Across the globe, the neck pain (NP) afflicts from 26 to 70 % of the adult population during their lifetime. Its treatment involves the use of medical and non-medical methods; however, the evidence base for their effectiveness and safety is currently considered contradictory. The purpose of this article is to summarize the data about the types and principles of various non-pharmacological treatments of the neck pain, their effectiveness and safety, as well as analysis of the latest recommendations for the use of physical methods of the neck pain treatment and discuss the authors’ own experience concerning the effectiveness and safety of some non-pharmacological methods (traction, physical exercises) in the complex treatment of these patients. To achieve this goal, we’ve performed the analysis of reference sources published in the MedLine, EMBASE, Cochrane Library, Scopus, Web of Science, CyberLeninka and Russian Science Citation Index (RSCI) databases during the recent decade; those sources containing the results of modern randomized controlled trials, meta-analyses and recent Cochrane reviews about the efficacy and safety of various non-pharmacological treatments of neck pain. The first part of the article presents our analysis of effectiveness and safety of some methods of physical therapy (ergo-, reflexo-, electro-, mechano-, ultrasound therapies, traction and chiropractic, massage) for the patients with neck pain. Comparisons were made both among the individual methods of neck pain non-pharmacological treatment and between sham and absent treatment. The second part of the article presents data on the efficacy and safety of other methods of physical therapy, modern recommendations for the management of patients with neck pain, and presents the programs of therapeutic physical training developed by the authors especially for the patients belonging to various disease stages. In the first part of the article, our analysis showed that despite the sufficient number of performed studies (for instance, the randomized ones), the extant evidence of its effectiveness and safety is contradictory, due to the low quality of most studies, lack of patient blinding etc. The results of studies differ significantly in terms of their performers, disease stages, patient categories etc. It confirms the need for high-quality large prospective double-blind randomized trials of the efficacy and safety of various physical therapy methods in the treatment of patients with neck pain intended to develop the recommendations for their use. 

Keywords: neck pain; physical therapy; physical rehabilitation; non-pharmacological methods

The NP may originate in various body systems: cartilages, intervertebral discs (or intervertebral fibrocartilages), facet joints, nerves, muscles and vessels, while the key contributing factors are subdivided into the endogenous (age, female sex, genetic and acquired systemic diseases) and the exogenous (injury, lifestyle and bad habits (smoking, alcohol consumption), inadequate ergonomic conditions etc.). At the moment, the NP is classified as to its duration (acute (under 6 weeks), sub-acute (from 6 weeks to 3 months) and chronic (over 3 months)), degree of severity, etiology and type (mechanical, neuropathic and referred pain (for instance, cardiac or vascular pa-
therapy-related pain)). There is also a division into the specific and non-specific NP; specific NP being classified in terms of the presence of severe conditions (injury, vertebral fractures, infectious, oncological and autoimmune conditions (rheumatoid arthritis, ankylosing spondylitis (AS), systemic lupus erythematosus etc.) and neurological symptoms (radiculopathy, spinal stenosis etc.), referred to as “red flags”. The timely evaluation of risk factors, differentiated approaches to the NP prevention, diagnostics and treatment is especially vital for the prognosis [1, 6], enabling the alleviation of principal medical-social outcomes.

At present, the NP treatment presupposes the use of drugs and non-drug treatment (physical therapy) [6]. The latter implies the use of various methods of physical effect, namely based on movement, mechanical, referred action, and influence of various natural factors (heat, light, water, electric energy, ultrasound (US) etc.). The methods of physical therapy (rehabilitation), intended for the treatment of neck pain syndromes, include the wide use of massage, therapeutic physical training, chiropractic, ergo- and psychotherapy. However, despite the large accumulated evidence base on the effectiveness of various physical therapy methods for treating the NP, namely reflected in the numerous Cochrane reviews, at the present time there is no unified approach to the management of those patients. The issue is contended by various specialists (physical therapists, chiropractors, experts in the conservative and alternative medicine) both within their individual fields and as to the management of patients during various stages of disease.

The aim of this study is to summarize the data as to the types, principles of various non-drug NP treatments, their efficacy and safety, analysis of the most recent recommendations as to the use of physical methods of NP treatment and discussion of the authors’ personal experience as to the effectiveness and safety of some non-drug NP treatments (traction therapy, therapeutic exercises) in the complex treatment of this category of patients.

In order to achieve the given aim, we have performed the analysis of reference materials presented in the MedLine, EMBASE, The Cochrane Library, Scopus, Web of Science, CyberLeninka and Russian Science Citation Index databases during the recent decade and based on the results of the modern randomized controlled trial, meta-analyses and the latest Cochrane reviews as to the effectiveness and safety of various non-drug NP treatment.

The first part of the article presents the findings on the effectiveness and safety of some physical therapy methods (ergo-, reflex-, electric, ultrasound therapy, mechanical, traction therapy and chiropractic, massage) used to treat the NP patients. The comparison was made both among the individual non-drug NP treatment methods, with sham or absent therapy.

**Ergotherapy** (occupational therapy, from Greek: εργον — labor and from Greek: θεραπεία — therapy, treatment) refers to the system of rehabilitation methods, intended for the recovery of daily patients’ activities taking into account their physical limitations. Considering the important negative effect of various factors attending the professional activities on the NP progress (for instance, the long compelled body position, neck for instance, use of computer mouse and keyboard, the prolonged stress put on one body part (mostly, the right one) with the scoliotic posture formation etc.), optimization of work-to-rest regimen, which, according to some researchers, is one of the effective approaches to the NP alleviation.

