studies were performed before and after the course of rehabilitation treatment. The following methods were used: clinical-instrumental, dynamometry, Functional Independence Measure (FIM), Hamilton's alarm scale (The Hamilton Anxiety Rating Scale (HARS)), military questionnaire.

The course of PT was performed into 3 periods: the first one – early post-immobilization, the second – late post-immobilization and the third – recovery, which were characterized by the corresponding functional states.

The developed PT algorithm in the MG included the following tools: kinesiotherapy (special exercises for the upper limb), Thera-band simulators, therapeutic massage, positioning, bimanual therapy, hydrokinesiotherapy, physiotherapy and motor actions to simulate the situation.

Patients and their relatives were provided with practical recommendations on the implementation of certain elements of the program of the algorithm of PT measures for independent research.

All statistical analyses were conducted using Statistica 10.0 (StatSoft, USA). Mean ± standard deviation (M ± 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. Statistical significance defined at $p < 0.05$.

RESULTS

An integrated approach today is a key point in the application of medical and rehabilitation measures for various diseases, in particular, for the recovery of patients with GWUL, which included such components as rehabilitation examination (objective and subjective); planning with forecasting the final result, taking into account short-term and long-term goals; intervention with the selection of individual and optimal for each patient means of PT, aimed at recovering motor functions and improving the quality of life of these patients; control and synthesis of the results (stage and final). In addition, the variety of disorders that accompany the diagnosis was taken under consideration.

Rehabilitation research was conducted using the methodological approaches of ICF before the start of PT activities and included:

- subjective examination (observation, survey) to identify the problems that concern the patient the most , which allowed to collect the data which are not specified in the personal file, to establish communication, to create an atmosphere of trust and cooperation. The results of the conversation helped to create a psychological portrait of the serviceman, on the basis of which further individual work was built. The HARS was used to determine the degree of anxiety;
- objective clinical examination of patients: analysis of case histories, questionnaires, dynamometry, testing using the FIM scale to determine the degree of activity of daily life and a questionnaire of a serviceman to determine the ability to perform their professional duties.

Based on the previous studies, the evaluation, final analysis and synthesis results were carried out step by step. After the survey, we moved on to the next stage – planning, which began with the definition of goals in SMART format. The peculiarities of injuries of the upper limb, the time of surgery, patient complaints, cognitive impairment were taken under consideration. Short-term and long-term goals were formed. Firstly, we analyzed the daily activities and needs of each patient, then determined the possibility of performing these activities in the identified functional disorders,

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

Period and goals	At the level of structure and function	At the level of structure and function
The first early post-mobilization period (2-22 days). Short-term goals: 1. improving the cognitive function; 2. increase functionality; 3. increase the strength of the muscles of the upper limb.	1. physiotherapy every other day, 30 min. each; 2. positioning – individual duration; 3. therapeutic massage – 15 min; 4. simulator systems Thera-band - 15 min.	1. hydrokinesiotherapy every other day – 20 min.; 2.kinesiological taping; 3. bimanual therapy – 20 min.; 4. moderate motor activity of purposeful actions with modeling of occupations, significant for each patient - individual duration.
The second period – late post-mobilization (23-45 days). Short-term goals: 1. increase the speed of movements of the upper limb; 2. improving daily life skills; 3. improving cognitive functions 4. improving movements for the capture and retention of objects.	1. physiotherapy every other day, 20 min. each; 2. positioning – individual duration; 3. therapeutic massage – 10 min.; 4. Thera-band simulators – 10 min.; 5. kinesitherapy – 15 min.	1. hydrokinesiotherapy every other day – 30 min.; 2. kinesiological taping; 3. bimanual therapy – 15 min.; 4. motor actions to simulate the situation – the duration is individual.
The third period – restorative (46-66 days) Short-term goals: 1. training the strength of the muscles of the upper limb; 2. consolidation of skills of functional independence 3. motivation for independent classes which are aimed at the consolidating and improving the results.	1. physiotherapy every other day, 10 min. each; 2. simulator systems Thera-band – 10 min.; 3. kinesitherapy – 20 min.	1. hydrokinesiotherapy every other day – 30 min. 2. kinesiological taping; 3. bimanual therapy – 15 min.; 4. motor actions to simulate the situation – individual duration; 5. adaptation of the environment.

