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ASSESSMENT OF THE EFFECTIVENESS OF MLS LASER THERAPY IN THE TREATMENT OF PATIENTS WITH KNEE OSTEOARTHRITIS

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Abstract: Knee osteoarthritis is the most frequent cause of pain. The article's main trust was to assess MLS laser therapy effectiveness in curing patients with gonarthrosis.
The research was conducted on the group of 30 patients with bilateral gonarthrosis. Clinical examinations included: visual analogue scale (VAS), estimating the scope of movability and the circumference of knee joints, the „Up & Go" test as well as the Laitinen questionnaire.
After the treatment, it was determined that the pain intensity assessed according to the visual analogue scale (VAS) decreased, the scope of movability improved and the circumference of knee joints was reduced. Moreover, it was noted that the time for performing the „Up & Go" test was reduced.
At the same time, it was proved that the implemented treatment improved the quality of patients' lives assessed according to the Laitinen questionnaire.

Key words: MSL laser therapy, knee osteoarthritis.

Introduction

Knee osteoarthritis (ChZSK) is the most frequent cause of joint pain, it constitutes either a significant social and economic problem, especially for the ageing society [1].

The disease process concerns not only the joint cartilage, but it pertains also to the whole joint, including the subchondral bone layer, ligaments, joint capsule, synovial membrane and periarticular muscles. Main symptoms of ChZSK include: pain located within the joint and the upper part of shank, joint stiffness, free movement restriction, joint tenderness accompanied by walking abnormalities [1].

According to the guidelines for therapeutic procedures recommended by the American College of Rheumatology (ACR), the European League Against Rheumatism (EULAR) and the Polish Society for Rheumatology (PTR), the treatment of the disease requires interdisciplinary collaboration and the cooperation of rheumatologists with physiotherapists, where non-pharmacological and pharmacological treatment are combined. Physiotherapy also plays a significant role (kinesytherapy, physiotherapy, medical massage, balneotherapy) [1, 2].

Currently, there are many treatment methods that help to reduce or remove the pain and have anti-inflammatory and antipyretic effect. The basic treatment is a conservative one, including pharmacology and physiotherapy. One of the physical methods used in treating knee osteoarthritis is laser therapy. In classical low-energy laser therapy, certain wavelength of laser radiation is used as a pulsed laser light or in a continuous mode. The development of technology caused that currently two wavelengths can be used at the same time, together with high-energy radiation. Multiwave Locked System (MLS) laser therapy allows to apply two different waves of laser radiation simultaneously – during one exposure. The wavelength of 808 nm is emitted in a continuous mode and the wavelength of 905 nm as a pulsed laser light. The main activities of MLS system include anti-inflammatory and antipyretic effect. Combining those two types of radiation emissions enables affecting the trick myelinated fibers, which gives immediate, but short-lasting painkilling impact, as well as the thin non-myelinated fibers, which results in a delayed but long-lasting painkilling effect. The advantage of implementing this kind of therapy is also the consistent distribution of laser radiation energy on the whole exposed surface. The therapy increases protein synthesis (DNA and RNA), collagen and ATP and influences the change of cell membranes' potential. Additionally, positive effects of laser therapy improve microcirculation, dilate blood vessels, improve vascularization and activate bone tissues. Painkilling effect of this treatment is connected with an increase in the number of endorphins and prostaglandins, hiperpolarization of cell membranes, improvement of metabolic processes and acceleration of resorption of exudation from places with inflammation. By improving the circulation, laser radiation stimulates nourishment and regeneration of cells.

Objectives of Proposed Research

The undertaken assessment was related to the effectiveness of MLS laser therapy in treating patients with knee

osteoarthritis, including knee joints movability, intensity of pain and the circumference of knee joints. Moreover, the influence of MLS therapy on the quality of life according to the Laitinen questionnaire was also evaluated.