In 2017, one of the recent metaanalyses published [7] explored the effect of various factors, namely the working conditions, on the NP frequency. The review included 20 prospective cohort studies and 2 randomized controlled trials (RCTs), published during the period of 1980–2016. The authors ascertain that the low satisfaction with the working conditions of the job (Relative Risk, RR 1.28; 95 % confidence interval (CI): 1.07-1.55), keyboard position in relation to the body (RR = 1.46; 95 % CI: 1.07-1.99), low variability of the working tasks (RR = 1.27; 95 % CI: 1.08-1.50) and increased muscle strain (medium and high, respectively: RR = 2.75; 95 % CI: 1.60-4.72 and RR = 1.82; 95 % CI: 1.14-2.90) are the reliable risk factors of the NP progress.

In 2018, the Cochrane review was released, analyzing the use of some ergonomic approaches to the optimization of professional activities and prevention of the upper limb and cervical spine diseases in the office staff [8]. The previously published review on the same subject was released in 2012; however, despite the existing studies emphasizing the negative effect of ergonomic violations on the bone-muscular disease risk, there is no clear evidence of positive optimization effect when the workplace arrangement was used to prevent those conditions. The new review included the findings of 15 RCTs (2165 employees); however, most studies were marked by a high risk of systemic mistake, coloring their conclusions. The evidence of medium quality confirmed that the upper limb support by means of an alternative mouse (2 trials) reduces the frequency of cervical spine and shoulder joint conditions (RR = 0.52; 95 % CI: 0.27-0.99), however, not at the level of the upper limb in general (RR = 0.73; 95 % CI 0.32-1.66). The neck and shoulder discomfort alleviation (standardized mean difference (SMD)) -0.41; 95 % CI: from -0.69 to -0.12 and discomfort of the upper right limb alleviation (SMD -0.34; 95 % CI: from -0.63 to -0.06) when the ergonomic conditions were optimized were confirmed by the weak-quality evidence.

Despite the obtained results, the authors also detected the evidence of medium-quality evidence as to the fact that the frequency of pathologies occurring at the level of the neck, shoulder joint and upper light limb did not differ significantly irrespective of the mouse being used: the ordinary or alternative one (2 studies: neck or shoulder joint: RR = 0.62; 95 % CI: 0.19-2.00; the upper right limb: RR = 0.91; 95 % CI: 0.48-1.72), as well as to the comparison of the upper limb support with the ordinary mouse or no support at all (2 studies: neck or shoulder joint: RR = 0.91; 95 % CI: 0.12-6.98; the upper right
Reflexotherapy — a method of physical influence on the active points of the human body by means of special needles (needle reflexotherapy), low-frequency electric current, and laser radiation and objects (metal balls, plates, stones etc.). The therapeutic effect of reflexotherapy is explained by the activation of the human body’s self-recovery mechanisms, realized indirectly through the nerve impulses, generated in the irritated active points and transmitted via the corresponding nerve centers. At present, one of the most widely-used methods of reflexotherapy is the needle reflexotherapy (needle therapy, acupuncture, from Latin: «aacus» — needle and from Latin: «punctura» (puango, pungere) — stick, sting), one of the modes of alternative medicine, widely used in the traditional Chinese practice, which implies the insertion of slender needles into some points on the human body, located on the meridians along which the Chi (Qi) “life energy” is circulating.

The role of acupuncture in treating the pain syndromes has been widely represented in the Cochrane reviews [9-11]. For instance, the Cochrane reviews analyzing the needle reflexotherapy’s effect on the NP treatment were published in 2016 [9, 10]. They analyze the results of 27 RCTs (number of subjects (n) = 5462), among which 3 studies were devoted to the patients afflicted by the acute to chronic pain after the whiplash injury (n = 205), 5 studies — to the patients afflicted by the chronic myofascial pain (n = 186), 5 studies — to the patients afflicted by the arthritis-associated chronic pain, (n = 542), 6 studies — to the patients afflicted by the chronic non-specific NP (n = 4011), 2 studies — to the patients afflicted by pain in combination with the radicular manifestations (n = 43) and 6 studies — to the patients afflicted by the sub-acute or chronic mechanical NP (n = 5111) with a low systemic error risk. The comparison of needle reflexotherapy’s effect on the neck pain syndrome dynamics, functional recovery and life quality was performed both as a sham procedure or no procedure at all. For the patients with mechanical pain, the positive effect of needle reflexotherapy was found in comparison with:

• its imitation (sham) at a mean duration of follow-up (from 3 months to 1 year);

• sham treatment or its absence in terms of pain syndrome degree of intensity at a short duration of follow-up (from 1 day to 3 months);

• sham treatment for disability at a short duration of follow-up (from 1 day to 3 months).

Generally, the findings based on the medium-quality evidence show the needle reflexotherapy’s advantage over the sham treatment (SMD -0.23; 95 % CI: from -0.20 to -0.07; p = 0.0006); however, that was detected during the short-term study rather than the long-term one. The authors have also observed that the needle reflexotherapy is a rather safe method of treatment with minimal side effects, which include the intensified pain syndrome, local edema, light-headedness and fainting. The studies inform us about the absence of life-threatening side effects and report the needle reflexotherapy’s cost-effectiveness. The authors also note that, since their recent survey of this issue, the RCT quality has greatly improved; thus, a risk of bias was rather low, allowing us to formulate the recommendations clearly.

