

The comparison of multi-waved locked system laser and low-frequency magnetic field therapy on hand function and quality of life in patients with rheumatoid arthritis - preliminary study

Porównanie wpływu biostymulacji laserowej i pola magnetycznego niskiej częstotliwości na funkcję rąk u pacjentów z reumatoidalnym zapaleniem stawów

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SUMMARY

Introduction: The progression of inflammation in rheumatoid arthritis (RA) leads to destruction of synovial membrane, joint surface, loss of function and mobility. Comprehensive rehabilitation consists of exercises, modalities, orthoses and occupational therapy.

Goal: The aim of this study was to compare the multi-waved locked system (MLS) laser therapy with low-frequency magnetic field (MF) therapy on hand function and quality of life in RA patients.

Methods: The study was conducted among 30 patients with RA. First group (n=15) received ten sessions MLS laser therapy (intensity 50%, 500 Hz, 808 nm, 905 nm), second group (n=15) received ten sessions MF therapy (5-23 Hz, 3-7.5 mT). The intensity of pain was assessed by Visual Analogue Scale, hand function by Brief Michigan Hand Outcome Questionnaire.

Results: Reduction of pain was reported in the MLS laser therapy group, but not in the MF group. In both groups a decrease of swollen joints number (Ritchie Articular Index) was observed. Moreover, improvement of hand function, grip strength and quality of life (Health Assessment Questionnaire) were also observed, especially in MLS laser therapy group.

Conclusion: MLS laser therapy appears to be more effective modality, than MF therapy in patients with RA with hand involvement.

Key words: rheumatoid arthritis, laser, magnetic field, quality of life

STRESZCZENIE

Wstęp: Reumatoidalne zapalenie stawów (RZS) jest układową chorobą tkanki łącznej, charakteryzującą się symetrycznym zapaleniem stawów, z początkowym zajęciem drobnych stawów rąk, prowadzącym do destrukcji stawów, deformacji i niepełnosprawności. Dużą skuteczność w leczeniu RZS przypisuje się zabiegom fizykoterapeutycznym, a wśród nich biostymulacji laserowej oraz polu magnetycznemu małej częstotliwości. Celem pracy było porównanie wpływu biostymulacji laserowej i pola magnetycznego niskiej częstotliwości na funkcję rąk oraz jakość życia u pacjentów z RZS.

Materiał i metody: Grupę badaną stanowiło 30 pacjentów z RZS. Pierwsza grupa (n=15) została poddana serii 10 zabiegów z wykorzystaniem pola magnetycznego niskiej częstotliwości, druga grupa (n=15) została poddana serii 10 zabiegów biostymulacji laserowej.

Wyniki: Uzyskano zmniejszenie dolegliwości bólowych w grupie chorych poddanych biostymulacji laserowej, w przeciwieństwie do pacjentów leczonych polem magnetycznym niskiej częstotliwości. W obu badanych grupach obserwowano zmniejszenie liczby obrzękniętych stawów, poprawę siły mięśni rąk oraz jakości życia, zwłaszcza w grupie chorych poddanej zabiegom laseroterapii.

Rezultaty: Powyższe wyniki badań mogą sugerować, że laseroterapia jest zabiegiem skuteczniejszym w leczeniu dolegliwości bólowych stawów rąk u pacjentów z reumatoidalnym zapaleniem stawów.

Słowa kluczowe: reumatoidalne zapalenie stawów, laser, pole magnetyczne, jakość życia

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INTRODUCTION

Rheumatoid arthritis (RA) is a chronic, progressive disease characterized by pain, inflammation and joint destruction. Involvement of hands in RA leads to deformation and impairment of functional abilities and quality of life in early stage of the disease. Pharmacological treatment and rehabilitation should constitute complex management of patients in every stage of the disease. The standard rehabilitation therapy composes of physical exercises, modalities (i.e. laser, magnetic field, electrotherapy) and supportive devices such as orthoses. The aim of physiotherapeutic management is focus on improvement quality of life by decrease of pain, swelling, reduction of stiffness and joint deformity [1].

The modalities are widely used in patients with musculo-skeletal diseases. The therapeutic effect of the multi-waved locked system (MLS) laser therapy and pulsed low-frequency magnetic field (MF) therapy is based on anti-inflammatory and analgesic function [2]. The MLS laser therapy is based on synchronized emissions of two wavelengths in continuous (808 nm) and pulsed (905 nm) irradiation mode [3,4]. The combination of two length waves is responsible for dual effect. The 808 nm wave has anti-inflammatory and anti-oedemic effect, while 905 nm wave causes analgesic action [4].