Table 2 Dynamics of dynamometry in the process of PT of the patients with GWUL, M±SD

Indexes	MG (n = 38)		CG (n = 38)	
	Before intervention	After intervention	Before intervention	After intervention
Strength of the injured hand (left), kg	18.76 ± 1.88	27.07 ± 0.73**	18.89 ± 1.91	23.43 ± 1.02
Strength of the injured hand (right), kg	23.80 ± 1.91	32.11 ± 1.04*	23.81 ± 1.89	27.42 ± 0.94*
Strength of the healthy hand (left), kg	32.81 ± 1.91	41.07 ± 0.83*	32.77 ± 1.98	35.11 ± 0.97
Strength of the healthy hand (right), kg	42.43 ± 2.14	49.03 ± 0.94*	41.84 ± 1.99	45.14 ± 0.84*
The strength index of the injured hand,%	33.57 ± 2.76	38.94 ± 0.87*	32.48 ± 2.53	34.11 ± 0.96
The strength index of the healthy hand,%	44.28 ± 3.54	56.32 ± 1.24**	43.63 ± 2.92	48.27 ± 1.27*

Note: *Significant difference in the main group (MG) and the control group (CG) before and after PT

which led to short-term goals in different periods of PT. The overall long-term goals are to improve the quality of life and independence in everyday life, return to professional responsibilities, and restore the functionality of the upper limb. The developed algorithm of measures is presented in Table 1.

Muscle strength was measured using the method of dynamometry to analyze and evaluate the effectiveness of PT of the patients with GWUL. It has been shown that at the beginning of the PT of patients with GWUL, muscle strength in both healthy and injured limbs in MG and CG was almost the same. Thus, the indicators of muscle strength of the wounded left arm in MG and CG were 18.76 ± 1.88 kg and 18.89 ± 1.91 kg and the right – 23.80 ± 1.91 kg and 23.81 ± 1.9, respectively, which was almost 2 times less than these indicators in MG and CG of healthy limbs. During the evaluation of the results of changes in muscle strength of the upper limbs of thematic patients after the 3-month course of PT revealed a positive trend in increasing muscle strength of the hand brush and forearm in both groups, but not everywhere the difference between MG and CG was not significant. Thus, the strength of the muscles of the wounded left arm in the exhaust in MG and CG after PT was 27.07 ± 0.73 ($p < 0.01$) and 23.43 ± 1.02 kg and the right – 32.11 ± 1.04 ($p < 0.05$) kg and 27.42 ± 0.94 ($p < 0.05$), respectively. Similar results were found in the assessment of the strength index of the muscles of the upper limbs. The dynamics of dynamometry in the process of PT in patients with GWUL are presented in Table 2.

The FIM was used to assess the impact of GWUL disorders on the level of functional independence and activity in daily life. After the PT course, functional improvement was observed in both study groups (the difference between the indicators was statistically significant compared to the previous result, $p < 0.01$). However, the positive dynamics in MG was more pronounced (the difference between the indicators is statistically significant compared to the CG result at the level of $p < 0.05$).

After the course of PT functional improvement was observed in both study groups (the difference between the indicators was statistically significant compared to the previous result at the level of $p < 0.01$). However, the positive dynamics in the MG was more pronounced (the difference between the indicators was statistically significant compared to the result of the CG at the level of $p < 0.05$).

Dynamics of indicadors of general assessment of functional independence of pacients before and after PT shown at the Fig. 1.

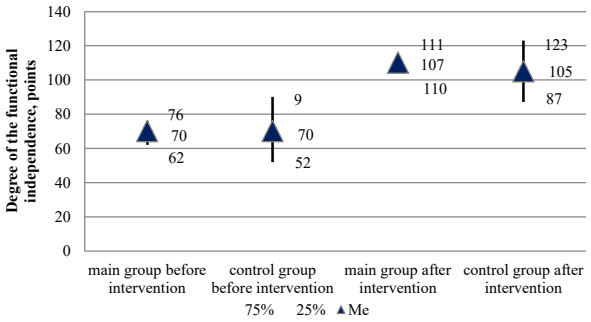

Figure 1 Dynamics of the degree of functional patiens` independence with gunshot wounds of the upper limbs under the influence of rehabilitation interventions on the FIM scale, points, Me (25 %;75 %)

We used a military questionnaire which was developed by us to assess the ability of servicemen to return to their professional duties.

