Baltic Journal of Health and Physical Activity

Volume 8 | Issue 2 Article 8

2016

Evaluation of the efficacy of low level laser therapy and cryotherapy in the treatment of gonarthrosis

Agnieszka Radziminska
Department of Physiotherapy, Division of Basic Therapy, Collegium Medicum in Bydgoszcz, Nicolaus Copernicus University in Torun, Poland, agnieszka.radziminska@gmail.com

Magdalena Weber-Rajek
Department of Physiotherapy, Division of Basic Therapy, Collegium Medicum in Bydgoszcz, Nicolaus Copernicus University in Torun, Poland

Justyna Lewandowska
Municipal Specialist Clinic in Torun, Poland

Ewelina Lulinska-Kuklik
Gdansk University of Physical Education and Sport, Poland

Agnieszka Straczynska
Department of Physiotherapy, Division of Basic Therapy, Collegium Medicum in Bydgoszcz, Nicolaus Copernicus University in Torun, Poland

See next page for additional authors

Recommended Citation

Radziminska A, Weber-Rajek M, Lewandowska J, et al. Evaluation of the efficacy of low level laser therapy and cryotherapy in the treatment of gonarthrosis. Balt J Health Phys Act. 2016; 8(2): 87-95. doi: 10.29359/BJHPA.08.2.08

Evaluation of the efficacy of low level laser therapy and cryotherapy in the treatment of gonarthrosis

Authors

Agnieszka Radziminska, Magdalena Weber-Rajek, Justyna Lewandowska, Ewelina Lulinska-Kuklik, Agnieszka Straczynska, and Waldemar Moska

Baltic Journal of Health and Physical Activity 2016;8(2):87-95
Journal of Gdansk University of Physical Education and Sport in Gdansk
e-ISSN 2080-9999

ORIGINAL

Evaluation of the efficacy of low level laser therapy and cryotherapy in the treatment of gonarthrosis

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

Agnieszka Radzimińska[1 DE], Magdalena Weber-Rajek[1 AC], Justyna Lewandowska[2 B], Ewelina Lulińska-Kuklik[3 DF], Agnieszka Strączyńska[1 C], Waldemar Moska[3 D]

[1] Department of Physiotherapy, Division of Basic Therapy, Collegium Medicum in Bydgoszcz, Nicolaus Copernicus University in Torun, Poland

[2] Municipal Specialist Clinic in Torun, Poland

[3] Gdansk University of Physical Education and Sport, Poland

abstract

Background Gonarthrosis is the most common form of osteoarthritis and it is included in the group of civilization diseases. Searching for the optimal treatment of this disease is still ongoing. Physical treatment methods play an important role. The aim of the study was to evaluate the effectiveness of laser therapy and cryotherapy in the treatment of the symptoms of degenerative changes in the knee joint.

Material/Methods The study involved 40 patients diagnosed with osteoarthritis of the knee. The patients were divided into two groups. Group I (n = 20) were patients who used low-level laser therapy (LLLT). Group II (n = 20) were patients who used cryotherapy. Before and after surgery, all patients were examined in the following areas: assessment of pain using the VAS (Visual-Analogue Scale); Pain assessment questionnaire modified by Laitinen; Sit-up test; measurement of circumference of knee joints. Statistical analyses were performed using Statistica 12.5.

Results The study has demonstrated a statistically significant improvement in the reduction of pain, a reduction in the swelling of knee joints and an improvement in the functionality of patients in both groups, with no statistically significant differences between the groups.

Conclusions Both low level laser therapy and cryotherapy proved to be effective treatments for the symptoms of osteoarthritis of the knee. There were no statistically significant differences in the efficacy of low level laser therapy and cryotherapy.

