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The Effectiveness of the Therapeutic Ultrasound on the Psycho-Physiological Functioning in Patients who Presented with Neck Pain

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A B S T R A C T

The aim of this study was to investigate the effectiveness of the therapeutic ultrasound on the psycho-physiological functioning in patients who presented with neck pain. There is a limited number of scientific studies which provide information on clinical effectiveness of the therapeutic ultrasound and its effect on the psycho-physiological functions. The present study investigated 100 patients (average age 55), 69 females and 31 males, who presented with neck pain. Treatment protocol consisted of 15 treatments spread over three weeks (five treatments per week). Patients were separated into the two groups (test and control). Both groups of patients undertook programed isometric exercises specific for the cervical spine as well as transcutaneous electrical stimulation. The test group received continuous therapeutic ultrasound on the neck five times a day with the intensity of 0.5 w/cm^2, while in the control group ultrasound machine was switched off during the therapy. It has been found that programed isometric exercises specific for the cervical spine in combination with transcutaneous electrical nerve stimulation (TENS) had the same therapeutic effect on the psycho-physiological functioning as the combination of these two therapies with the therapeutic ultrasound.

***Key words**: neck pain, transcutaneous electrical nerve stimulation (TENS), isometric exercises, therapeutic ultrasound, psycho-physiological functions, placebo effect*

Introduction

Neck pain is one of the most common health problems and one of the major reasons for sick leave among the working population. Nearly one third of the general population experience neck pain during the lifetime[1,2] with the highest prevalence in the middle age group. Neck pain combined with the severe physical impairment affect between 1.7% and 11.6 % of the general population.

In a general practice survey of adults in the United Kingdom (UK), 25% of women and 20% of men reported current neck pain[3]. In a Norwegian survey of 10000 adults, 34% of responders had experienced neck pain in the previous year[4]. A UK survey of 7669 adults found that 18% had neck pain at the time of the survey, and half of those (58% of the symptomatic patients responded) still had pain when asked one year later[5].

After back pain, neck pain is the most frequent musculoskeletal cause of consultation in primary care worldwide. In the UK about 15% of hospital based physiotherapy and in Canada 30% of chiropractic referrals are for neck pain[6,7]. In some industries, neck related disorders account for as much time off work as low back pain[8]. Every year between 11 and 14.1% of active population experience reduced working capacity due to neck problems regardless of the type of work they do. Neck problems seem to be most common in older people, females, smokers, people with previous pain experience, emotional and social difficulties, unsatisfactory employment status, poor ergonomic postures and repetitive movements at work place[9,10]. Unfortunately, there is a little evidence that modification of the work place and improved posture re-

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duce incidence of neck pain[10,11]. Some studies describe connection between neck pain and anxiety, depression, stiffness and physical activity[12].

Etiology of neck pain is poorly understood and it is believed that it involves several factors[13]. Vast majority of neck pain experiences do not have an obvious origin, and it is assumed that mechanical factors are the most important reason for neck pain. The fact that the etiology of neck pain is unspecified, justifies uncertain results of the applied therapy. Most likely the main predispositions for neck pain are the modern life style, sedentary jobs and inadequate body posture. However, apart from the degenerative changes on the intervertebral joints and discs which can also occur in low back pain, other factors such as extensive muscular, ligament and tendon strain, injuries, congenital vertebral malformations[12], inflammatory rheumatic diseases, infectious diseases (acute and chronic), tumors (benign and malignant), metabolic conditions (osteoporosis), psychological factors, migrated pain due to affected internal organs (pharynx, larynx, thyroid gland, aorta, heart, diaphragm, trachea) or upper limbs. Neck pain after whiplash injury also fits into this category, provided no bony injury or neurological deficit is present[14].

Immediate proximity and the direct contact of the musculoskeletal sections in the neck with the neurovascular structures and the specific nature of its anatomy are the main reason for the variety of symptoms that arise in that region. Depending on the affected anatomical structure, we can talk about cervical, cervicocephalic, cervicobrachial syndrome or cervical myopathy.

Clinical symptoms of the cervical syndrome involve pain in the posterior and the paramedian muscles, usually in the middle section of the cervical spine, increased muscular tension and limited movement to one or more directions. This can be accompanied by local burning sensations and muscle tenderness that arises from trigger points. Pain can also occur in other surrounding anatomical structures such as the collar bone and the shoulder blade. Pain is the leading symptom of the vertebral syndrome and the main cause of the muscular spasm which results in a reduced functional status of the cervical spine. In addition, muscular hyper tonus lowers pH of the surrounding environment which causes increased sensitivity of the nociceptors and in return increase sensitivity to pain. Cervical vertebral arteries smooth musclues are often affected by the same changes which results in reduced blood circulation[15].

When pain becomes chronic it is difficult to predict the outcome[13]. Three recent studies completed on 1535 patients[5,16,17] found that the best predictors of an unfavorable outcome one year after presentation with neck pain were severity of the initial pain and concomitant back pain. At least 10% of affected people develop chronic neck pain[1]. Neck pain causes severe disability in 5% of affected people[2].

Nearly always mechanical neck pain responds to conservative therapy, but the optimal treatment for neck pain is yet to be established. There is a small number of scientific studies which describe effectiveness of the standard therapeutic measures used in treating neck pan in clinical practice[18]. Only few treatments have been assessed in high quality randomized studies.

