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ORIGINAL ARTICLE

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Evaluation of analgesic effectiveness of infrared radiation and interference currents in degenerative diseases

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

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Key words: *degenerative diseases, physical therapy, pain, gerontology*

Abstract

Background: *The aim of this research is to evaluate analgesic effectiveness of infrared radiation and interference currents in degenerative diseases of joints. On the grounds of current practical and theoretical experience, the following hypothesis was formed: Application of interference currents and infrared radiation constitutes effective analgesic therapy in degenerative diseases, and in the case of the applied treatment, its effectiveness is long-term.*

Material/Methods: *Tests were conducted on a group consisting of 32 women and men in the age range of 65-87 years of age suffering from a degenerative disease of the knee joint. The patients were applied a series of 10 treatments with application of the Sollux lamp for 15 minutes and interference currents of 50-100 HZ frequency for 5 minutes and 90-100 Hz for 10 minutes during treatment. Evaluation of the efficiency of therapy was checked by means of the VAS scale and the Laitinen scale.*

Results: *The results indicate an efficient analgesic effect according to the VAS scale immediately after treatment* p = *0.002 and a month after treatment* p = *0.000 as well as according to the Laitinen scale immediately after treatment* p = *0.004 and a month after treatment* p = *0.004.*

Conclusions: *Application of infrared radiation and interference currents indicates an analgesic effect. These treatments may be alternative or supportive to pharmacological treatment in the case of degenerative changes in people who are over 65 years of age. Results of the research suggest continuation of further research on the effectiveness of the above-mentioned therapy and the length of preserving analgesic results in people with degenerative diseases of joints.*

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Introduction

Pain is associated with consciousness and is a synonym of suffering; connected with motor organs, it is often caused by degenerative disease of joints [1], [2]. Progressive degenerations, at first of a cartilage and then of the following subcondral layers and finally of the bone tissue itself may be a symptom of ageing of an organism and wearing of the osteoarticular system [3], [4]. If pain and dysfunction assist, they are called lesions [5]. Pain and dysfunction are among the most important symptoms in a degenerative disease [6] and the main reason for the patient to make an appointment with the doctor; moreover, along with proceeding disability, it leads to a considerable decrease in the quality of life [7], [8]. Medical research of pain frequency confirms its intensity being connected with the patient's age. The frequency of occurrence of chronic pain increases alongside with ageing of the organism. It concerns 80% of 65-year-old people and almost 100% people who are over 80 years of age. Despite progress in medicine, as many as 40% of sick people who suffer from pain claim dissatisfaction with therapy [9],[10].

Physical therapy offers a wide range of treatment which may be applied in the case of various forms of pain [11], [12]. The applied treatment and methods depend on the reason for pain occurrence, time of its duration and intensity [13]. Treatments with interference current, that is current of medium frequency (3000-5100 Hz) are chosen as effective analgesic therapies [14], [15], [16].

The aim of this research is to evaluate analgesic effectiveness of infrared radiation and interference currents in degenerative diseases of joints. On the grounds of current practical and theoretical experience, the following hypothesis was formed: Application of interference currents and infrared radiation constitutes effective analgesic therapy in degenerative diseases [17], [18], and in the case of the applied treatment, its effectiveness is long-term.

Material and methods

Research was conducted on a group of 32 women and men in the age bracket of 65-67 years of age. Among them 22% had higher education, 44% had secondary education, 19% had vocational education and 16% elementary one. 34% of subjects showed physical activity and 60% were beneficiaries of the pension scheme. The subjects were administered a series of 10 treatments with application of a Sollux lamp with a red filter during a period of 15 minutes and interference current of frequency of 50-100 HZ for 5 minutes and 90-100Hz for 10 min in treatment of degenerative disease of the knee joint. Patients who underwent treatments were qualified by a rehabilitation doctor in the Clinic of Rehabilitation of the St. Adalbert Specialist Hospital. Examinations were conducted before therapy, after two-week therapy and four weeks after the completed therapy.