Key words gonarthrosis, low level lase therapy, cryotherapy

article details

Article statistics **Word count:** 3,105; **Tables:** 4; **Figures:** 0; **References:** 19
Received: January 2016; **Accepted:** June 2016; **Published:** June 2016

Full-text PDF: http://www.balticsportscience.com

Indexation: AGRO, Celdes, CNKI Scholar (China National Knowledge Infrastructure), CNPIEC, De Gruyter - IBR (International Bibliography of Reviews of Scholarly Literature in the Humanities and Social Sciences), De Gruyter - IBZ (International Bibliography of Periodical Literature in the Humanities and Social Sciences), DOAJ, EBSCO - Central & Eastern European Academic Source, EBSCO - SPORTDiscus, EBSCO Discovery Service, Google Scholar, Index Copernicus, J-Gate, Naviga (Softweco, Primo Central (ExLibris), ProQuest - Family Health, ProQuest - Health & Medical Complete, ProQuest - Illustrata: Health Sciences, ProQuest - Nursing & Allied Health Source, Summon (Serials Solutions/ProQuest, TDOne (TDNet), Ulrich's Periodicals Directory/ulrichsweb, WorldCat (OCLC)

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict of interest: Authors have declared that no competing interest exists.

Corresponding author: Dr n. med. Agnieszka Radzimińska, Katedra Fizjoterapii, Zakład Podstaw Fizjoterapii, Collegium Medicum w Bydgoszczy, Uniwersytet Mikołaja Kopernika w Toruniu; e-mail: agnieszka.radziminska@gmail.com; phone no.: tel. +48 52 585-58-52

INTRODUCTION

Gonarthrosis is the most common form of osteoarthritis and it is included in the group of civilization diseases. The World Health Organization and the United Nations announced the period between 2000 and 2010 as the Bone and Joint Decade. Before the end of 2009, the Bone and Joint Decade was extended until 2020 [1]. On the basis of epidemiological data it can be assumed that the problem of osteoarthritis in Poland affects several million people, a quarter being related to the knee joints. Pain is the main reason that forces a patient with osteoarthritis to visit a doctor [2]. The pathogenesis of pain in osteoarthritis is multifactorial. The degenerative process begins in the articular cartilage, which is not innervated and therefore it is not a source of pain. The pain starts in the periarticular tissue (trailer tendons and muscles located near the surface of the joint, the joint capsule, ligaments), and with microfractures in the subchondral bone layer, the inflammation of the synovium, the increased intra-articular pressure caused by the accumulation of articular effusion [3, 4].

Analgesic, anti-inflammatory, and anti-oedema treatment is very important for patients with the locomotor system diseases, as it allows them to function with reduced dosage of analgesic drugs, to increase their mobility, and thereby to improve their quality of life. Searching for the optimal treatment of this disease is still ongoing. Physical treatment methods play an important role. This study aims at two of them: low level laser therapy and cryotherapy.

The analgesic effect of laser therapy results from the stimulation of metabolic processes in mitochondria (energy metabolism through ATP), increased blood and lymph flow in vessels, increased production of endorphins, inhibition of the release of inflammatory mediators, the reduction of swelling, the increase in activation of the descending antinociceptive system and primary nerve endings hyperpolarization [5-9].

The mechanism of cryotherapy treatment is complex. In the first phase there is a contraction of blood vessels, then their expansions by even four times, which appears about four minutes after the procedure and it may persist for more than two hours. Increased blood supply to tissues causes higher oxygen concentration in the muscles, which in turn reduced lactate and histamine concentration, increases the level of bradykinin and angiotensin, and thus reduces pain. The analgesic effect of cryotherapy is also associated with increased levels of endorphins, the reduction of the nociceptive nerve conduction routes, especially myelinless C-fibres [10].

In view of the above, the aim of the study was to evaluate the effectiveness of laser therapy and cryotherapy in the treatment of symptoms of degenerative changes in the knee joint.

MATERIAL AND METHODS

The study was conducted at the Municipal Specialist Clinic in Torun (Poland). The study involved 40 patients diagnosed with osteoarthritis of the knee. All patients gave informed consent for the research. Based on physician in charge patients were assigned to two groups. Group I (n = 20): 14 women and 6 men, aged 53–76 years (mean age 62.5 years), who were treated with low level laser

therapy (LLLT). The laser wave length used for the therapy was 820 nm, the amount of energy delivered to the tissue was in the range of 5–10 J/cm2, the number of treatments – 10, contact method (6 points, in the slit joint). Group II (n = 20): 16 women and 4 men, aged 46–75 years (mean age 62.1 years), who were treated with cryotherapy (liquid nitrogen). Treatment time: 1–3 minutes (depending on the sensitivity of the patient), the number of treatments – 10. Before and after the treatment, all patients were examined in terms of:

- the assessment of pain with the use VAS (the visual-analogue scale);
- the assessment of pain with the use of modified Laitinen's questionnaire of pain indicators;
- sit-ups test;
- measurement of knee joints circumference.