In 2017, there was another Cochrane review published, analyzing the needle reflexotherapy’s effectiveness in neuropathic pain treatment [11], as the latter is often attending the NP. Having explored the present RCTs on the topic, the authors could not find any evidence as to the needle reflexotherapy’s efficacy in this category, though some RCTs confirm that its combination with the drug regimen is more effective for the pain syndrome’s intensity alleviation by the visual analogue scale (VAS; n = 104; SMD -1.02; 95 % CI: from -1.09 to -0.95) and life quality improvement (n = 104; SMD -2.19; 95 % CI: from -2.39 to -1.99) compared to the monotherapy of the drug regimen. The use of needle reflexotherapy did not allow eradicating the pain syndrome completely (the 10-cm VAS indices were 5.8 cm in the needle reflexotherapy group and 6.2 cm in the sham group, where 0 = no pain) and a dubious effect between the groups (studies of a very low quality, n = 45; SMD -0.4; 95 % CI: from -1.83 to 1.03).

As soon as this year, there was another systematic review and metaanalysis printed, studying the needle reflexotherapy’s effectiveness in the patients with a stable regional myofascial head and neck pain [12]. The findings demonstrated the high indices of safety and significant differences (-19.04 points; 95 % S1: from -29.13 to -8.95) as to the intensity of pain syndrome (according to the VAS), compared with the sham procedure or no procedure at all, allowing the authors to make a conclusion that the needle reflexotherapy may be effective and safe for the treatment of myofascial pain in the head and neck region.

Electrotherapy (ET) — a method of occupational therapy based on the electric current or electromagnetic field effect on the human body. This method is grounded in the knowledge that human body is a natural conductor of the charged particles. Numerous physiological processes in the human body (transmission of nervous impulses, transportation of substance via a cellular membrane) are
associated with the occurring difference in potentials and electric current, while the electromagnetic field or electric current may provoke various effects in the human body depending on their force or frequency.

The use of electric current in medicine began from the second half of the 18th century after the invention of the first electric capacitor (Leyden jar) and galvanic element. In the 19th century, Duchenne de Boulogne, considered the “father of electrotherapy”, laid the grounds of the modern methods of direct and alternating low-frequency currents. The further studies confirmed that some substances are able to penetrate the undamaged skin, aided by the electric current. The data promoted the arising electrophoresis (based on the medication’s penetrating the body due to the electric current). After N. Tesla invented the high-frequency transformer, Jacques-Arsène d'Arsonval suggested another method of electric treatment – darsenvalization, while in the 20th century diathermy (the use of high-frequency current of low voltage and great force). At the present moment, the scope of ET methods has widely expanded, though some of them did not demonstrate their effectiveness in the scientific studies and was barely used.

The nature of ET consists in the electric current or electromagnetic field transmission via continuous or intermittent impulses (depending on the method) from the machine’s terminals to the electrodes (through the small metal plates with wet tissue liners), fixed at certain regions of the patient’s body, requiring treatment. At the moment, there are various ET methods, depending on the force and electromagnetic field or current frequency used:

a. direct electric current: galvanization (direct current of low voltage (30-80 V) and low force); electrophoresis;

b. alternating current of low frequency: electrostimulation, electrosleep therapy, electroanesthesia;

c. high-frequency current: local darsenvalization, while in the 20th century diathermy (the use of high-frequency current of low voltage and great force). At the present moment, the scope of ET methods has widely expanded, though some of them did not demonstrate their effectiveness in the scientific studies and was barely used.

d. electromagnetic field of a high frequency: ultra-high-frequency treatment (frequency of 30-300 MHz); microwave therapy (frequency of 300-300,000 MHz); inductothermy (alternating high-frequency magnetic field performing mostly a thermal action. One of the inductothermy’s subtypes is inductopyrexia, which consists in raising the patient’s body temperature to 39° and higher); inductothermy (general darsenvalization, weak impulse high-frequency electromagnetic field application);

e. magnetotherpay (alternating magnetic field’s application);

f. franklinization (electric charges and static electric field of high voltage, medium voltage of 30-50 kV, local application of 10-20 kV).

Nowadays, there is varying evidence on the ET in terms of the frequency. For instance, the use of low-frequency ET based on the direct current of low voltage (limb exposure – 20-30 mA, face and mucous membrane exposure – up to 5 mA) improves the blood circulation and promotes the tissue regeneration while the high-frequency ET (alternating high-frequency current) provokes the vascular spasm, intensifying the blood circulation and reducing the congestion. The impulse ET with a direct current, conducted by the impulses of different voltage and duration, also improves circulation and removes congestion and edema.

The positive effect of direct (the so-called, galvanic) current is mainly realized through the nociceptor suppression. This effect, known as the “gateway of pain”, is the cornerstone of all classical forms of the stimulating ET. Under the physiological conditions and in accordance with the “gateway” theory, the control of nociceptive impulsion passing from the periphery to the brain within the afferent spinal entry is performed by the suppressing substantia gelatinosa neurons, activated by the impulsion from the periphery via thick Aβ and Aδ-type fibers and descending cerebral structures, which are obstructing the nociceptive impulses from the primary afferents to the corresponding neurons. The ET, suppressing the nociceptive activity, increases the pain sensitivity “threshold” and positively affects the pain intensity. The galvanic current may also be used to intensify the effectiveness of local therapy, namely while introducing the medication (ionophoresis), thanks to its pronounced effect promoting the percutaneous ionized substance transportation. Since the ET’s positive effect is limited by the site of electric current exposure; its main indications being the acute radicular pain and inflammation of the peri-articular structures (tendons and ligaments).