Matherial and Methods

The study was conducted on 30 people (26 women and 4 men) with knee osteoarthritis, treated in the Rehabilitation Clinic in the University Clinical Hospital in Bialystok with the permission of the Bioethics Commission. The people were from 39 to 77 years of age and the period during which the pain lasted was from 1 to 21 years. Patients received written information about the conducted therapy and signed the Informed Consent Form for the research.

Clinical assessment was conducted on the basis of the interview and physical examination before the commencement of treatment as well as after two weeks of therapy. Pain was assessed according to the visual analogue scale (VAS) and at the same time the ill filled in the Laitinen questionnaire. The measurements of the scope of movability and the circumference of knee joints were taken and the „Up & Go" test was conducted.

The patients qualified to the study suffered from the confirmed knee osteoarthritis with II° progression of radiological changes according to Kellgren Lawrence.

MLS laser therapy was implemented with the use of a scanner from ASA company with the following parameters: length of continuous wave – 808 nm, pulsed laser light – 905 nm, power – 330mW, frequency of 700 Hz, intensity of 50% and a dose of 11,55J. The treatment took 3.5 minutes. The exposure was given on a knee joint. The treatments were repeated every day, for the period of two weeks (without Saturdays and Sundays).

Data analysis was conducted in SPSS statistical package and the visualization of results in Microsoft Office Excel 2007. Research problems were verified with the parametric student's t-test for the dependent trials (repeated measurements). In all the analyses, the assumed materiality level was $p<0,05$. When the result was different from or lower than 0.05, the zero hypothesis related to the lack of differences between the measurements was rejected and the alternative one, which was connected with significant differences between the results of two measurements, was adopted.

Examination Results

Pain intensity according to the VAS scale.

After the treatment, a statistically significant reduction of pain in the VAS scale ($p<0,001$) was achieved. The parameters reached from M=6,2 (SD=1,95) before the treatment and M=3,63 (SD=1,90) after the treatment (Fig. 1)

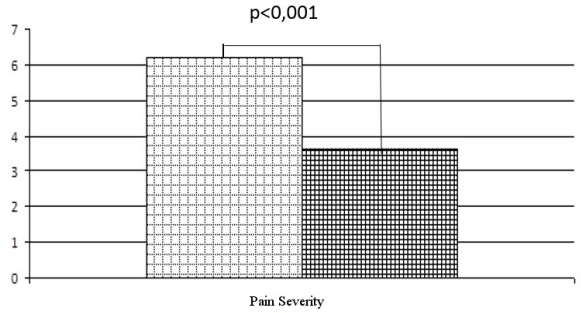

Fig. 1: Descriptive statistics for the examined group of studying women (N=54).

The Laitinen questionnaire.

It was determined that MLS therapy reduced the intensity of pain t(29)=3,97. The values reached from M=2,03 (SD=1,43) before the treatment to M=1 (SD=0,53) after the treatment. The treatment reduced the frequency of pain t(29)=4,91. The values reached from M=2,43 (SD=1,45) before the treatment to M=1,17 (SD=0,65) after the treatment. The achieved results were statistically relevant $p<0,001$. The implemented treatment reduced the amount of painkillers' intake t(29)=4,65. The values reached from M=1,23 (SD=0,82) before the treatment to M=0,7 (SD=0,84) after the treatment. The achieved result was statistically relevant $p<0,001$. At the same time, the proposed laser therapy positively influenced the physical activity of patients t(29)=2,41. The achieved result was statistically relevant $p<0,001$. The values reached from M=1,47 (SD=1,57) before the treatment to M=0,8 (SD=0,61) after the therapy (Fig. 2).

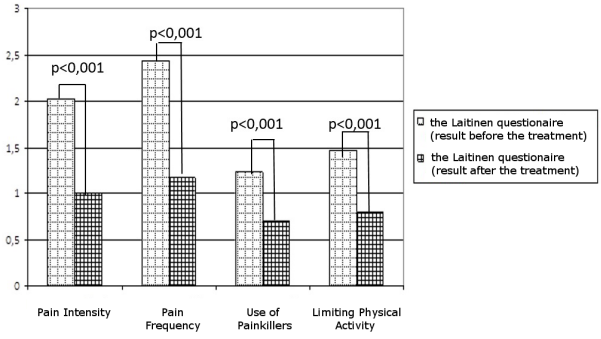

Fig. 2: Descriptive statistics for the examined group of studying women (N=54).