The most commonly used treatments for neck pan include analgesics, anti-inflammatory agents, tricyclic antidepressants, strategies to improve posture, and stress management. Other modalities like acupuncture, traction, electrotherapy, and psychotherapy are of uncertain value and need further study[19].

The most essential therapeutic approach to neck pain includes reduction of pain which is also a prerequisite for an active physiotherapeutic intervention. The principal medications used for neck pain are analgesics and nonsteroidal anti-inflammatory drugs. Low doses of tricyclic antidepressants such as amitriptilin 10–30 mg at night are also beneficial. Muscle relaxants are as effective as placebo with common side effects such as drowses[20.]

Therapeutic Ultrasound (US) is a noninvasive, painless physical-therapeutic method used to reduce pain and muscle spasm and improve blood circulation. It is the most commonly used thermo-therapeutic method[21]. The therapeutic frequencies of the ultrasound are between 0.5 and 5 MHz, with the most common frequency of 1MHz[22.] A 1MHz ultrasound will penetrate about 3–5 cm below the skin whereas a 3MHz ultrasound unit will only penetrate about 1–2 cm and as such is used in treating skin surface lesions[23,24].

Transcutaneous electrical nerve stimulation (TENS) is currently one of the most commonly used forms of electroanalgesia[25]. It is indicated to treat all sorts of pain, acute and chronic[25]. TENS device is a small, battery operated unit consisted of two or four silicone self-adhesive electrodes, covered by conductive gel, cable connected with the stimulator. Electrodes are positioned at the point of the most intense pain[26]. TENS devices produce different number of impulses (frequency), the im , and intensity. Some TENS units offer modulation, which allows the frequency, duration, and intensity to be intermittently changed, which allows different groups of nerve fibers to be stimulated. The frequencies used in pain therapy are in the range of 1 to 150 Hz, impulse duration is between 0.04 and 0.3 ms and the electrical current between 0 and 6 mA.

It has been demonstrated that TENS also has a beneficial effect on the lower back pain and the reduced consumption of analgesics[27–29]. Two clinical studies presented clinically and statistically significant reduction in pain intensity immediately after the application of the high frequency TENS[30,31].

It is well documented that the muscular system plays an important role in stabilizing the joints. In view of the fact that the spine is consisted of small joints (zygapophysial joints), medical gymnastic is a key element in preventing spinal disorders. Deep neck muscles have an important role in stabilizing cervical spine. Scientific studies have shown that hypotrophy of the neck muscles is in strong correlation with neck pain[32]. Several ran-

domized controlled studies confirmed moderate benefit of different types of kinesiotherapy, such as proprioceptive exercises, strength exercises, endurance exercises, coordination exercises[33–37]. These types of kinesiotherapy were more effective than analgesics, nonsteroidal anti-inflammatory drugs or myorelaxants[38,39], like methods for stress control[40,41].

Therapeutic ultrasound has been studied and applied in clinical practice for a long time[42]. Although it has been used in a wide range of clinical conditions from skin lesions to malignant tumours, there is a lack of evidence about its clinical effectiveness based on established physiological mechanisms[43,44].

Application of the therapeutic ultrasound in neck pain has not been extensively studied. It would be of great benefit to further investigate its therapeutic effect on neck pain and investigate possible mechanisms to reduce pain and improve psycho-physiological of the patients.

Materials and Methods

Testing was conducted on 100 consecutive patients from the outpatient clinic of Department of Rheumatology, Physical Medicine and Rehabilitation of »Sestre milosrdnice« University Hospital Centre in Zagreb during one year (February 2010 – February 2011). Criteria for inclusion of patients in the study were: malignancies in the past five years, except non-malignant tumours, non-infectious and infectious inflammation (acute or chronic), including inflammatory rheumatic diseases, fever of any etiology, severe forms of metabolic disease (diabetes, thyroid disease etc.), a serious disease of the cardiovascular system, the more serious cases of the neurological diseases and conditions (eg. Multiple sclerosis, cerebrovascular accident (insult), more serious mental illnesses and conditions, fresh (recent) trauma of the neck (back 3 months before testing), metallic foreign body in the neck or near the cervical region, pacemaker heart, pregnancy, patients in whom the last 3 month of physical therapy applied in the area of the cervical region.

Participants were not allowed to participate in other clinical studies and the identity of participant is protected. The study was conducted in accordance with the principles of good clinical practise (Ministry of Health and Social Welfare Republic of Croatia, Regulations on clinical trials and good clinical practice, of Official Gazette 2007 and the Helsinki Declaration on ethical preferences of medical research on humans (review in October 2008)[45]. Each subject (participant) signed an informed consent prior the first examination. They were folowed by clinical examinations and responded to specific questionnaire.

The questionnaire included general demographic data, test data from a disability due to pain in the neck, which includes some information regarding the psycho-physiological functioning of patients such as ability to read, to concentrate, to work, to drive, to sleep as well as the degree of pain at rest and in motion. Global ratings of patients pain and pain ratings of subjects by examiner was evaluated using a horizontal visual analogue scale (VAS)100 mm long, with the left endpoint, there is a mark without pain, and the right of the strongest possible pain[46–48].