At the present time, one of the effective methods of alleviating the pain syndrome, widely used in the clinical practice, is the electrical nerve stimulation (ENS) or transcutaneous electrical nerve stimulation (TENS). According to the recent studies, the alternating or modulated direct electric current (galvanic stimulation) may suppress and slow down the pain-associated potentials, not only on the spinal but also the higher levels; and despite the fact that the galvanic current’s effectiveness is often restricted by the intervention site, some researchers point out that the ENS analgesic effects may be observed at the segmental site, both at the ipsi- and contralateral dimensions. If the high-frequency TENS activates the mechanisms of suppressing the pain mechanism transition in the nervous system due to the electric impulses originating from the electrodes placed over the pain focus blocking the pain signals which enter the brain. This is the reason why the low-frequency TENS stimulates the endorphins production, thus inhibiting the pain naturally.

Another ET method is electric muscle stimulation (EMS); its principal characteristics being similar to the TENS, excluding its intensity which results in an extra muscle contraction. According to the recent studies, the oscillatory muscle stimulation by means of a modulated direct, alternating or interferential currents promotes the articularcartilaginous motion volume expansion, muscle force increase, prevention of atrophic and dystrophic changes.
Another secondary mechanism of positive influence on the muscle pain syndrome is the alleviation of muscle spasm and improvement of blood circulation.

At present, it is well known that the constant, alternating or pulsed electromagnetic fields induce the electric current within the tissue; this effect being the cornerstone of the pulsed electromagnetic field therapy (PEMF)’s effect. The latter is mostly used for the intensified regeneration of various tissues and pain alleviation. Unlike the PEMF, repetitive magnetic stimulation (rMS) is a rather novel neurophysiological method enabling the physician to perform a percutaneous induction of the nerve fibers by the stimulating electric currents. The method implies using extremely powerful and abrupt magnetic impulses (up to 60 impulses per second with a peak current of 15,000 A; field strength of 2.5 T) created by the special coils over the target site. The method gained a wide circulation in the neurology due to its main use: to stimulate the brain function and peripheral nerve system. Nowadays, the rMS’s positive effect was confirmed for the treatment of myofascial pain.

The ET being one of the non-drug methods of NP treatment was often evaluated in the Cochrane reviews of 2005, 2009 and 2013. The most recent review of 2013 [13] included the findings of 20 RCTs recruiting 1239 NP patients and using various ET regimens (short or long ones) in order to study its influence on pain, functioning, disability, satisfaction with treatment and life quality of the NP patients with/out radiculopathy and with cervicogenic headaches. The authors reported that most of the analyzed RCTs had a high systemic error risk; however, the existing evidence demonstrate a certain positive effect from the pulsed electromagnetic field therapy (PEMF), repetitive magnetic stimulation (rMS) and transcutaneous electrical nerve stimulation (TENS) compared with placebo in the chronic NP patients. Other studies with a high systemic error risk revealed that the continuous magnetic influence (beads worn by the patient on the neck), modulated galvanic current, ionophoresis and EMS are no more effective than placebo.

According to the expert opinion, patients with an acute neck pain syndrome subjected to the TENS experience a likely relief, which is greater than in the case of EMS, though not in the case of therapeutic physical training and infrared radiation, chiropractic and ultrasound treatment. There was no confirmed positive effect of the TENS when the latter was combined with the infrared radiation, thermal care, and therapeutic physical training or combined with the cervical collar, physical exercises and painkillers. The use of ionophoresis is as effective as no treatment at all, intercurrent current or a combination of traction therapy, physical exercises and massage as far as the treatment of acute NP was concerned.

In case of the myofascial neck pain, the TENS, frequency Modulated Neural Stimulation (FREMS), which is a subtype of the TENS, and repetitive magnetic stimulation (rMS) reduce the pain intensity to a greater extent than placebo.

The studies of the ET effect on the functioning, disability, satisfaction with treatment and life quality of the NP patients (n = 4) did not enable the authors to make any definite conclusions or offer their recommendations. The studies did not reveal any side effects of the ET.

In 2019, there was another Cochrane review published on the TENS’ efficacy as a monotherapy or in combination with other methods of treating the chronic NP [15]. The analysis was based on 7 RCTs recruiting 651 subjects (aged 31.7-55.5 years on average) and being held in three different countries (Turkey, Jordan, China) and lasting from a week to 6 months. Most studies deal with the constant TENS regimen with a frequency of 60-100 Hz, impulse width of 40-250 µс and intensity described as a nice tingling sensation with a slight spasm, prescribed in the daily sessions of 20-60 minutes. Despite the high risk of systemic error, the authors recognize a positive TENS influence on neck pain syndrome’s intensity (VAS indices: SMD -0.10; 95 % CI: -0.97 to 0.77) and the increased ratio of subjects who reported a pain intensity reduction (1.57, 95 % CI 0.84 – 2.92) compared with the sham treatment; there were no side effects and undesirable phenomena associated with that method. Despite the data obtained, the authors made a conclusion that there was not enough evidence supporting the efficacy of that chronic NP treatment method, requiring further well-organized RCTs.