Assessment of knee joints movability.

The analysis showed that the treatment significantly improved the flexion of a right knee joint t(29)=5,41. The values reached from M=103,5° (SD=16,36) before the treatment to M=111,83° (SD=17,39) after the treatment (Fig. 3).

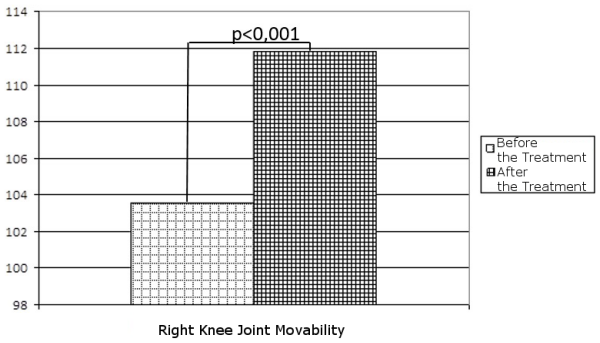

Fig. 3: Descriptive statistics for the examined group of studying women (N=54).

The treatment also improved movability of a left knee joint t(29)=3,61. The values reached from M=102,83° (SD=13,75) before the treatment to M=109,83° (SD=18,87) after the treatment. The achieved results were statistically relevant (Fig. 4).

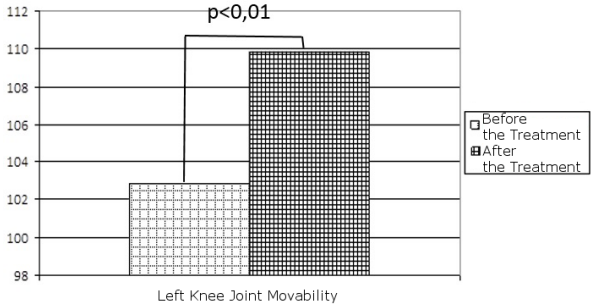

Fig. 4: Descriptive statistics for the examined group of studying women (N=54).

The received therapy influenced the reduction in right knee joint circumference t(29)=6,5. The values reached from M=42,13cm (SD=3,83) before the treatment to M=40,9cm (SD=3,93) after the treatment (Fig. 5).

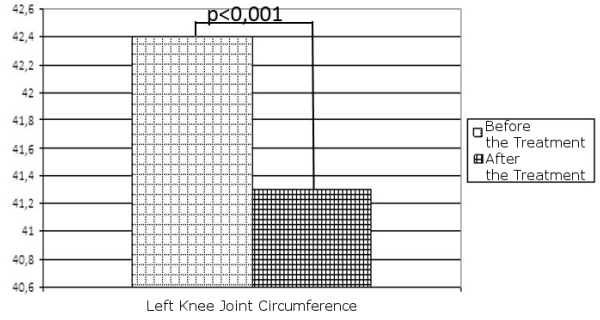

Fig. 5: Descriptive statistics for the examined group of studying women (N=54).

The reduction in a left knee joint circumference was noted t(29)=6,28. The values reached from M=42,4cm (SD=3,71) before the treatment to M=41,3cm (SD=3,84) after the treatment. The achieved results were statistically relevant p<0,001 (Fig. 6).

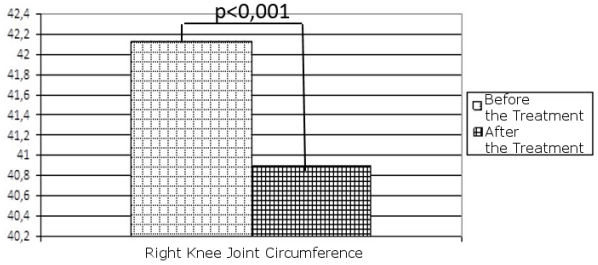

Fig. 6: Descriptive statistics for the examined group of studying women (N=54).