Assessment of degree of muscle tension of paravertebral muscles (measured) by manual palpation

By method or way of manual palpation, examiner graded the degree of muscle tension (or spasm) of paravertebral muscles in cervical region, and is marked with a 0 if there is no tension, while the existence of tensions were graded with 1 to 3 plus[49–50]. Researcher palpated all available paravertebral muscles of the region, particulary the m. trapezius, which is the most superficial muscle covering the back of the neck, from his point of departure from the medial superior linnea nuchae with protuberation occipitalis externa, with the ligament nuchae with torn like extensions of the seventh cervical vertebra, along the direction of muscle or the insertion of the lateral third of the rear edge of the clavicle, the upper surface of the acromion and the rear edge of the blades at the withers. Then m. sternocleidomastoideus was palpated from left and right sides of the neck from insertion of the mastoid extension, along the thread of muscle fibres to connect to clavicle.

The application of therapeutic ultrasound

After collecting the data outlined earlier 100 respondents (participants) were classified in the study (test) (50) and control (50) group study group received a continuos therapeutic ultrasound applications in the paravertebral area of the cervical region by mobile technique, while the patient was sitting. Physioterapist moved ultrasound probe (transducer head) at a speed of about 4 cm/sec, a tilt of the ultrasound head was maximum 7 degrees[51]. Moveable ultrasound applicator head size of 5 cm and have been carried rotational movement in one direction, thus achieving a uniform distribution of ultrasound energy through tissues. Intensity of ultrasound energy was 0,5 W/cm^2, 1 MHz frequency, and duration of application 5 minutes. Between the ultrasound head and participants skin commercial contact gel has been applied to prevent the dispersion of ultrasound energy. Therapeutic ultrasound machine (apparatus) that has been used is Sonoplus 492 Enraf Nonius. For the control group, the procedure was identical, except that machine is switched off, thus ultrasound energy was not transmitted. The process is being conducted in both groups once daily for 15 days (3 weeks, with breaks during Saturday and Sunday).

Application of transcutaneous electrical nerve stimulation (TENS)

In both groups of participants (control and studied) was then applied transcutaneous electrical nerve stimulation (TENS) in the paravertebral area in the cervical

region, with two electrodes that are made of silicone rubber, adhesive (selfadhesive), covered with conductive gel, a cable linked to the stimulator[52]. Electrical stimulation was frequency of 80Hz, duration of 180 microseconds. TENSMed P82 machine has been used. Duration of each application was 20 minutes, as with the application of ultrasound during 15 days (3 weeks with breaks during Saturday and Sunday). During the application of TENS patient was also in sitting position.

Medical gymnastics

Both groups of participants were performing medical gymnastics for the cervical spine under the supervision of a physiotherapist for 15 minutes a day for 15 days (3 weeks except Saturdays and Sundays). Participants were actively perfoming static exercises in the seated position in front of a mirror in a way that the neck vertebrae are mobilised against the resistance of their own hands palm placed to forehead with crossed fingers in the direction of inclination. Thereafter the patient placed palms of the hands with crossed fingers occipitally and moved head in direction of reclination. Strengtening of the muscle that perform lateroflexion to the right and lateroflexion to left, was performed in a way that patient put palm of his hand first on right side of the face, then on the left side of the face and mobilise resistance against own hand palm, neck first in the direction of lateralflexion to the right, then lateralflexion to the left. Finally strengthening of the muscles of the cervical spine rotators was done, in a way that can rotate the neck first into the right, and then to left side, all against the resistance of own palm, 10 repetitions was performed in each direction. Duration of one contraction was 8 seconds, a pause between contractions was16 seconds. Participants were then reffered (instructed to take) from a neutral neck position to position cervical spine to half the amplitude of possible movement of inclination, reclination, lateroflexion to the left, lateroflexion to the right, rotation to the right of resistance against the palms of the hands. In the same way participants were mobilising neck in all directions, the same order as from the neutral position. Ten repetitions were performed with duration of contraction of 8 seconds with double longer pause.

All of the abovementioned parameters were collected immediately before and after completing the cycle of intervention, and one month after the end of intervention. Between the end of intervention and the last evaluation participants avoided sudden, uncontrolled movement of the neck, work in irregular forced neck position, work in unfavourable microclimatic condition, and the increasing static and/or dynamic loads of the cervical spine, while they continued to carry out daily medical gymnastic by following learned procedure.

Application of the drugs (medicine)

Troughout the research (study) it was allowed to use analgetics or non steroid antireumathics (NSAID) always at the same dosage. In the case of deterioration (worsening of condition) use of paracetamol as »escape medication« was allowed with a total dose recorded.

Statistics and Results

Results of research (different measured variables) were tested with statistical program version Statistical Package for the Social Science 13 (SPSS) from which were used different tests. From 100 participants with neck pain there were 69 women and 31 men. Age of participants was between 20 to 80 years, and the mean was 55.5. Neck pain in all examined persisted for a minimum of 14 days in research. Intensity of pain before research was 4 and more according to Visual Analogue Scale (VAS).