Ultrasound therapy consists in treatment by means of 20,000 Hz waves, which was imperceptible to the human ear. Nowadays, some, but not every scientist confirm its inflammatory, analgesic and spasmylytic effect, explaining the ultrasound therapy indication to treat the NP. The positive therapeutic effect of ultrasound may be explained by the mechanical, thermal and physical-chemical effects resulting in the pronounced changes occurring in the tissues and cells, namely the microvibrations affecting the cellular functional state, permeability of tissues, acid-alkaline balance etc. The ultrasound’s thermal effect intensifies the biochemical processes in the tissues, expands the blood and lymph vessels, thus improving the microcirculation. The ultrasound also activates a number of enzymes, intensifies the tissue oxide-reducing processes, increases the mitotic cellular activity associated with the biologically-active substance secretion (histamine, serotonin etc.).

There are various frequencies (high, medium and low-power ultrasound) and regimen of ultrasound — continuous transmission or pulsed transmission (performed with certain pauses), direct (affecting only the relevant site) transmission or indirect (via nerve fibers and blood vessels) transmission etc. The clinical practice involves phono­phoresis (from Greek: φωνή – «sound» + φόρεω – «I carry») or sonophoresis (from English: «sound» – a combined method of treatment including both the ultrasound and medication applied directly to the site of ultrasound action.

There was a recent systemic review [14] on the ultrasound efficacy in the NP treatment. The authors con-
ducted their search in PubMed and Cochrane Library and selected 5 RCTs (average number of patients varying from 26 to 102, and the NP duration varying from 3 to 6 months); however, no data was found confirming the significant positive ultrasound effect in the NP patients following their treatment. Out of all the RCTs analyzed, the two trials did not report any positive ultrasound effect compared with the sham treatment; however, one of the studies demonstrated its ability to diminish the pain syndrome intensity, though with no extra advantage compared with the injections into the trigger points. The authors point out that the ultrasound’s effect may be associated with its frequency (use of various ultrasound power), influencing the treatment’s outcomes. Thus, there is little evidence as to the ultrasound efficacy at the moment, requiring other great randomized prospect studies of its therapeutic value.

Mechanotherapy (from Greek: «mechano» — mechanism + Greek «θεραπεία» — therapy, treatment) — method of physical therapy, implying some moves (exercises) and use of certain equipment (exercise machine etc.). According to many researchers, mechanotherapy may be used as an independent method of the NP treatment, or in combination with physical rehabilitation, namely therapeutic physical training, massage and other methods. This therapy improves the mobility of the joints, some muscles and their groups, prevents the atrophic and degenerative processes affecting them, and normalizes the functional activity of the human body. In terms of individual demands, mechanotherapy involves the machines for the patient’s individual performing of active or passive moves either under control or involving the outside assistance (mechanisms or another person).

One of the mechanotherapy’s subtype is the traction therapy (TT, extension, from Latin: «tractus» — extension + Greek: «θεραπεία» — treatment). At present, the TT is used for the complex NP treatment, though may be used as an independent method [16]. According to the questionnaire, 4,000 physiotherapists employed by the US orthopedic departments, when asked about the TT role in the NP treatment, answered that 76.6 % were using the TT in their practice, and 93.1 % would be using the TT in combination with other methods of non-drug treatment, or in combination with physical rehabilitation, namely therapeutic physical training, massage and other methods. This therapy improves the mobility of the joints, some muscles and their groups, prevents the atrophic and degenerative processes affecting them, and normalizes the functional activity of the human body. In terms of individual demands, mechanotherapy involves the machines for the patient’s individual performing of active or passive moves either under control or involving the outside assistance (mechanisms or another person).

To treat the neck pain syndrome, the physicians tend to apply the following TT methods according to the patient’s body position:

a. vertical: in a sitting position, with Glisson loop weighted by the leads at the loop’s free end;

b. horizontal: in a lying position on a slanting bed (lower limbs higher than the head), head immobilized. The neck traction is performed by the body’s own weight or by means of leads of various weight. The traction may last for some time (non-stop or static traction) or repeat itself periodically with a set period of treatment time (cycle +/-).

Depending on the TT mechanism, there are manual, semi-manual and automatic TTs. Recently there are automatic systems of neck traction with electronic operating blocks, intended to set the regulated dynamic loading with “traction-relax” cycles and also to develop the customized programs for the individual patients. There are also “dry” and underwater TTs, the latter implying the patient’s staying in the swimming pool or baths. The positive effect of underwater traction is explained by the combined effect of mechanical and thermal factors (warm water promotes an additional relaxation of the muscle spasms, diminishment of edema and pain). Depending on the TT performer, there are auto- and heterotractions (patient or another person), and depending on the rhythm, — non-stop (constant) and intermittent (cyclic) tractions [16].

According to the experts, there are few side effects of TT, as usual; however, they may include the headache, nausea, fainting and injury of the adjacent tissues.

Some, though not all, X-ray studies demonstrate that at the moment of traction the intervertebral space may grow by 1-2 mm, while the vertical size of intervertebral foraments may grow by 0.2-0.6 mm which may be attributed to the stretching of injured spinal motion segment’s spasmmed muscles [16]. The pressure reduction in the intervertebral disc favors the diminished compression at the level of anterior internal vertebral venous plexuses and posterior longitudinal ligament, resulting in a reduced venous and cerebrospinal fluid congestion, edema at the place of root exiting from the spinal canal and at the place of intervertebral ligaments and improved circulation and metabolism in the adjacent structures. Furthermore, the TT use eradicates the intervertebral articular subluxation and reduces the muscle contracture in the damaged spinal motion segment.