Results of the „Up & Go" test.

The analysis proved that the treatment significantly influenced the duration of the „Up & Go" test t(29)= 4,88. The values reached from M=9,6s (SD=1,87) before the treatment to M=8,73s (SD=1,68) after the treatment. The achieved results were statistically relevant p<0,001 (Fig. 7).

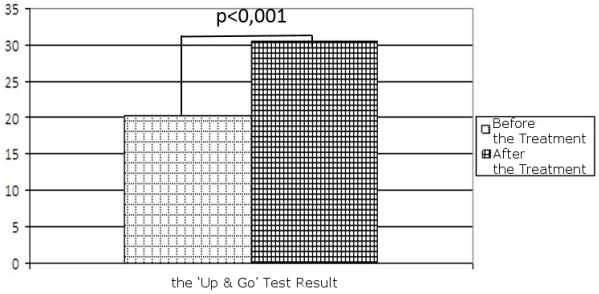

Fig. 7: Descriptive statistics for the examined group of studying women (N=54).

Summary of the Results and Discussion

Knee osteoarthritis belongs to the most frequent chronic diseases of the locomotor system. The most recent recommendations related to conservative treatment include implementation of both pharmacological and physiotherapeutic treatment [1,2]. In literature, the significance of rehabilitation by kinesitherapy [2–5], massage and manual therapy [2,6] as well as physiotherapy [7–17] is often emphasized. In practice, the most frequently used one is low-energy laser therapy, which gives the possibility of a single emission of a continuous wave or a pulsed laser light. Implementation of MLS laser therapy, which consists of combining

and synchronizing the generated continuous and pulsed laser emission in the field of infrared radiation, enables to achieve the painkilling, anti-inflammatory and anti-edema effect [18–20].

Gworys et al. emphasized the significance of laser therapy for the ill suffering from knee osteoarthritis. Four groups of patients were assessed (n=125). The first group experienced single-wave laser radiation with the 810 nm wavelength, power of 400 mW and a dose of 8 J/point, the second one had double-wave MLS beams with power of 1100 mW, frequency of 2000 Hz and a dose of 12.4/point. The third group was treated with double-wave radiation with the dose of 6.6 J/point. Finally, the fourth group received placebo laser therapy. The analogue VAS scale, the Lequesne Scale as well as the modified Laitinen questionnaire were used to assess the impact of therapy. In all the first three groups, the statistically relevant alleviation of pain and the improvement in functional capacity were achieved. The most significant therapeutic effects were observed in the second group that received MLS therapy with a dose of 12.4 J/point [19].

The effectiveness of MLS laser therapy was proved by the study of Gasztych et al. Among 90 patients with gonathrosis, three groups were distinguished. The first one received placebo laser therapy. The second group experienced the radiation with a dose of 3.95 J/cm^2 and the third one of 2.09 J/cm^2. The analogue VAS scale, the modified Laitinen questionnaire as well as the Lequesne Scale were used to assess the impact of the therapy. Higher effectiveness was observed in the two groups compared to the one receiving placebo. The most significant effectiveness was determined in the second group that received MLS therapy with a dose of 3.95 J/cm^2 [20].

Similar results were achieved in own research. Significant alleviation of pain according to the VAS scale was noted, with 6.2 before the therapy to 3.63 after the treatment.

Other works describe the utilization of single laser radiation during the therapy.

Kujawa, J. et al. treated with laser biostimulation a group of 32 patients with gonathrosis. Laser radiation with the wavelength of 810 nm, power of 400 mW and a dose of 8 J was implemented. The method of punctual and contractual exposure by a probe was used. Pain was assessed with the VAS scale and the modified Laitinen questionnaire. With the use of thermovisual examination, the temperature of knee joint tissues was established. The authors achieved alleviation of pain and normalization of temperature of the knee joints that experienced the exposure [21].