Motor actions with simulation of the situation in MG consisted of performing exercises that are similar in their impact on the professional actions and physical activity of servicemen of different military specialties, and served as an important means of recovering, lost skills after injury, compared to CG, which used standard PT, aimed

Table 3 Dynamics of the indicators of the military questionnaire in the process of PT, points, Me (25%;75%)

Indexes	MG (n = 38)		CG (n = 38)	
	Before intervention	After intervention	Before intervention	After intervention
1. Ability of wearing the equipment	2 (1;3)	5 (4;5)**	2 (1;3)	4 (3;4)*
2. Physical ability of holding the weapons	1 (1;2)	5 (4;5)**	1 (1;2)	3 (3;4)*
3. Physical ability of shooting	2 (1;3)	5 (4;5)**	2 (1;2)	3 (3;4)*
4. Ability of protecting actions	1 (1;2)	5 (4;5)**	1 (1;2)	3 (3;4)*

Note: *Significant difference in the main group (MG) and the control group (CG) before and after PT

mainly at restoring the structure and function of the damaged upper limb, which is reflected in the indicators of the military questionnaire (Tab. 3). According to all indicators, there were positive changes in MG (by 3 – 4 points) compared to CG (by 1 – 2 points).

The Hamilton anxiety scale was used to assess the level of anxiety in thematic patients (Fig. 2). It was shown that clinically detected anxiety was observed in patients before the rehabilitation intervention. After the course of PT in the MG in most patients no symptoms of anxiety were observed, although the condition of some patients can be described as "borderline" (closer to critical condition). In CG, despite the positive dynamics, in the vast majority of patients after the course of PT there were still anxious symptoms of varying severity (the difference between the main and control groups was statistically significant at the level of $p < 0.05$).

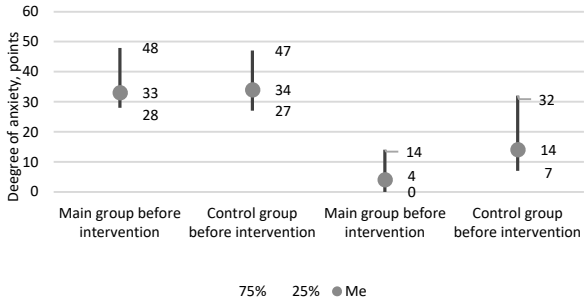

Figure 2 Dynamics of anxiety of the Hamilton scale during the PT process of the patients with GWUL

DISCUSSION

The high prevalence of combat injuries of the upper limb and their negative consequences, which consist of a sharp decrease in the professional and social capabilities of a person, require close attention of PT specialists to this category of injured. It has been shown that the recovering of the upper limb function and the return of the wounded to professional activity largely depends on the severity of polystructural damage (Ostroushko et al., 2016; Strafun et al., 2018; Klapchuk et al., 2020). Based on this, when we were implementing PT measures, we took under consideration not only the segments of the affected limb and their number, but also the severity of polystructural damage. In addition, in the process of rehabilitation treatment in each case involved the entire upper limb with a reasonable balanced arrangement of aspects for specialized exposure, taking into account a differentiated approach to each patient.

It was revealed that after receiving polystructural gunshot wounds, patients suffered the most from the loss of strength, which significantly affected the functionality of the patients, which reduced their quality of life and had alarming consequences. When choosing research methods, emphasis was placed on the methods that, in our opinion, are the most informative. In addition, the proposed approach allowed the PT process to focus not only on recovering strength, but also on recovering lost self-care skills and achieving patients' personal goals. The data that was obtained in assessing the impact of disorders resulting from GWUL on the level of functional independence and activity in everyday`s life, showed that at the beginning of the course of PT there was an insufficient level of social skills of these patients, but after the rehabilitation in most patients there were positive results, in the form of "making desicion", "social integration" and in self-service actions in both MG and CG groups. At the same time, the increase of activity in everyday`s life had a positive effect on the mental state of patients with gunshot wounds of the upper limbs, particularly under the influence of rehabilitation measures in patients of the main group significantly were reduced the anxiety symptoms.

In the works of most authors who deal with this problem, it is noted that a prerequisite for achieving the desired results of rehabilitation of patients with gunshot wounds is an understanding of its concept and basic provisions such as early start and

timeliness, consistency and continuity, complexity combined with individual approach, control and correction, phasing and objective evaluation of results (Strafun et al., 2017; Kalmykov et al., 2018; Kalinkina et al., 2021; Shestopal et al., 2021).