Normal distribution measured variables

Normal distribution measured continuous variables were measured with Kolmogorov-Smirnov test in order of evaluation of further statistical analysis. Distribution of most variables is statistically significantly different from normal Gauss distribution. Only variable which follow Gauss distribution is age. Because of these results of research which were expected considering population, variables and sample size in further process nonparametric statistical tests were used for differences between groups, moreover by equivalent of parametric tests while, for variable »age« with normal distribution of results were used parametric tests for detection of difference in groups.

TABLE 1
DIFFERENCES IN MEASURED VARIABLES BEFORE TREATMENT

Variables	MWU	Z	P
VAS pain at rest in mm	1113	–0.97	p>0.01
VAS pain during movement in mm	893	–2.52	p<0.05
GPES pain in mm	1151	–0.71	p>0.01
GDES pain in mm	1139	–0.79	p>0.01
Evaluation of neck muscle tension by palpation	1030	–1.97	p<0.05
Intensity of pain	881	–2.82	p<0.01
Reading	977	–2.04	p<0.05
Headache	1222	–0.21	p>0.01
Concentration	1117	–0.97	p>0.01
Work	1021	–1.71	p>0.01
Car driving	1211	–0.29	p>0.01
Sleep	1220	–0.22	p>0.01
Sum of self evaluation	1094	–1.08	p>0.01

GPES – Global patient evaluation score, GDES – Global doctor's evaluation score; VAS – Visual analogue scale, MWU – Result of Mann-Whitney U test; Z – Standardised result of Mann-Whitney U nonparametric test for testing difference in results between two groups of patients; p – Probability

Differences in measured variables between study and control group before treatment

In order to establish differences in measured variables between study and control group before the treatment nonparametric Mann-Whitney U test has been applied (Table 1). Results show that there is no statistically significant difference in most measured variables between study and controlled group before treatment. Significant difference with probability of 5% ($p<0.5$) was recorded in pain during movement, evaluation (score) of tension in neck muscles and in more quality read from scale of self evaluation, while differences significant with probability of 1% ($p<0.01$) were found at variable: intensity of pain from self evaluation scale (Table 1). In order of evidence in which direction these differences go in Table 2 shows mean of both groups of sample for variables were difference between research and control group showed to be significant. Results indicate that difference always follows priority direction for control group (better movement and circulation hence less pain and incapacity).

TABLE 2
MEAN RANGE OF STUDY AND CONTROL GROUP BEFORE TREATMENT

Pairs of measures which are compared		Mean Range
VAS pain at rest in mm	Study group	57.65
	Control group	43.35
Evaluation of neck muscle tension by palpation	Study group	54.91
	Control group	46.09
Reading	Study group	55.96
	Control group	45.04
Intensity of pain	Study group	57.88
	Control group	43.12

VAS – Visual analogue scale

TABLE 3
DIFFERENCES IN MEASURED VARIABLES BETWEEN STUDY AND CONTROL GROUP AFTER 15 TREATMENTS

Variables	MWU	Z	P
VAS pain at rest in mm	1215	–0.25	p>0.01
VAS pain during movement in mm	979	–1.88	p>0.01
GPES pain in mm	1122	–0.90	p>0.01
Intensity of pain	1134	–0.85	p>0.01
Reading	1168	–0.60	p>0.01
Headache	1092	–1.14	p>0.01
Concentration	957	–2.14	p<0.05
Work	1157	–0.69	p>0.01
Car driving	1044	–1.48	p>0.01
Sleep	1136	–0.81	p>0.01
Sum of self evaluation	1028	–1.53	p>0.01

GPES – Global patient evaluation score; VAS – Visual analogue scale; MWU – Result of Mann-Whitney U test, Z – Standardised result of Mann-Whitney U nonparametric test for testing difference in results between two groups of patients; p – Probability

Difference in measured variables between study and control group after 15 treatments

Results of possible difference of measured variables between study and control group after applied therapeutic ultrasound treatment are shown in Table 3. Results indicated that there is no statistically significant difference with most measured variables at study and control groups after 15 treatments. Significant differences with probability of 5% ($p<0.05$) are found only at variable: concentration of self evaluation score (Table 3). In order to show in which direction above mentioned differences go in Table 4 mean of both groups of patients where there is difference between study and control group showed to be significant. Results indicate that difference for both variables goes in priority direction for control group (Table 4).

TABLE 4
MEAN OF STUDY AND CONTROL GROUPS AFTER 15 TREATMENTS

Pairs of measures which are compared		Mean Range
Concentration	Study group	56.36
	Control group	44.64

Difference in measured variables between study and control group one month after end of treatment

Results of measured variables in their differences between study and control group a month after end of treatment shown in Table 5. Results indicate no statistically significant difference in measured variables in study and control group after one month of treatment (Table 5).

Results in Table 6 have shown statistically significant differences between test and control group before treatment, after 15 treatments, one month after treatment, according to the intensity of pain and tension in the neck muscle palpation. To see in which direction differences go the mean ranks are calculated and shown in Table 7. Based on the ranking it can be concluded that for all pairs in which they showed significant differences, the most favorable results achieved in the measurement after a month (less pain), then after 15 treatments, and the worst before treatment (Table 7).

Discussion and Conclusion

Study results in this research showed that in study and control group there is statistically significant less pain with probability of 1% as immediately after therapy (15 treatments), also 1 month after physical therapy (Tables 6, 7).