Statistical analysis was performed with a use of Statistica 12.5. Distribution of variables was tested using the Shapiro-Wilk test. The distribution of variables does not meet the assumptions of normal distribution, hence the use of nonparametric tests. In order to compare the test results obtained before and after the treatment in group I (n = 20) and group II (n = 20), the Wilcoxon test with significance level $\alpha = 0.05$ was used. In order to compare the test results obtained before and after treatment in group I and group II, the U Mann-Whitney test with significance level $\alpha = 0.05$ was used.

RESULTS

The comparison of results of the variables before and after the treatment is shown in Table 1 (before) and Table 2 (after).

Table 1. The values of Z test statistics and p-value obtained in the U Mann-Whitney test at the significance level $\alpha = 0.05$ for the comparison of the analysed variables before treatment in Group I and Group II

Variable	U Mann-Whitney's test	
	Z statistics	p value
VAS before treatment	-1.44338	0.148916
Laitinen's questionnaire – pain intensity before treatment	-1.81221	0.069955
Laitinen's questionnaire – pain frequency before treatment	-0.755929	0.449692
Laitinen's questionnaire – analgesic drugs usage before treatment	-1.03280	0.301700
Laitinen's questionnaire – physical activity restrictions before treatment	0.00	1.00000
Sit-ups test before treatment	-0.394771	0.693012
Knee joint circumference before treatment	1.443376	0.148916

Table 2. The values of Z test statistics and p-value obtained in the U Mann-Whitney test at the significance level α = 0.05 for the comparison of the analysed variables after treatment in Group I and Group II

Variable	U Mann-Whitney's test	
	Z statistics	p value
VAS before treatment	0.509525	0.610385
Laitinen's questionnaire – pain intensity after treatment	-1.06066	0.288845
Laitinen's questionnaire – pain frequency after treatment	0.00	1.000000
Laitinen's questionnaire – analgesic drugs usage after treatment	0.00	1.000000
Laitinen's questionnaire – physical activity restrictions after treatment	0.990536	0.321913
Sit-ups test after treatment	0.707107	0.479501
Knee joint circumference after treatment	1.590990	0.111613

Comparing p-values based on Z statistics at the level of significance α = 0.05, it was found that there was no statistically significant difference in the results obtained before and after treatment both in Group I and in Group II with regard to: pain level measured in VAS, pain intensity and frequency, analgesic drugs used to relieve the pain and physical activity restrictions evaluated by Laitinen's questionnaire, as well as in the sit-ups test results and knee joints circumferenece measurement.

In order to compare the results obtained in the tests before and after treatment in Group I, the Wilcoxon test with significance level α = 0.05 was used. The results are shown in Table 3.

Table 3. The values of the test statistics Z and p-value obtained in the Wilcoxon test at significance level α = 0.05 in Group I

		Med	$\overline{x}$	Q_1	Q_3	Min	Max	Wilcoxon's test	
								Z statistics	p value
VAS	before	7.50	6.75	5.00	8.50	3	10	3.919930	0.000089*
	after	4.00	2.70	0.00	5.00	0	6		
Laitinen's questionnaire – pain intensity	before	2.00	2.30	1.00	3.00	1	4	3.823007	0.000132*
	after	1.00	1.15	0.50	2.00	0	3		
Laitinen's questionnaire – pain frequency	before	2.00	2.20	1.00	3.00	1	4	3.407771	0.000655*
	after	1.00	1.20	0.00	2.00	0	4		
Laitinen's questionnaire – physical activity restrictions	before	1.00	0.65	0.00	1.00	0	2	2.201398	0.027709*
	after	0.00	0.35	0.00	1.00	0	1		
Laitinen's questionnaire – use of analgesic drugs	before	1.00	1.50	1.00	2.00	0	4	3.059412	0.002218*
	after	0.50	0.75	0.00	1.50	0	2		
Sit-up test	before	0.00	2.05	0.00	4.00	0	10	2.665570	0.007686*
	after	2.50	3.20	0.00	5.00	0	10		
Knee joint circuits	before	40.00	40.00	37.50	43.00	33	46	2.201398	0.027709*
	after	40.00	39.40	37.00	41.50	33	46		