It is shown that PT tools, which are based on the principles of the ICF (Buylova, 2013; World Health Organization, 2018), provide restoration of not only the physical but also the psychological sphere of the man, namely, significantly improve all components of moral and psychological readiness of servicemen.

According to Strafun et al. (2017) working with the entire limb, it is necessary to improve certain motor skills (speed, strength, endurance) in combination with the recovering of the coordination structure of movements with a particular mental tension of the serviceman.

Yuriev et al. (2021) note that using the physical therapy is debatable, which is similar with its effect on the professional actions and physical activity of servicemen of different military specialties and can serve as important means of recovering of the lost skills after the injury.

The research confirmed the authours` opinion about the complex and diverse impact of rehabilitation measures on the patients` condition. These data are generally consistent with the data of Ivashchenko et al. (2016) about the positive effect of motor activity and the mental state of patients with combat injuries and supplement the data of Allami et al. (2017) about the indicators of quality of combatants` life. On the other hand, it should be noted that the problem of application of PE measures with GWUL is insufficiently covered in scientific sources, the issue of using the ICF does not have a proper scientific and practical basis, which requires further research of this issue.

CONCLUSION

The application of the developed algorithm of the PT actions of patients with gunshot wounds of the upper limb in the context of the biopsychosocial approach on the basis of ICF promoted essential improvement of indicators of muscle strength, functional independence and, in general , quality of life, in comparison with the standard program of medical institution and can be used in practice of PT specialists, doctors, health and rehabilitation centers in order to further improve comprehensive programs of PT, taking under consideration and implementing the latest advances and methods in the rehabilitation of thematic patients.

REFERENCES

ALLAMI M., YAVARI A., KARIMI A. et al. Health-related quality of life and the ability to perform activities of daily living: a cross-sectional study on 1079 war veterans with ankle-foot disorders. *Military Medical Research.* 2017; 4 (1): 37.

BÄCKMAN P.B., RIDDEZ L., ADAMSSON L. et al. Epidemiology of firearm injuries in a Scandinavian trauma center. *European journal of trauma and emergency surgery: official publication of the European Trauma Society*. 2020; 46 (3): 641-647.

BELMONT P.J., OWENS B.D., SCHOENFELD A.J. Musculoskeletal Injuries in Iraq and Afghanistan: Epidemiology and Outcomes Following a Decade of War. *The Journal of the American Academy of Orthopaedic Surgeons*. 2016; 24(6): 341-348.

BURIANOV A.A., YARMOLYUK Y.A., VAKULICH M.V. et al. Classification of a firearm injury of extremities. *Chronicle of traumatology and orthopedics.* 2018; (1-2): 146-149.

BUYLOVA T.V. International classification of functioning as a key to understanding the philosophy of rehabilitation. *Journal MediAl.* 2013; (2): 26-31.

DEREKA T. Dependence of public health on country's economic indicators. *Zdravotnicke Listy*. 2020; 2: 82-90.

GAIDA I.M., BADYUK M.I., SUSHKO YU.I. Peculiarities of structure and current of modern combat trauma among servicemen of the Armed Forces of Ukraine. *Pathologia.* 2018; 15 (1): 73-76.

HOROSHKO V.R., KUCHYN IU.L. Peculiarities of the course of post-traumatic stress disorders, depending on the type of anesthesiological provision, during the implementation of reconstructive surgical interventions after firearms wounds of the limbs. *Pain, anaesthesia & intensive care*. 2021; (2): 49-55.

IVASHCHENKO S.N., SHAKHLINA L.YA.-G., LAZAREVA O.B. Peculiarities of designing the phased model of physical rehabilitation of servicemen injured as a result of military opera-

tions. *Scientific Journal of National Peda-gogical Dragomanov University.* 2016; 3 (72): 63-67.

KALINKINA O., LAZARIEVA O., KALINKIN K. et al. Influence of PNF therapy on the active range of motion in proximal humerus gunshot injury patients. *Sport Mont.* 2021; 19 (S2): 177-181.

KALMYKOV S. KALMYKOVA YU. Topical issues of physical therapy for gunshot lesions of the diaphysis of the shoulder. *Slobozhanskyi herald of science and sport*. 2018; (1): 24-30.