Hegedus et al. indicate the anti-edema effect of laser radiation. Among 27 of the studied people, two groups were distinguished, where the first one experienced punctual laser radiation with the wavelength of 380 nm, power of 50 mW and a dose of 6 J/point, whilst the second group received placebo. The patients from the first group were noted to experience statistically relevant alleviation of pain, improvement in joints movability as well as alleviation of pain while pressing and edema [22].

Similar results were achieved in own research. The scope of movability was improved by 7 degrees in a left knee joint and by 8 degrees in a right knee joint.

Niemierzycka in her work used the pressure contractual method of laser radiation with the power of 80 mW and the wavelength of 830 nm. Statistically significant difference was demonstrated between all the pain indices, specified in the modified Laitinen questionnaire [23].

Similar results were obtained in own research. Statistically significant improvement in all the indices included in the Laitinen questionnaire was achieved: the decrease in pain intensity and frequency of its occurrence. Patients received fewer painkillers and their physical activity improved.

The research conducted by Ciechanowska et al. determined the effectiveness of laser therapy given in the therapy combined with the cold therapy and the compression therapy. Thirty patients with knee osteoarthritis received the punctual laser radiation with the wavelength of 810 nm, power of 400 mW and surface density of 4-6 J/cm^2. The level of pain was assessed with the VAS scale and the Laitinen questionnaire. The measurements of knee joints circumference were taken and the following functional tests were done: squat test, unrestricted mobility on the distance of 6 meters and the „Up & Go" test. After the treatment, alleviation of pain, reduction in knee joint circumferences and the improvement in the patients' functionality were achieved.

Own observations also show that the implemented therapy causes decrease of knee joints' edema, which is manifested by the reduction in their circumference by 1.16 cm, on average.

Another person who aimed to assess the effectiveness of laser therapy used in conjunction with other physical methods was Łukowicz et al. The research was conducted on five groups of patients, who were given subsequently: low-energy laser therapy, low-energy laser therapy combined with cryotherapy, cryotherapy, magnetotherapy as well as magnetotherapy combined with low-energy laser therapy. Laser with the power of 400 mW, wavelength of 810 nm and a dose of 5-8 J/cm^2 was applied. The highest effectiveness, assessed according to the Laitinen questionnaire and a functional squat test, was achieved by laser therapy combined with magnetotherapy. However, in the group where laser therapy was combined with cryotherapy, the effectiveness in pain alleviation and decrease in knee joints circumference was reported, which indicates the reduction in exudations [24].

In the present study, we also managed to improve the speed of performing the „Up & Go" test from 9.6 seconds determined by the therapy to 8.73.

In the other research of Gur et al., 60 patients with knee osteoarthritis were given laser therapy combined with gymnastics. In the first group (30 persons), the laser therapy treatment lasted 5 minutes and used a dose of 3 J and the other group received the treatment with a dose of 2 J, which took 3 minutes. In both cases, a significant improvement was noted when it comes to experiencing pain, the scope of join movability, morning stiffness and the ability to walk and function, assessed according to the WOMAC scale [25].

The effectiveness in implementing the laser radiation in treating patients with knee osteoarthritis was proved by the research conducted by Alfredo et al. The laser biostimulation treatment with a dose of 3 J and combined with exercises was implemented. The results were compared to the ones obtained from the group receiving placebo. The statistically relevant pain alleviation, improvement in join movability as well as functional improvement, according to the WOMAC scale were noted in the first group.

The conducted research indicates the effectiveness of MLS laser therapy in conservative treatment of knee osteoarthritis. It improves the indices of pain assessment as well as the clinical ones. It leads to the improvement in the scope of movement, lessening the circumference of joints and lowering the medical tests values. Laser therapy has painkilling, anti-inflammatory and anti-edema effects, leads to the reduction in exudation and normalizes microcirculation.

Conclusions

1. After MLS laser therapy, the intensity of pain in patients with knee osteoarthritis was reduced.
2. MLS laser therapy leads to the improvement in the scope of knee joint movability.
3. MLS laser therapy reduces the circumference of knee joints.
4. MLS laser therapy improves the quality of patients' lives assessed according to the Laitinen questionnaire.

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