Significantly lower evaluation score of pain experience from participants and doctors in study and control group proves that use of physical – therapeutic procedures has valid use in patients with neck. As there was same result in study and control group, already medical

TABLE 5
DIFFERENCES IN MEASURED VARIABLES A MONTH AFTER END OF TREATMENT

Variables	MWU	Z	P
VAS pain at rest in mm	1176	-0.55	p>0.01
VAS pain during movement in mm	1224	-0.19	p>0.01
GPES pain in mm	1232	-0.13	p>0.01
GDES pain in mm	1249	-0.01	p>0.01
Evaluation of neck muscle tension by palpation	1208	-0.32	p>0.01
Intensity of pain	1220	-0.23	p>0.01
Reading	1219	-0.23	p>0.01
Headache	1196	-0.40	p>0.01
Concentration	1200	–0.40	p>0.01
Work	1174	–0.56	p>0.01
Car driving	1139	–0.83	p>0.01
Sleep	1156	–0.69	p>0.01
Sum of self evaluation	1229	–0.15	p>0.01

GPES – Global patient evaluation score; GDES – Global doctor's evaluation score; VAS – Visual analogue scale, MWU = Result of Mann-Whitney U test; Z – Standardised result of Mann-Whitney U nonparametric test for testing difference in results between two groups of patients; p – Probability

or even gymnastic with use of transcutaneous electrical nerve stimulations was achieving analgesia, which indicated that by use of therapeutic ultrasound additional analgesic effect has not been achieved. This research proved that there is statistically significant difference between control and study group 15 days after the treatment taking in account self evaluation of concentration in direction of lesser concentration in control group which has not used ultrasound treatment (Tables 3, 4).

Several studies show that experience of pain influence cognitive processes and hence concentration as well[53–55]. Pain has a role of alarm system in organism to warn that something is not right. Perception of pain is effective remainder that we are going over (or that we surpassed) our physical and mental abilities[56]. In this research patients concentration in study and control groups showed improvement immediately after therapy (15 treatments) and a month after undergoing treatment. However statistically significant improvement was verified in study group when observed correlation straight after therapy (15 treatments) and month after therapy while in control group there was no statistically significant improvement of concentration at probability of 1%, after treatment (15 treatments), and month after applied intervention. In connection with therapeutic ultrasound at control group has been concluded that placebo effect has positive effect on concentration of patients who suffered chronic pain. Participants in study reported that their concentration is considerably better after treatment (placebo effect) than before treatment. Hence, placebo effect is significant in this parameter as well, which is known fact for numerous other types of treatments[57–58].

TABLE 6
MEAN VALUES OF MEASURED DEPENDENT VARIABLES OF THE TEST AND CONTROL GROUP AND THE RESULTS OF FRIEDMAN TEST

Variables	Before treatment (M±sd, C,D)				After 15 treatments (M±sd, C,D)				After one month of treatments (M±sd, C,D)				The results of Friedman test, χ^2 (df = 2, p<0,01)
Intensity of the pain – test group	2.7	0.62	3.0	3	1.4	0.85	1.0	1	0.8	0.89	1.0	0	76.13
Tension in the neck muscle palpation – test group	3.3	0.51	3.0	3	2.2	0.60	2.0	2	1.6	0.60	2.0	2	82.06
Tension in the neck muscle palpation – control group	3.1	0.40	3.0	3	30.6	27.29	30.0	0	20.2	24.62	10.0	0	76.28
Intensity of the pain – control group	2.3	0.68	2.0	2	0.3	0.06	0.3	0.32	0.3	0.06	0.3	0.32	54.04

TABLE 7
MEAN OF RANKS IN THE THREE MEASUREMENTS FOR TEST AND CONTROL GROUP

Variables	Mean of ranks		
	Before treatment	After 15 treatments	After one month of treatments
Tension in the neck muscle palpation – test group	2.90	1.85	1.25
Intensity of the pain – test group	2.87	1.86	1.27
Tension in the neck muscle palpation – control group	2.86	1.78	1.36
Intensity of the pain – test group	2.73	1.80	1.47

Today understanding is that sense of pain is complex experience which include perceptive-cognitive, emotional-motivational and behaviour components and develops by performing very intense imitation and/or by tissue damage in organism[59–61]. Numerous psychological conditions and processes can affect pain perception; different emotional states, significance which can be attributed to pain experience, expectation, existing experience of pain, attention, state of strong suggestibility like placebo effect, personality attributes and like[62]. Several studies have been done in order to establish correlation between locus of control and pain perception generally show that perception of control (or lack of it) significantly influence persons pain experience, as well as on person's ability to face up with painful experience[63–68]. In pain management of crucial importance is whether person believe that pain can be controlled and how interprets pain which experiences[69].

From results of this research can be concluded that because of belief and expectations of participants that ultrasound treatment would help in a way of reducing pain intensity, participants report reduction of pain intensity after placebo effect. Above mentioned placebo effect is supported by fact that therapeutic ultrasound, as differ from transcutane electrical nerve stimulation, electrostimulation, interferent electricity patients do not feel during its application[70].