The efficacy of mechanical traction for the NP with/ out radiculopathy treatment is evaluated in the Cochrane review analyzing the RCT findings in the medical, chiropractic and paramedical sources [18]. The mechanical traction is used as an independent method or in combination with other treatment methods and compared against placebo or other interventions. The evaluating criteria include the pain, disability, overall effect, patient satisfaction with treatment and life quality. Out of 7 selected RCTs (the total number of subjects is 958), only one (n = 100) had a low risk of systemic error. This study did not confirm any significant discrepancies in the effect (SMD = 0.16; 95 % CI: from -0.59 to 0.27) of static traction and its sham version (placebo) in order to reduce the pain intensity or to improve the functioning of NP patients suffering from the radicular symptoms. The comparison RCTs of mechanical traction’s efficacy against other treatment methods did not reveal any significant differences with non-steroid anti-inflammatory drug treatment (NSAIDs, naproxen, 250 mg) (SMD = -0.26; 95 % CI: from -0.54 to
In terms of NP intensity relief and with chiropractic (RR = 0.33; 95 % CI: 0.08-1.32) in terms of overall effect. In addition, the RCTs recruiting 536 subjects with/without radicular symptoms demonstrated that the effect of mechanical traction is significantly lower than the one of needle reflexotherapy (RR = 4.31; 95 % CI: 2.93-6.34). It is confirmed that the mechanical traction has no advantage over other non-drug methods of chronic NP treatment, namely chiropractic and thermal care.

The authors made a conclusion that at the moment there is no evidence as to the advantage of cyclic or non-stop mechanical traction in reducing the pain syndrome intensity, improving the functioning or the overall condition of patients compared with the sham traction (placebo), drug treatment or other conservative therapies of chronic NP.

A decade after the publication of this analysis, there appeared another systemic review with a metaanalysis [19] on the TT role as an independent method or in combination with other methods to treat the NP patients with radiculopathies, analyzing the RCT data on the pain syndrome dynamics and disability. Unlike the previous data, the systemic review contained the evidence of moderate positive effect on the pain intensity in the short to medium term follow-ups (g = -0.85; 95 % CI: from -1.63 to -0.06) and g = -1.17; 95 % CI: from -2.25 to -0.10, respectively) and disability in the medium term follow-up (g = -1.05; 95 % CI: from -1.81 to -0.28). There was also revealed a positive TT influence on the NP indices in the short-term follow-up (g = -0.85; 95 % CI: from -1.39 to -0.30).

The TT efficacy in the complex treatment of patients with cervical degenerative disease and vegetative disturbances was studied by our Department since the beginning of last decade [20]. It was revealed that the patients with neuro-reflectory manifestations are characterized by the preponderance of sympathetic autonomic activity, which has a significant influence on the TT efficacy. The authors suggested a differentiated treatment approach based on the combined TT and drug treatment along with the venotoxic agents depending on the functional condition of the autonomic nervous system, cerebral hemodynamic indices, age and sex.

**Massage** (from French: «masser» – to rub down and from Arabic: «mass» – to touch) – a complex of mechanical and reflectory procedures, performed at the human body surface by means of rubbing, stroking, pressing or vibrating. Nowadays, there are many well-known techniques made by the human hands or various special devices in the air, water and other media. The regulated mechanical irritation conditioned by the procedure promotes relaxation or stimulation of skeletal muscles, reduction of muscle spasm, improved circulation and diminished venous congestion.

For a long time, there were various massage techniques being used to treat the NP. In 2012, the published Cochrane review delved into the massage’s influence on pain, functioning, overall effect, as well as patient satisfaction, side effects and disease costs for the NP patients compared with other treatment methods, either directly after their use or under a long-term follow-up [21]. The detailed analysis of reference sources prompted the authors to select 15 RCTs, though all of them had a rather high risk of systemic error. Most studies were evaluating the effect directly following the treatment regimen rather than the long-term consequences. Furthermore, only 4 out of 15 studies thoroughly explored the massage techniques. The findings demonstrated that some massage techniques (traditional Chinese massage, classical and modified technique of muscle strain under the masseur’s hands) were more effective for the improved functioning and reduced muscle strain compared with the control or sham treatment (placebo). According to the review’s authors, massage may be more effective compared with the instructive programs on the short-term (acute) pain syndrome. The compression techniques and passive muscle stretching were more effective for the diminished neck pain intensity on condition of their combined used compared with one individual method. The comparison of massage against other non-drug methods of the NP treatment (thermal procedures, therapeutic physical training, needle reflexotherapy, chiropractic and instructive programs) did not reveal its extra advantage. Only 5 out of 15 studies reported the side effects, namely pain or discomfort after the procedures. The overall depreciation of the patient condition was noted among the side effects of only one study. Furthermore, one study informed about the reduced arterial pressure in 22 % patients after the treatment.

The authors claimed that despite the confirmed positive short-term massage’s influence on the neck pain syndrome intensity they could not make any conclusive decision or recommendation as to the practical implementation, due to the limitation of the studies’ quality. Further trials are required to evaluate the long-term implications.

The **manual therapy (MT)** (from Latin: ‹manus› – hand and Greek: «θεραπεία» – therapy, treatment) – one of the non-drug treatment methods, realized by the biomechanical influence of the performer’s touch on the damaged tissues of bone-muscular system (manipulation therapy), internal organs (visceral osteopathy) and head (craniosacral therapy).