*p<0.05

Me – median; $\overline{x}$ – mean average; Q1 – first quartile; Q3 – third quartile; Min – minimum; Max – maximum; p – probability value

A comparison of results obtained by patients after treatment with the low level laser to the results obtained before treatment shows that at a significance level $\alpha = 0.05$ there are statistically significant ($p < 0.05$) differences in the results of all tests performed.

In order to compare the results obtained in the tests before and after treatment in Group II the Wilcoxon test with significance level $\alpha = 0.05$ was used. The results are shown in Table 4.

Table 4. The value of the test statistics Z and p-value obtained in the Wilcoxon test at the significance level $\alpha = 0.05$ in Group II

		Me	$\overline{x}$	Q_1	Q_3	Min	Max	Wilcoxon's test	
								Z statistics	p value
VAS	before	7.00	6.90	5.00	9.00	0	10	3.583936	0.000339*
	after	3.00	2.25	0.00	3.50	0	5		
Laitinen's questionnaire – pain intensity	before	2.50	2.40	1.00	3.00	1	4	3.823007	0.000132*
	after	1.00	0.65	0.00	1.00	0	2		
Laitinen's questionnaire – pain frequency	before	2.50	2.55	2.00	3.00	1	4	3.823007	0.000132*
	after	0.00	0.90	0.00	1.50	0	4		
Laitinen's questionnaire – physical activity restrictions	before	1.00	1.20	1.00	1.00	0	3	2.022600	0.043115*
	after	1.00	0.90	0.00	1.00	0	3		
Laitinen's questionnaire – use of analgesic drugs.	before	1.00	1.20	0.00	2.00	0	3	2.665570	0.007686*
	after	0.00	0.65	0.00	1.00	0	3		
Sit-ups test	before	0.00	2.20	0.00	4.40	0	10	3.295765	0.000982*
	after	5.50	4.95	3.00	7.00	0	10		
Knee joint circuits	before	37.00	37.55	33.00	41.00	31	46	2.520504	0.011719*
	after	37.00	36.75	32.00	42.00	33	44		

*p<0.05

Me – median ; $\overline{x}$ – mean average; Q1 – first quartile; Q3 – third quartile; Min – minimum; Max – maximum; p – probability value

A comparison of results obtained by patients after treatment with cryotherapy to the results obtained before treatment shows that at a significance level $\alpha = 0.05$ are statistically significant ($p < 0.05$) the difference in the results of all tests performed.

DISCUSSION

Assessment the effectiveness of LLLT and cryotherapy in the treatment of gonarthrosis has been examined by many authors. Nakamura et al. [11] applied laser treatment to 35 patients with chronic knee joint pain. They received low level laser therapy (830 nm, 1000 mW, 20.1 J/cm2, four points were irradiated per session twice a week for 4 weeks). The visual analogue scale (VAS) was used to determine the effects of LLLT for chronic pain, and after the end of the treatment regimen significant improvement was observed ($p < 0.001$). After treatment, no significant differences were observed in the knee joint range of motion.

Ammar [12] compared the effect of monochromatic infrared photo energy (MIPE) and LLLT in improving pain and function in knee osteoarthritis (KO).

Sixty participants with KO completed the program and were randomly assigned into two groups. Group 1 (experimental, n = 30) received MIPE and exercises. Group 2 (control, n = 30) received LLLT and exercises. Both groups received two sessions per week for six weeks. The outcome included pain intensity measured on the visual analogue scale, and the physical function was measured with the lower extremity functional scale, before and after 12 therapy sessions (6 weeks after the start of the intervention). There were statistically significant improvements in pain intensity and lower extremity functional scale stores ($p < 0.005$) in each group. However, no significant differences were recorded between the groups ($p < 0.005$).