Measurements were taken by means of the VAS (Visual Analogue Scale) scale [19], [20] of a modified assessment questionnaire of pain intensity according to Laitinen [21] and closed questions questionnaire of own construction. The visual–analogue VAS scale is a method according to which the subjective intensity of suffered pain is determined. The VAS scale is made by line, usually of 10 cm long, at which the opposite ends and particular segments are marked. The line may be vertical or parallel. The patient has to mark a point at this line which corresponds to the intensity of felt pain at a given moment. Values "0" on the scale are assigned to a total lack of pain and "10" is the strongest possible pain. Owing to the VAS method, we may compare the intensity of pain in a patient mainly before and after application of the treatment.

Another tool used in research was a modified questionnaire of pain intensity according to Laitinen. This scale, besides measuring pain intensity simultaneously allows assessing other factors assisting pain, namely:

- taking pain killers,
- intensity of pain occurrence,
- limiting motor activity.

The patient assesses each of the examined factors on a 5-degree scale in the range from 0 to 4, where:

- 0 means: without pain, does not occur, no help
- 1 means: mild, periodical, does not occur, without medicine, no help
- 2 means: strong, frequent, big doses, demanding partial help
- 3 means: very strong, very frequent, permanent, big doses, demanding partial help,
- 4 means: not sustainable, continuous pain, permanently very big doses, demanding full help.

Information concerning treatment of the interviewed people was subjected to statistical analysis. The calculations were made with software for statistical data analysis STATISTICA – basic statistics, tables and ANOVA tests.

Qualitative variables were presented by means of the number of observations. Quantitative variables were presented by means of descriptive characteristics (mean and standard deviation). Results at $p < 0.05$ were accepted as statistically significant.

Results

Table 1. Statistics of mean and standard deviation of particular components of pain ailments before treatment and after its completion in the examined patients

Variable	Before treatment	After treatment
	x ±s	x ±s
Pain ailments according to the VAS scale	6.594 ±1.316	3.281 ±1.971
Intensity of pain according to the Laitinen scale	2.531 ±0.761	1.125 ±0.751
Frequency of pain occurrence according to the Laitinen scale	2.593 ±1.043	1.156 ±0.883
Application of painkillers according to the Laitinen scale	1.812 ±1.060	0.531 ±0.671

Variable: intensity of pain according to the VAS scale

Figure 1 illustrates mean values of pain ailments before and directly after a series of 10 treatments, measured according to the VAS scale in 32 patients.

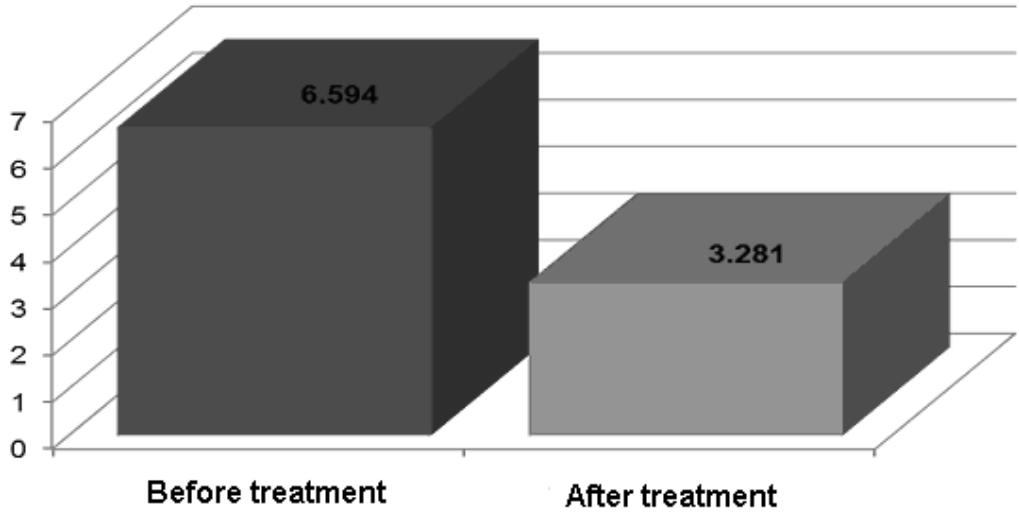

Fig. 1. Mean values of pain ailments of the subjects before and directly after treatment according to the VAS scale

Before treatment, the mean value of pain ailments equalled x = 6.594 at standard deviation of ±1.316; directly after treatment the values equalled respectively 3.281 ±1.971. The presented results confirm that pain ailments, directly after treatment, in all subjects essentially decreased. The observed changes of mean values are statistically significant at the level of $p < 0.0014$ before treatment and $p < 0.0018$ after treatment.