The traditional MT methods are:
- **Manipulation technique** (ManT) employing the short and rather weak impact-producing movements intended to regenerate the articular mobility or shift some spinal elements in the direction of its natural anatomic condition;
- **Mobilization technique** (MobT) employing a series of moves intended to stretch the vertebrae in a soft manner, as well as to increase the articular mobility by the rhythmic moves repeating the physiological motion scope;
- **Soft technique** (SoT) characterized by the absence of abrupt moves and passive muscle strain with their fur-
ther relaxation, repeated alternatively and intended to reduce the muscle tone. This MT technique involves the post-isometric relaxation (PIR), based on the increased muscle tone reduction, developing after a short-term muscle strain. The method implies a 2-phase action: first a short-term (6-10 sec.) low-intensity isometric muscle strain attended by the patient’s breathing retention, followed by a passive muscle stretching by the performer.

The manual therapy differs from other hand-using methods, such as a massage, to a dramatic extent in terms of its approaches and strength dose. The masseur is usually “working” the soft tissues, while the manual therapist is working the joints, intervertebral disks, tendons and ligaments, internal organs.

The efficacy of various MT techniques in the NP treatment was evaluated numerous times by the Cochrane reviews of 2004, 2010. The latest review of 2015 [22] analyzed the results of 51 studies (2920 subjects, 18 RCTs on ManT MT/ MobT MT compared to the controls; 34 studies on ManT MT/ MobT MT efficacy compared to other treatment methods and 1 study including both comparisons). Having compared them, the authors made the following results:

1. **ManT MT on the cervical spine level compared with no treatment.** For the patients with a sub-acute or chronic NP, the one-time MT manipulation results in the reduced pain syndrome directly after the procedure (during 1 day), though not in a short-term follow-up (from 1 day to 3 months). The conclusion was based on the results of 3 low- and very low-quality studies (n = 154).

2. **ManT MT on the cervical spine level compared with other treatment methods:**
   a. for patients with an acute or chronic NP, the prescribed ManT regimen results in the similar pain syndrome alterations, functional abilities, life quality (QoL), overall effect and patient satisfaction indices both with ManT MT sessions directly after the completion of treatment (during 1 day) or with a short-term (up to 3 months) and medium-term (from 3 months to 1 year) follow-up. The analysis was based on the results of 2 studies from medium to high quality (n = 446).
   b. for patients with an acute or sub-acute NP, the numerous ManT MT sessions are more effective than some other medications in the reduction of pain syndrome intensity and improvement of functioning directly (during 1 day) after treatment (1 study of a moderate quality, n = 182) and on condition of a long-term (more than 1 year) follow-up (1 study of a moderate quality, n = 181). Similar results were obtained in terms of patient functioning improvement in the medium-term follow-up (1 study of a moderate quality, n = 182).
   c. for patients with a chronic NP, the numerous ManT MT sessions (2 studies of a low quality, n = 125) may be more effective than a massage regimen in the reduction of pain syndrome intensity and improvement of functioning in the short- and medium-term follow-up. The numerous ManT MT sessions are more effective than TENS (1 study of a very low quality, n = 65) in the reduction of pain syndrome intensity during the short-term follow-up.
   d. for patients with an acute NP, the numerous ManT MT sessions at the neck level may be more effective than ManT MT sessions at the chest level (1 study of a very low quality, n = 20) in the reduction of pain syndrome intensity and improvement of functioning during the short- and medium-term follow-up.

3. **ManT MT on the thoracic spine level compared with no treatment.** Three studies (n = 150) explored the effectiveness of one MT manipulation session directly after its completion and during the short- and medium-term follow-up. During the short-term follow-up, the MT manipulation performed on the thoracic spine results in the reduction of pain syndrome intensity in subjects with an acute or sub-acute NP (5 studies of a medium quality, n = 346): the measure of effect (SMD): -1.26; 95 % CI: from -2.24 to -0.55) in subjects with an acute or chronic NP. Similar results were obtained in terms of positive dynamics of pain indices, functioning and patient life quality during the medium-term follow-up (from 3 months to 1 year; one study of a low quality, n = 111).

4. **ManT MT on the thoracic spine level compared with other treatment methods.** No analyzed study reveals the data required to formulate any conclusions. For the patients with a chronic NP, one ManT MT session was comparable in terms of its effect with MobT MT (1 study, n = 100) in the reduction of neck pain syndrome intensity evaluated directly after the manipulation.

5. **MobT MT compared with no treatment.** The MobT MT as an independent intervention (2 studies of a low and very low quality, n = 57) did not reduce the NP intensity to a greater extent than no treatment.

6. **MobT MT compared with other treatment methods:**
   a. for patients with an acute or sub-acute NP, the anterior-posterior MobT MT (1 study of a very low quality, n = 95) may be more effective in the reduction of neck pain syndrome intensity compared with other MobT MT techniques directly after the treatment (during one day).
   b. for patients with a chronic NP and temporomandibular joint (TMJ) dysfunction, the numerous MT sessions in TMJ treatment (1 study of a very low quality, n = 38) may be more effective than the cervical MobT MT in the reduction of neck pain syndrome intensity and improvement of functioning directly after the treatment (during one day) and on condition of a medium-term follow-up.
   c. for patients with a sub-acute and chronic NP, the cervical MobT MT as a monotherapy has an efficacy which does not differ from the ultrasound therapy, TENS, needle reflexotherapy and massage (4 studies from a low to very low quality, n = 165) in terms of pain syndrome dynamics, functioning, life quality and patient satisfaction with treatment results both on the treatment completion and during the medium-term follow-up. Furthermore, the use of laser therapy combined with MT may be
more effective than the separate use of those methods (1 study of a very low quality, n = 56).