KHOMENKO I.P., KOROL S.O., KHALIK S.V. et al. Clinical and Epidemiological analysis of the structure of combat surgical injury during Antiterrorist operation / Joint Forces Operation. *Ukrainian journal of military medicine.* 2021; 2 (2): 5-13.

KLAPCHUK Y.U.V., BURYANOV O.A., YAR-MOLYUK Y.O. et al. The current state of diagnosis and treatment of servicemen with gunshot wounds of large joints: review of the literature. *Current Aspects of Military Medicine.* 2020; 27 (2): 110-123.

LAW OF UKRAINE. Fundamentals of the Legislation of Ukraine on Health Care, No. 2802-XII/1992. [Internet]. Kyiv: Information of the Verkhovna Rada of Ukraine [updated 2020 Jun 24; cited 1993 Nov 19]. Available from: https://zakon.rada.gov.ua/laws/show/2801-12#Text

MEADE A., HEMBD A., CHO M.J. et al. Surgical Treatment of Upper Extremity Gunshot Injures: An Updated Review. *Annals of plastic surgery.* 2021; 86 (3S Suppl 2): S312-S318.

MITCHELL S.L., HAYDA R., CHEN A.T. et al. The Military Extremity Trauma Amputation/ Limb Salvage (METALS) Study: Outcomes of Amputation Compared with Limb Salvage Following Major Upper-Extremity Trauma. *The Journal of bone and joint surgery. American volume*. 2019; 101 (16): 1470-1478.

MORISCOT A., MIYABARA E.H., LANGEANI B. et al. Firearms-related skeletal muscle trauma: pathophysiology and novel approaches for regeneration. *NPJ Regenerative medicine*. 2021; 6 (1): 17.

OSTROUSHKO A.D., POPADYUHA Y.A. The study features of the musculoskeletal system to determine the effectiveness of rehabilitation measures in gunshot injuries of the shoulder joint. *Scientific Journal of National Pedagogical Dragomanov University*. 2016; (Issue 3K1): 135-138.

SCHOENFELD A.J., DUNN J.C., BADER J.O. et al. The nature and extent of war injuries sustained by combat specialty personnel killed and wounded in Afghanistan and Iraq, 2003-2011. *The journal of trauma and acute care surgery*. 2013; 75 (2): 287-291.

SHESTOPAL N., BALAZH M., KOVELSKA A. et al. The impact of rehabilitation program on quality of people`s life with forearm or hand gunshots using physiotherapy methods. *Journal of Physical Education and Sport*. 2021; 21 (5 Art 347): 2591-2600.

STRAFUN S.S., BORZYKH N.O., KURINNY I.M. et al. Clinical and organizational aspects of firearm injuries of the upper extremities. *Trauma.* 2017; 18 (6): 64-68.

STRAFUN S.S., BORZYKH N.O., TSYM-BALIUK YA.V. Estimation of the treatment efficacy in the wounded persons with the gun–shot polystructural damages of upper extremities. *Klinicheskaia Khirurgiia.* 2018; 85 (7): 62-66.

STRAFUN S.S., BORZYKH N.O., YARMO-LYUK Y.A. et al. Using of controlled negative pressure in the complex treatment of victims with gunshot wounds of extremities. *Klinicheskaia Khirurgiia.* 2017a; (7): 45-47.

TSEMA IE., BESPALENKO A. Analysis of limb amputations during armed conflict at the East of Ukraine. *Norwegian Journal of Development of the International Science.* 2016; (1): 79-80.

WORLD HEALTH ORGANIZATION. International Classification of Functioning, Disability and Health (ICF). *WHO.* [Internet]. 2018. Available from: http://www.who.int/classifications/icf/en/

WORLD MEDICAL ASSOCIATION. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. *JAMA.* 2013; 310 (20): 2191-2194.

YURIEV S., MIKHNYUK O., RODIONOV M. et al. The role and place of applied military sports in the physical training of future officers of the Armed Forces of Ukraine. *Scientific journal National Pedagogical Dragomanov University.* 2021; (Issue 9): 149-152.

ZARUTSKYI YA.L., ZAPOROZHAN V.M. *Military-polova surgery.* Odessa: ONMedU, 2016, 415 p., ISBN 978-966-443-078-1.