Kheshie et al. [13] compared the effects of LLLT and high-intensity laser therapy (HILT) on pain relief and functional improvement in patients with gonarthrosis. 53 male patients participated in this study. Patients were randomly assigned into three groups and treated with HILT and exercise (HILT + EX), LLLT and exercise (LLLT + EX), and placebo laser plus exercise (PL + EX) in groups 1, 2, and 3, respectively. The pain level was measured by the visual analogue scale (VAS) and the knee function was measured by the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). The result showed that HILT and LLLT combined with exercise were effective treatment modalities in decreasing the VAS and WOMAC scores after 6 weeks of treatment. HILT combined with exercises was more effective than LLLT combined with exercises, and both treatment modalities were better than exercises alone in the treatment of patients with gonarthrosis.

Al Rashoud et al. [14] conducted a randomised, double-blind, comparative clinical trial. Forty-nine patients with knee osteoarthritis were assigned at random into two groups: an active laser group (n=26) and a placebo laser group (n=23). Using a gallium aluminium arsenide laser device, patients received either active or placebo LLLT at five acupuncture points on the affected knee during nine sessions. Patients were assessed using the visual analogue scale (VAS) and the Saudi Knee Function Scale (SKFS) at baseline, the fifth treatment session, the last treatment session, 6 weeks post intervention and 6 months post intervention. VAS scores showed a significant improvement in the active laser group compared with the placebo laser group at 6 weeks post intervention and 6 months post intervention using the independent samples test. SKFS scores also showed a significant improvement in the active laser group compared with the placebo laser group at the last treatment session and 6 months post intervention.

Alghadir et al. [15] conducted a study whose aim was to investigate the effect of LLLT on pain relief and functional performance in patients with chronic knee osteoarthritis (OA). Forty patients with knee OA were randomly assigned into an active laser group (n = 20) and a placebo laser group (n = 20). The LLLT device used was a Ga-As diode laser (50 mW, 850 nm, and a diameter beam of 1 mm). Eight points were irradiated and received dosage of 6 J/point, 48 J/cm2 in each session. The placebo group was identical but treated without emission of energy. LLLT was applied two times per week over the period of 4 weeks. Outcome measurements included pain intensity at rest and at movement on the visual analogue scale, knee function used the Western Ontario McMaster Universities Osteoarthritis Index scale, and ambulation duration. These measurements were collected at baseline and post-intervention. The

results showed significant improvements in all assessment parameters in both groups compared to the baseline. The active laser group showed significant differences in pain intensity at rest and movement, the knee function, and ambulation duration when compared with the placebo group. Therefore, LLLT seemed to be an effective modality for short-term pain relief and function improvement in patients with chronic knee OA.

There are also studies that do not confirm the effectiveness of LLLT in the treatment of knee osteoarthritis. Huang et al. [16] performed a systematic review of randomized controlled trials in MEDLINE, EMBASE, ISI Web of Science, and the Cochrane Library on the efficacy of LLLT in the treatment of degenerative knee osteoarthritis (KOA). Databases were systematically searched from January 2000 to November 2014. Of 612 studies, nine studies (seven double-blind, two single-blind, totalling 518 patients) met the criteria for inclusion. Based on seven studies, the visual analogue scale (VAS) pain score right after therapy (within 2 weeks after the therapy) was not significantly different between LLLT and control. No significant difference was identified in studies conforming to the World Association of Laser Therapy (WALT) recommendations (four studies) or on the basis of osteoarthritis severity. There was no significant difference in the delayed response (12 weeks after the end of therapy) between LLLT and control in VAS pain (five studies). Similarly, there was no evidence of LLLT effectiveness based on the Western Ontario and McMaster Universities Arthritis Index (WOMAC) pain, stiffness or function outcomes (five and three studies had outcome data right after and 12 weeks after therapy, respectively).