To sum up the results, the authors indicate that for subjects with an acute or sub-acute neck pain syndrome a separate MT manipulation at the thoracic level results in a short-term reduction of pain syndrome intensity, while for subjects with an acute or chronic pain the functional capacities improve compared with the control. The significant distinctions of various MT techniques (MobT MT or ManT MT) in terms of their efficacy while being evaluated during various follow-up terms (directly after the procedure and during the short- and medium-term follow-up) were not explored. For the patients with acute or sub-acute neck pain syndrome the ManT MT regimen at the cervical level results in a more pronounced reduction of pain syndrome and improvement of functional capacities than the use of some medications (various NSAIDs, analgesics, opioids and muscle relaxants combinations) both after the manipulation's completion and during the medium- and long-term follow-up. However, one should stress that the use of this method requires a high professionalism of the performer, since the inadequate manipulations at the cervical level may lead to the severe side effects (blood circulation disorders due to the vertebral artery's injury).

Thus, our analysis of the reference sources on the efficacy and safety of various therapeutic physical trainings in the NP treatment confirmed that despite the few performed, namely randomized, trials, at present the evidence as to their efficacy and safety are considered dubious due to the low quality of most trials, lack of blinding etc. The results vary significantly depending on their performers, duration of the disease, categories of patients etc. Those facts prove the necessity of high-quality large prospective double-blind randomized trials on the efficacy and safety of various therapeutic physical trainings in the NP treatment in order to develop recommendations as to their use.

Conflicts of interests. Authors declare the absence of any conflicts of interests and their own financial interest that might be construed to influence the results or interpretation of their manuscript.

Information of each author’s individual contribution:
N. Grygorieva – concept and design of the study, writing the paper; V. Povoroznyuk – analysis of the obtained material, editing the paper; S. Nemerska – editing the paper.

References
Біль у шиї: сучасні підходи до використання методів немедикаментозного лікування. Частина I

Резюме. Біль у шиї вражає від 26 до 70 % дорослого населення планети протягом життя. Його лікування передбачає використання медикаментозних та немедикаментозних методів, проте доказів база щодо ефективності й безпечноності останніх на сьогодні суперечлива. Метою цієї статті є узагальнення даних щодо видів, принципів дії різних методів немедикаментозного лікування болю в шиї, їх ефективності та безпечноності, аналізу останніх рекомендацій щодо використання фізичних методів лікування болю в шиї та обговорення власного досвіду авторів щодо ефективності й безпечноності деяких немедикаментозних методів. На основі цього аналізу, автори пропонують комплекси немедикаментозного лікування для хворих у різні періоди захворювання. Повернувшись до використання фізичних методів, автори відзначають їх ефективність при веденні хворих з інтенсивними відносно терапевтично активними симптомами, зокрема, при більшості хворих, що потребують індивідуальної програми фізичної терапії.

Ключові слова: біль у шиї; фізична терапія; фізична реабілітація; немедикаментозні методи
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Боль в шее: современные подходы к использованию методов немедикаментозного лечения. Часть I

Резюме. Боль в шее поражает от 26 до 70 % взрослого населения планеты в течение жизни. Ее лечение предусматривает использование медикаментозных и немедикаментозных методов, однако доказательная база относительно эффективности и безопасности последних на сегодняшний день противоречива. Целью этой статьи является обобщение данных относительно видов, принципов действия различных методов немедикаментозного лечения боли в шее, их эффективности и безопасности, последних рекомендаций по использованию физических методов лечения боли в шее и обсуждение собственного опыта авторов относительно эффективности и безопасности некоторых немедикаментозных методов (тракционная терапия, лечебная гимнастика) в комплексном лечении больных данной категории. Для достижения цели проведен анализ литературных источников в базах данных MedLine, EMBASE, The Cochrane Library, Scopus, Web of Science, CyberLeninka и РИНЦ за последние 10 лет, содержащих результаты современных рандомизированных контролируемых исследований, метаанализов и последних кокрановских обзоров относительно эффективности и безопасности использования различных методов немедикаментозного лечения боли в шее. В первой части статьи представлены результаты анализа относительно эффективности и безопасности некоторых методов физической терапии (эрготерапии, рефлексотерапии, электро-, ультразвуковой терапии, механотерапии, тракционной и мануальной терапии, массажа) в лечении пациентов с болью в шее. Сравнение проводили как между отдельными методиками физической терапии боли в шее, так и с ее имитацией или отсутствием терапии. Во второй части статьи представлены данные относительно эффективности и безопасности других методов физической терапии, современные рекомендации по ведению пациентов с болью в шее и разработанные авторами комплексы лечебной гимнастики для использования в разные периоды заболевания. Проведенный нами анализ в первой части статьи показал, что, несмотря на достаточное количество выполненных, в том числе рандомизированных исследований, на сегодняшний день доказательства ее эффективности и безопасности подлежат сомнениям в связи с низким качеством большинства проведенных исследований, отсутствием их ослепления и др. Результаты исследований значительно отличаются в зависимости от их исполнителей, периода заболевания, категории больных и др. Все это доказывает необходимость проведения высококачественных крупных проспективных двойных слепых рандомизированных исследований относительно эффективности и безопасности различных методов физической терапии в лечении пациентов с болью в шее для разработки рекомендаций относительно их использования.

Ключевые слова: боль в шее; физическая терапия; физическая реабилитация; немедикаментозные методы