Pulsed low-frequency MF therapy is an established therapeutic modality for various indications in rheumatic diseases. The studies showed reduction of pain, improvement of functional performance in patients with musculoskeletal diseases – knee osteoarthritis, fibromyalgia, RA [5,6].

The aim of study was to compare the short term efficacy of MLS laser therapy and low-frequency MF therapy on hand function in RA patients.

MATERIAL AND METHODS

A randomized, prospective trial was carried out on 45 patients with RA according to the classifications criteria of the American College of Rheumatology and European League Against Rheumatism [7]. Patients were recruited from Department of Rehabilitation, Medical University of Białystok. All participants signed terms an informed consent form before the therapy. Patients were randomly assigned into the three groups: MLS laser therapy (n=15), MF therapy (n=15) and control group with RA without physiotherapy (n=15). The randomization was performed using Research Randomizer [8]. The survey could not be blinded, because of the different forms of device used during the procedures.

The study included patients with subacute or chronic course of the RA. The subjects were excluded if they met any of the following criteria: injury of hands with skin lesions,

diagnosis of neoplastic disease, implantation of cardiac pacemaker, physiotherapy on hands in the previous three months, changes of the pharmacological treatment in previous three months, pregnancy. All patients were treated with methotrexate in doses of 10-15/week, without non-steroidal anti-inflammatory drugs therapy.

The therapy was carried out every day with Saturday-Sunday break for two weeks (10 sessions).

The MLS laser is the example of low level laser therapy (LLLT). The MLS laser used double, equally penetrating wavelength (808 nm – in continuous emission, 905 nm in pulsed emission) to a depth of 3-4 cm, by scanning method. The parameters of MLS laser therapy (laser M6, ASA®) were: intensity 50%, frequency 500 Hz, dose 118,1 J, time of each session 2,5 minutes. The each hand was exposed separately. The magnetic field therapy was performed using the device (MF-20, Magnetronic®) generating pulsed, low-frequency, bipolar, rectangular impulses. The sessions started with parameters 5 Hz and 3 mT, gradually increasing to 23 Hz and 7,5 mT at last session.

All patients finished the study. No adverse effects were observed. Patients were assessed by a trained evaluator at the beginning and after two days from the ending of treatment, using the following instruments. The clinical assessment consisted of the activity indices – disease activity score 28 (DAS 28) and Steinbrocker Index [9,10].

The pain was assessed by Visual Analogue Scale (VAS) between 0 and 10 cm, which 0 represented no pain and 10 - maximum pain. The number of tender joint was assessed by Ritchie Articular Index (RAI) [11]. Dynamometer (SAEHAN Hydraulic Pinch Gauge, SH5005) was used for evaluation of grip strength on each hand. For the assessment of hand function Brief Michigan Hand Outcome Questionnaire (Brief MHQ) was used. The Brief MHQ contains 12 items with responses on a 1 through 5 Likert scale regarding overall hand function and the activities of daily living [12,13]. The quality of life was measured by Health Assessment Questionnaire (HAQ) [14]. The HAQ assessed the degree of difficulty in performing activities of daily living. The measurements were repeated three times on both hands and the mean value was calculated. All questionnaires have been validated for the Polish language. The study received approval from the Local Bioethical Committee.

Statistical analysis was performed using STATISTICA version 10.0 (StatSoft, Inc). Continuous variables were analysed by non-parametric methods, using the Wilcoxon signed-rank test. The comparisons between groups were assessed by ANOVA test. The correlations for non-parametric values

were calculated by Spearman test. The results were considered as significant with $p < 0.05$.

RESULTS

Forty five patients were studied. The patients' characteristics was displayed in Table 1. The assessed groups were homogenous in the variables studied at the beginning of the treatment ($p > 0.05$). The disease duration correlated with Steinbrocker Functional Index ($r = 0.53$, $p < 0.001$). The activity of disease (DAS 28) correlated with Steinbrocker Functional Index ($r = 0.51$, $p < 0.01$).

In the group of patients with MF therapy, the change of pain intensity (VAS) was not observed ($p = 0.29$). However, the MLS laser therapy significantly reduced the VAS ($p = 0.001$). The tenderness of joints described by RAI decreased in the both treatment groups, though the reduction was more pronounced after laser therapy ($p = 0.001$). The function of right hand described by grip strength improved in both groups equally. The improvement in left hand was better in group of patients receiving MLS laser therapy. In the both groups of patients increase of Brief MHQ was observed, especially after MLS laser therapy. The study showed improvement overall quality of life assessed by HAQ in both groups after therapy. The results are presented in Table 2.