Kopacz et al. [17] evaluated the effect of local cryotherapy treatment on the range of motion in the knee joint in patients with osteoarthritis. In addition, they analysed potential changes in symptoms of pain among the patients. The study group consisted of 50 patients (39 women and 11 men) and was homogeneous in terms of disease. Patients were subjected to 10 daily treatments of local cryotherapy on the area of the knee. Before cryotherapy, patients were examined anthropometrically, and the BMI was calculated. An interview was collected regarding coexisting diseases, and pain was examined according to VAS. The range of motion was measured in all patients in the knee joint using a goniometer before and after treatment. In all patients who underwent a series of treatments there was a considerable improvement in flexion and extension of the knee. Considering the analysis of pain assessed by VAS, in all patients a significant reduction in the value indicated by the respondents on the scale after the series of treatments was demonstrated.

In other studies the effectiveness of cryogymnastics on the functional efficiency, the quality of life and pain perception among patients with gonarthrosis was evaluated. The study involved a group of 50 people diagnosed with gonarthrosis. Patients were tested twice. The first examination was conducted before the therapy, the second examination was conducted after 10 cryotherapy treatments. To assess the results of cryogymnastics, goniometric measurement was taken, along with the WOMAC questionnaire and functional test Up & Go. They found that the applied local cryotherapy and exercise in the studied group was effective in increasing the joint range of motion, improving the quality of life and patients' functional efficiency [18].

In study of Fidut-Wrońska et al. [19], 50 patients with gonarthrosis were treated by means of local cryotherapy and other physical therapy methods. The control group included 38 matched patients with gonarthrosis, treated with the same physical therapy methods, but without cryotherapy. Evaluation methods were based on the authors' tailored questionnaire, the VAS scale and the WOMAC questionnaire. The physical examination consisted of the measurements of body height and weight, the range of motion (ROM) in the knee joints and the knee circumference and a series of functional tests. The results indicate that ROM of the knee joints increased by 11.3° in the study group and by 3.1° in the control group. The circumference was reduced by 1.1 cm in the study group and by 0.4 cm in the control group. The value of the WOMAC index was diminished by 17.3% in the study group and by 11.9% in the control group. After the treatment, the study group covered 8.7 stairs more while ascending and 9.2 more while descending whereas the control group covered 3.9 and 4.3 stairs respectively. Similarly, after the treatment patients from the study group did 5.5 squats more compared to 1.7 squats performed by the control group subjects.

The results of this study showed that both the laser and cryotherapy proved to be effective treatment for the symptoms of degenerative changes in the knee joints. An analysis of the test results before treatment between the two groups showed no statistically significant differences, reflecting the homogeneity of groups. Both therapies have proven effective in reducing pain and swelling of the knee joint and in improving the functionality of patients.

CONCLUSIONS

Both low level laser therapy and cryotherapy proved to be effective treatment for the symptoms of osteoarthritis of the knee.

There were no statistically significant differences in the efficacy of low level laser therapy and cryotherapy.

REFERENCES

[1] Górecki A. Problemy leczenia zmian zwyrodnieniowych stawu biodrowego i kolanowego [The problems treatment of degenerative changes in the hip and knee] In: Kruczyński J, ed. Dekada kości i stawów 2000-2010 [The bone and joint decade 2000-2010]. Kraków; 2000, 22-32. Polish.

[2] Földes K, Bálint P, Gaál M, Buchanan WW, Bálint GP. Nocturnal pain correlates with effusions in diseased hips. J Rheumatol. 1992;19:1756-1758.

[3] Mc Alindon TE, Snow S, Cooper C, Dieppe PA. Radiographic patterns of osteoarthritis of the knee joint in the community: the importance of the patellofemoral joint. Ann Rheum Dis. 1992;51:844-849.

[4] Pinals RS. Mechanisms of joint destruction, pain and disability in osteoarthritis. Drugs. 1996;52(Supl.):14-20.

[5] Liu H, Colavitti R, Rovira II, Finkel T. Redox-dependent transcriptional regulation. Circ Res. 2005;97(10):967-74.