However, positive placebo effect showed short term effect; participants reported (evaluate) that their concentration was better 15 days after treatment, but there was no significant difference in placebo effect 15 days after therapy and month after therapy (Table 5). At the same time it is concluded positive effect of therapeutic ultrasound at clinical group according to how the participants evaluated their concentration. Differences follow in direction that concentration is longer in participants after 15 treatments. Also, participants reported that their concentration is of better quality even month after therapy with ultrasound in comparison to concentration before treatment. Conclusively could be said that therapeutic ultrasound does not bring improvement in measured variables because already just a acknowledgement about attending treatment at control group brings the same effect.

Medical gymnastics or kynesitherapy has dominant role in treatment and rehabilitation of osteo muscular system and undeniably is the most valuable method of physical therapy. Main goals of medical gymnastics is establishing, maintenance or expanding of range of movements, maintenance and expanding muscle strength, expanding of endurance, developing and improvement of movement coordination, increase in speed of movements, improvement of posture and body position, prevention and correction of different deformations, improvement of function of some organic systems and conditioning of organism[71].

Physical-therapeutic procedures speed up regression of discomfort (difficulties), improve functionality of (affected person) patient. Despite what has been perceived so far about therapeutic ultrasound from results that its use is not necessary in treatment of neck pain because ailment, discomfort in study and control group regressed with equal intensity and time.

Based on results of applied research some features which lead to conclusions:

- Results of research showed that in both groups was achieved statistically significant pain reduction what show that sufficient analgesic effect have been achieved even without therapeutic ultrasound
- Research proved strength of placebo effect because therapeutic ultrasound cannot be felt during treatment what in patients consciousness induce belief in its effectiveness.
- Regression of difficulties such as pain, contraction, tension of paravertebral muscles, lowering of movement in neck segment of spine was achieved with equal intensity and amount of time in both groups what proves that therapeutic ultrasound does not have more significant therapeutic effect than transcutaneous electrical nerve stimulation and medical gymnastics.

REFERENCES

1. MÅKELÅ M, HELIÖVAARA M, SIEVERS K, IMPIVAARA O, KNEKT P, AROMAA A, Am J Epidemiol, 134 (1991) 1356. — 2. COTE P, CASSIDY D, CARROLL L, Spine, 23 (1998) 1689. DOI: 10.1097/00007632-199808010-00015. — 3. URWIN M, SYMMONS D, ALLISON T, BRAMMAH T, BUSBY H, ROXBY M, SIMMONS A, WILLIAMS G, Ann Rheum Dis, 57 (1998) 649. — 4. BOVIM G, SCHRADER H, SAND T, Spine, 19 (1994) 1307. DOI: 10.1097/00007632-199406000-00001. — 5. HILL J, LEWIS M, PAPAGEORGIOU AC, DZIEDZIC K, CROFT P, Spine, 29 (2004) 1648. DOI: 10.1097/01.BRS.0000132307.06321.3C. — 6. HACKETT GI, HUDSON MF, WYLIE JB, JACKSON AD, SMALL KM, HARRISON P, O'BRIEN J, Br Med J (Clin Res Ed), 294 (1987)24. DOI: 10.1136/bmj.294.6563.24. — 7. WAALEN D, WHITE P, WAALEN J, J Can Chiropract Assoc, 38 (1994) 75. — 8. KVARNSTROM S, Scand J Rehabil Med, 8 (1983)1. — 9. FEJER R, KYVIK KO, HARTVIGSEN J, Eur Spine J, 15 (2006) 834. DOI: 10.1007/s00586-004-0864-4. — 10. COTE C, VAN DER VELDE G, CASSIDY JD, CARROLL LJ, HOGG-JOHNSON S, HOLM LW, CARRAGEE EJ, HALDEMAN S, NORDIN M, HURWITZ EL, Spine, 33 (2008) 60. DOI: 10.1097/BRS.0b013e3181643ee4. — 11. HOLM L, CARROLL LJ, CASSIDY D, HOGG-JOHNSON S, COTE P, GUZMAN J, PELOSO P, NORDIN M, HURWITZ E, VAN DER VELDE G, CARRAGEE E, Spine, 33 (2008) 52. DOI: 10.1097/BRS.0b013e3181643ece. — 12. ARIENS GA, VAN MECHELEN W, BONGERS PM, BOUTER LM, VAN DER WAL G, Am J Ind Med, 39 (2001) 180. DOI: 10.1002/1097-0274(200102)39:2<180::AID-AJIM1005>3.0.CO;2-#. — 13. BORGHOUTS JA, KOES BW, BOUTER LM, Pain, 77 (1998)1. DOI: 10.1016/S0304-3959(98)00058-X. — 14. SPITZER WO, SKOVRON ML, SALMI LR, CASSIDY DJ, DURANCEAU J, SUISSA S, ZEISS E, Spine, 20 (1995)1. — 15. OLSZEWSKI J, MAJAK J, PIETKIEWICZ P, LUSZCZ C, REPETOWSKI M, Otolaryngol Head Nech Surg 134 (2006) 680. DOI: 10.1016/j.otohns.2005.11.023. — 16. KJELLMAN G, SKARGREN E, OBERG B, Disability and rehabilitation, 24 (2002) 364. — 17. HOVING JL, DE VET HC, TWISK JW, DEVILLE WL, VAN DER WINDT D, KOES BW, BOUTER LM, Pain, 110 (2004) 639. DOI: 10.1016/j.pain.2004.05.002. — 18. AKER PD, GROSS AR, GOLDSMITH CH, PELOSO P, BMJ, 313 (1996) 1291. DOI: 10.1136/bmj.313.7068.1291. — 19. BINDER AI, BMJ, 334 (2007) 527. — 20. BINDER AI, Neck pain syndromes, Clinical Evidence, accessed 1.2.2011. Available from: URL: www.clinicalevidence.com/ceweb/conditions/msd/1103/1103_updates.jsp. — 21. ROBERTSON