Table 1. Clinical characteristics of the groups.

| | Laser group n=15 | MF group n=15 | Control group n=15 | P values |
|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|----------|
| Mean age, years (SD) | 68 (9.6) | 59.5 (8.06) | 59.3 (9.8) | 0.051 |
| Mean duration of disease, years (SD) | 15.5 (14.9) | 13.8 (8.06) | 16.6 (14.2) | 0.98 |
| Gender (F/M) | 14/1 | 12/3 | 11/4 | 0.33 |
| Steinbrocker Functional Index, n | I - 3 II - 6 III - 3 IV - 3 | I - 4 II - 4 III - 4 IV - 3 | I - 3 II - 6 III - 3 IV - 3 | 0.71 |
| DAS 28 | 5.3 (1.7) | 5.2 (1.2) | 5.1 (1.4) | 0.85 |

Table 2. The variables assessed in the group of patients with MLS and MF therapy.

| Variable (mean ± SD) | MLS laser therapy | | P values | MF therapy | | P values | |
|-------------------------|-------------------|----------------|------------|---------------|----------------|-------------|------|
| | Pre-treatment | Post-treatment | | Pre-treatment | Post-treatment | | |
| VAS (±SD) | 4.3 (2.9) | 1.6 (1.8) | 0.001 | 4.2 (2.5) | 3.2 (2.3) | 0.24 | |
| RAI | 13.2 (11.9) | 4.8 (5.2) | 0.001 | 15.5 (19.5) | 4.9 (3.6) | <0.01 | |
| Grip strength | Right hand | 15.4 (8.9) | 26.3 (8.7) | 0.01 | 17.1 (13.3) | 22.8 (16.9) | 0.01 |
| | Left hand | 16.8 (8.8) | 25.7 (7.7) | 0.001 | 18.1 (11.7) | 22.4 (13.6) | 0.03 |
| Brief MHQ | 45.2 (16.6) | 68.5 (13.1) | <0.001 | 46.8 (22.8) | 62.3 (14.7) | <0.01 | |
| HAQ | 0.78 (0.6) | 0.5 (0.4) | <0.01 | 1.05 (0.6) | 0.75 (0.5) | <0.01 | |

SD – standard deviation, VAS – Visual Analogue Scale, RAI – Ritchie Articular Index, Brief MHQ – Brief Michigan Hand Outcome Questionnaire, HAQ – Health Assessment Questionnaire, MLS – multi-waved locked system, MF – magnetic field

DISCUSSION

The physiotherapeutic management of RA is complex and requires proper treatment.

The treatment includes therapeutic exercises, modalities, joint protection strategies (e.g. splint, assistive devices) and massage therapy. The selection of the most favourable modality is problematic. The study presents short-term effect of MLS laser and MF therapy.

The previous reports concerning LLLT on hands in patients with RA showed divergent results. The study presented by Palmgren et al. conducted among 35 patients with involvement of MCP and PIP joints, showed improvement of strength and flexibility, reduction of pain, morning stiffness and swelling in experimental group with LLLT [15]. However, Johannsen et al. observed lack of differences in morning stiffness and pain, after LLLT in patients with hand involvement RA [16].

The next report, presented by Meireles et al., confirmed above results [17]. The study was conducted among 82 patients with RA. The aluminum gallium arsenide laser (785 nm, dose 3 J/cm²) was administered on hands of patients with RA. In most of assessed variables (VAS, morning stiffness, grip strength), the difference at the end of LLLT was not observed.

During systematic review of literature, we found only few studies concerning pulsed low-frequency MF therapy in patients with RA. Shupak et al. presented the positive influence of MF therapy on central nervous system in decrease of pain ratings in patients with RA [6]. In addition, the previous reports based on rats models showed positive effect in reduction of oedema and inflammatory cells infiltrations [18].

In available literature, no comparative studies between MLS laser and MF therapy were found.

The MLS laser therapy is associated with anti-inflammatory, anti-oedematous and analgesic action. There are few data concerning action of lasers with dual wave-length in musculoskeletal diseases. The last studies showed beneficial effect of MLS laser therapy in reduction of pain in subjects with knee joint osteoarthritis and improvement of microcirculation in patients with Raynaud's phenomenon [3, 4].

The both interventions were beneficial, although the results observed in study showed superiority of MLS laser

therapy in reduction of pain, RAI and improvement of hand function and quality of life in patients with RA.

CONCLUSION

No available literature is available concerning comparison between MLS laser and low-frequency MF therapy in RA patients. Presented study has some limitations regarding to small examined population, and short time of observation. The analysis should be also broaden of long - term assessment of patients after finishing the treatment.

Results suggest that effectiveness of MLS laser therapy appears to be more favourable than MF in fast relieving of pain, although further studies should be performed.

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