[6] Cidral-Filho FJ, Mazzardo-Martins L, Martins DF, Santos ARS. Light emitting diode therapy induces analgesia in a mouse model of postoperative pain through activation of peripheral opioid receptors and the L-arginine/nitric oxide pathway. Lasers Med Sci. 2014;29:695-702.

[7] Moriyama Y, Nguyen J, Akens M, Moriyama EH, Lilge L. In vivo effects of low-level laser therapy on inducible nitric oxide synthase. Laser Surg Med. 2009;41(3):227-231.

[8] Mitchell UH, Mack GL. Low-level laser treatment with near-infrared light increases venous nitric oxide levels acutely: a single-blind, randomized clinical trial of efficacy. Am J Phys. Med Rehabil. 2013;92:151-156. Chow RT, Johnson MI, Lopes-Martins RA, Bjordal JM. Efficacy of low-level laser therapy in the management of neck pain: a systematic review and meta-analysis of randomised placebo or active-treatment controlled trials. Lancet. 2009;374:1897-1908.

[9] Straburzyńska-Lupa A, Straburzyński G. Fizjoterapia z elementami klinicznymi [Physiotherapy with clinical elements]. Warszawa: Wydawnictwo Lekarskie PZWL; 2008. Polish.

[10] Nakamura T, Ebihara S, Ohkuni I, Izukura H, Harada T, Ushigome N. Low level laser therapy for chronic knee joint pain patients. Laser Ther. 2014;23(4):273-7.

[11] Ammar TA. Monochromatic infrared photo energy versus low level laser therapy in patients with knee osteoarthritis. J Lasers Med Sci. 2014;5(4):176-82.

[12] Kheshie AR, Alayat MS, Ali MM. High-intensity versus low-level laser therapy in the treatment of patients with knee osteoarthritis: a randomized controlled trial. Lasers Med Sci. 2014;29(4):1371-6.

[13] Al Rashoud AS, Abboud RJ, Wang W, Wigderowitz C. Efficacy of low-level laser therapy applied at acupuncture points in knee osteoarthritis: a randomised double-blind comparative trial. Physiotherapy. 2014;100(3):242-8.

[14] Alghadir A, Omar MT, Al-Askar AB, Al-Muteri NK. Effect of low-level laser therapy in patients with chronic knee osteoarthritis: a single-blinded randomized clinical study. Lasers Med Sci. 2014;29(2):749-55.

[15] Huang Z, Chen J, Ma J, Shen B, Pei F, Kraus VB. Effectiveness of low-level laser therapy in patients with knee osteoarthritis: a systematic review and metaanalysis. Osteoarthritis Cartilage. 2015;23(9):1437-44.

[16] Kopacz Ł, Lubkowska A, Byczkowska I, et al. Wartość terapeutyczna krioterapii miejscowej w leczeniu pacjentów z gonartrozą [The therapeutic value of local cryotherapy in the treatment of patients with gonarthrosis]. Fizjoterapia Pol. 2014;4(13):31-36. Polish.

[17] Pop T, Skrzypek B, Pop K, Rusek W. Wpływ kriogimnastyki na poprawę sprawności funkcjonalnej i jakość życia pacjentów z chorobą zwyrodnieniową stawu kolanowego [Impact of local cryogymnastics on functional efficiency, quality of life and pain perception among patients with gonarthrosis]. Postępy Rehab. 2012;26(3):27-33. Polish.

[18] Fidut-Wrońska J, Latosiewicz R, Janikowska K, Sokołowski K. Ocena skuteczności włączenia krioterapii miejscowej w leczeniu gonartrozy [Assessment the effectiveness of the inclusion of local cryotherapy in the treatment of gonarthrosis]. Fizjoterapia Pol. 2012;3(4):241-250. Polish.

Cite this article as:
Radzimińska A, Weber-Rajek M, Lewandowska J, Lulińska-Kuklik E, Strączyńska A, Moska W. Evaluation of the efficacy of low level laser therapy and cryotherapy in the treatment of gonarthrosis. Balt J Health Phys Act. 2016;8(2):87-95.