VJ, BAKER KG, Phys Ther, 81 (2001) 1339. — 22. TER HAAR G, Progress in Biophysics and Molecular Biology, 93 (2007) 111. — 23. GANN N, Clin Manage, 11 (1991) 64. — 24. ZISKIN M, MCDIARMID T, MICHLOVITZ S, Therapeutic ultrasound. In: MICHLOVITZ S (Ed) Thermal agents in rehabilitation (F. A. Davis, Philadelphia, 1990). — 25. MATIJEVIĆ V, GRAZIO S, Fizikalna terapija u liječenju pacijenata s križoboljom. In: GRAZIO S, BULJAN D (Eds) Križobolja (Naklada Slap, Jastrebarsko, 2009). — 26. GRAZIO S, NEMČIĆ T, MATIJEVIĆ V, SKALA H, Fizikalna terapija u liječenju boli. In: JUKIĆ M, MAJERIĆ KOGLER V, FINGLER M (Eds) Bol — uzroci i liječenje (Medicinska naklada, Zagreb, 2011). — 27. MELZACK R. VETERE P. FINCH L, Phys Ther 63 (1983) 489. — 28. CHEING G. HUI-CHAN C, Archives of Physical Medicine and rehabilitation 80 (2009) 305. — 29. CHEING G. HUI-CHAN C, J Rehabil Med. 35 (2003) 15. DOI: 10.1080/16501970306101. — 30. CHEING GL, HUI CHAN CW, Arch Phys Med Rehabil 80 (1999) 305. DOI: 10.1016/S0003-9993(99)90142-9. — 31. MARCHAND S, CHAREST J, LI J, CHENARD JR, LAVIGNOLLE B, LAURENCELLE L, Pain, 54 (1993) 99. DOI: 10.1016/0304-3959(93)90104-W. — 32. CHIU TT, LAM TH, HEDLEY AJ, Spine, 30 (2005) E1. DOI: 10.1191/0269215505cr920oa. — 33. BINDER AI, BMJ, 334 (2007) 3527. DOI: 10.1136/bmj.39127.608299.80. — 34. AKER PD, GROSS AR, GOLDSMITH CH, PELOSO P, BMJ, 313 (1996) 1291. DOI: 10.1136/bmj.313.7068.1291. — 35. Philadelphia Panel. Evidence-based clinical practice guidelines on selected rehabilitation interventions for neck pain, Phys Ther, 81 (2001) 1701. — 36. SARIG-BAHAT H, Man Ther 8 (2003) 10. DOI: 10.1054/math.2002.0480. — 37. KAY TM, GROSS A, GOLDSMITH C, SANTAGUIDA PL, HOVING J, BRONFORT G, Cochrane Database Syst Rev, 3 (2005). — 38. VILJANEN M, MALMIVAARA A, UITTI J, RINNE M, PALMROOS P, LAIPPALA P, BMJ, 327 (2003) 327. — 39. YLINEN, J, Eura Medicophys, 43 (2007) 119. — 40. WALING K, SUNDELIN G, AHLGREN C, JARVHOLM B, Pain, 85 (2000) 201. DOI: 10.1016/S0304-3959(99)00265-1. — 41. WALING K, JAÖRVHOLM B, SUNDELIN G, Spine, 27 (2002) 789. DOI: 10.1097/00007632 — 200204150-00002. — 42. WOOD RW, LOOMIS AL, London, Edinburgh, Dublin Philosophical Magazine J Sci, 4 (1927)417. — 43. YOUNG SR, DYSON M, Ultrasonics, 28 (1990)175. DOI: 10.1016/0041-624X(90)90082-Y. — 44. QUAN KM, SHIRAN M, WATMOUGH DJ, Phys Med Biol 34 (1989) 1719. DOI: 10.1088/0031-9155/34/11/019. — 45. WMA, Declaration of Helsinki, accessed 12.2.2011. Available from: URL: http://www.wma.net/en/30publications/10policies/b3/index.html. — 46. CHAPMAN CR, CASE KL, DUBNER R, Pain, 22 (1985) 1. DOI: 10.1016/0304-3959(85)90145-9. — 47. MYLES PS, TROEDEL S, BOQUEST M, REEVES M, Anesth Analg, 89 (1999) 1517. DOI: 10.1213/00000539-199912000-00038. — 48. DIXON JS, BIRD HA, Ann Rheum Dis, 40 (1981) 87. DOI: 10.1136/ard.40.1.87. — 49. ZEC Ž, KONFORT N, Ispitivanje snage mišića, Manuelna metoda, 2nd edition (Zavod za rehabilitaciju »Dr. Miroslav Zotović«, Beograd, 1972). — 50. HISLOP HJ, MONTGOMERY J, Muscle testing — techniques of manual examination. 6th edition. In: SAUNDERS WB (Ed) Prinicples of Manual Muscle Testing (Philadelphia, 1995). — 51. JAJIĆ I, Terapijski ultrazvuk, In: JAJIĆ I, Fizikalna medicina (Medicinska knjiga, Zagreb, 1996). — 52. JAJIĆ I, Transkutana električna živčana stimulacija. In: JAJIĆ I, Fizikalna medicina (Ed) (Medicinska knjiga, Zagreb, 1996). — 53. BINGEL U, ROSE M, GLÄSCHER J, BÜCHEL C, Neuron 55 (2007) 157. DOI: 10.1016/j.neuron.2007.05.032. — 54. ECCLESTON C, CROMBEZ G, Psychol Bull 123 (1999) 356. DOI: 10.1037//0033-2909.125.3.356. — 55. MORIARTY O, MCGUIRE BE, FINN DP, Progress in Neurobiology 93 (2001) 385. DOI: 10.1016/j.pneurobio.2011.01.002. — 56. ALDRICH S, ECCLESTON C, Social Science & Medicine, 50 (2000) 1631. DOI: 10.1016/S0277-9536(99)00391-3 — 57. WOLMAN BB, Dictionary of Bihevioral Science, 2nd Edition (Academic Press, New York, 1989). — 58. WAGER TD, RILLING JK, SMITH EE, SOKOLIK A, CASEY KL, DAVIDSON RJ, KOSSLYN SM, ROSE RM, COHEN JD, Science, 303 (2004) 1162. DOI: 10.1126/science.1093065. — 59. MARKANOVIĆ D, Odnos tolerancije boli i nekih tehnika kontrole boli s lokusom kontrole. MS thesis. (University of Zagreb, Zagreb, 2005). — 60. PETZ B, Psihologijski rječnik (Prosvjeta, Zagreb,1992). — 61. SARAFINO EP, The Nature and Symptoms of Pain. In: SARAFINO EP, WILEY J (Eds) Health Psychology: Biopsychosocial Interactions, 2nd Edition (John Wiley & Sons Inc, New York, 1994). — 62. HAVELKA M, Zdravstvena Psihologija (Naklada Slap, Zagreb, 2000). — 63. WAXENBERG LB. The relationship between handedness, brain lateralization, and pain experience. PhD Thesis. (Univ. Microfilms International, The Sciences & Engineering, 2000). — 64. GOLDBERG J, WEISENBERG M, DROBKIN S, BLITTNER M, GOTESTAM KG, Cognitive Therapy & Research, 21 (1997) 525. DOI: 10.1023/A:1021805418093. — 65. ROKKE PD, AL ABSI M, LALL R, OSWALD K, Journal of Behavioral Medicine, 14 (1999) 491. — 66. FELDNER MT, HEKMAT H, Journal of Behavior Therapy & Experimental Psychiatry, 32 (2001) 191. DOI: 10.1016/S0005-7916(01)00034-9. — 67. TAYLOR SE, Pain and Its Management. In: FRIEDMAN HS, SILVER RC (Eds) Health Psychology, 2nd Edition (McGraw-Hill, Inc., New York, 1991). — 68. HAHN SE, Personality and Individual Differences, 29 (2000) 729. DOI: 10.1016/S0191-8869(99)00228-7. — 69. CRNKOVIĆ M, Reuma, (2011) 5. — 70. POITRAS S, BROSSEAU L, Spine, 8 (2008) 227. DOI: 10.1016/j.spinee.2007.10.022. — 71. NEMČIĆ T, Medicinska gimnastika. In: GRAZIO S, BULJAN D (Eds) Križobolja (Naklada Slap, Jastrebarsko, 2009).

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UČINAK TERAPIJSKOG ULTRAZVUKA NA PSIHOFIZIOLOŠKO FUNKCIONIRANJE BOLESNIKA S VRATOBOLJOM

S A Ž E T A K

Cilj istraživanja u ovom radu bio je utvrditi učinkovitost terapijskog ultrazvuka na psihofiziološko funkcioniranje u bolesnika sa bolovima u vratu. Malo je znanstveno utemeljenih informacija o djelotvornosti terapijskog ultrazvuka u kliničkim studijama, a dokaza o njegovom učinku na određene psihofiziološke funkcije nema. U ispitivanje je bilo uključeno 100 bolesnika, 69 žena, 31 muškarac, s bolovima u vratu (prosječna dob 55 godina). Protokol liječenja uključivao je 15 tretmana, odnosno pet tretmana tjedno. Pacijenti su bili podijeljeni u dvije skupine (ispitivana i kontrolna). Obje skupine provodile su izometričke vježbe po programu za vratnu kralježnicu i dobivale su transkutanu električnu nervnu stimulaciju. Ispitivana skupina primala je kontinuirani terapijski ultrazvuk na vrat 5 minuta dnevno sa intenzitetom 0,5 W/cm^2, dok je kod kontrolne skupine tijekom primjene terapijskog ultrazvuka aparat bio isključen. Izometričke vježbe izvođene po programu za vratnu kralježnicu i transkutana električna nervna stimulacija jednako su učinkovite u poboljšanju pokretljivosti vrata i vertebralne arterijske cirkulacije kao i izometričke vježbe izvođene po programu za vratnu kralježnicu, transkutana električna nervna stimulacija s dodatkom terapijskog ultrazvuka.