Table 2. Analysis of variance for measurements – variable: pain ailments according to the VAS scale

Variable	SS	df	MS	F	*p*
Pain ailments before treatment	26.052	7	3.721	3.228	0.0014
Pain ailments after treatment	60.540	5	12.108	5.253	0.0018

Explanations: SS – Sum of Squares, df – degrees of freedom, MS – mean squares, F – value of testing function, p – value of probability

Variable: intensity of pain before and after treatment according to the Laitinen scale

Figure 2 presents an assessment of pain intensity by subjects according to the Laitinen scale before and directly after a series of 10 treatments. The examined group was submitted to tests depending, among others, on determining the intensity of pain before and after treatment according to the following scale: 0 – without pain, 1 – mild, 2 – strong, 3 – very strong, 4 – unbearable.

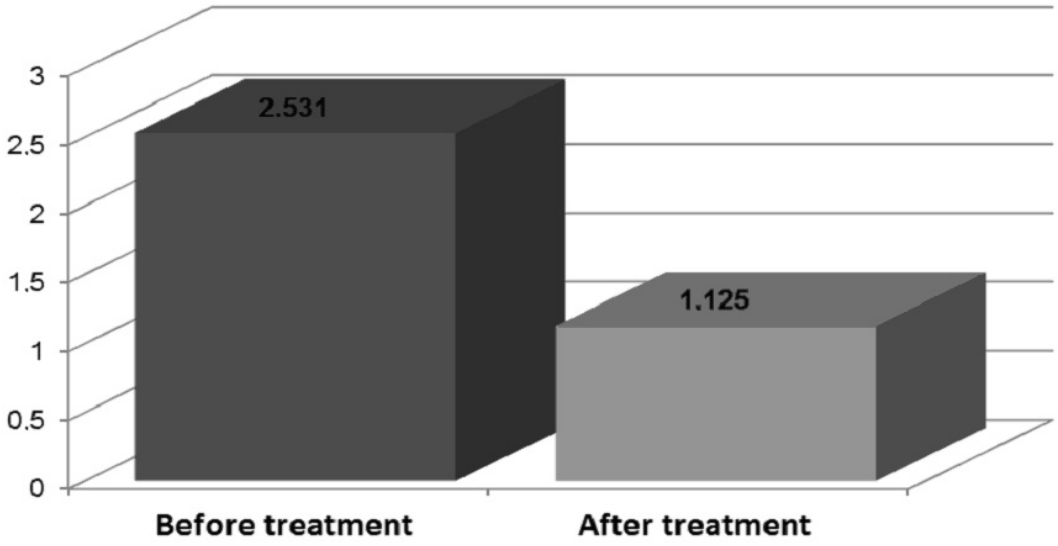

Fig. 2. Mean values of pain ailments in subjects according to the Laitinen scale

Before treatment the mean value of pain intensity equalled 2.531 ±0.761, and after treatment 1.125 ±0.751. Analysis of variance indicates that mean values of pain intensity measured according to the Laitinen scale after treatment distinctly decreased. No case of an increase in pain intensity was noted. The conducted examinations gave a statistically significant result at the level of $p < 0.005$ before treatment and $p < 0.004$ after 10 treatments.

Table 3. Analysis of variance for measurements – variable: intensity of pain according to the Laitinen scale

Variable	SS	df	MS	F	*p*
Intensity of pain before treatment	6.517	3	2.172	5.312	0.005
Intensity of pain after treatment	5.888	3	1.962	4.733	0.004

Variable: Frequency of pain occurrence according to the Laitinen scale

In Figure 3 mean values of the frequency of pain occurrence according to the Laitinen scale are presented. The patients who were examined before treatment and directly after a series of 10 treatments determined the frequency of pain occurrence on a scale 0-4.

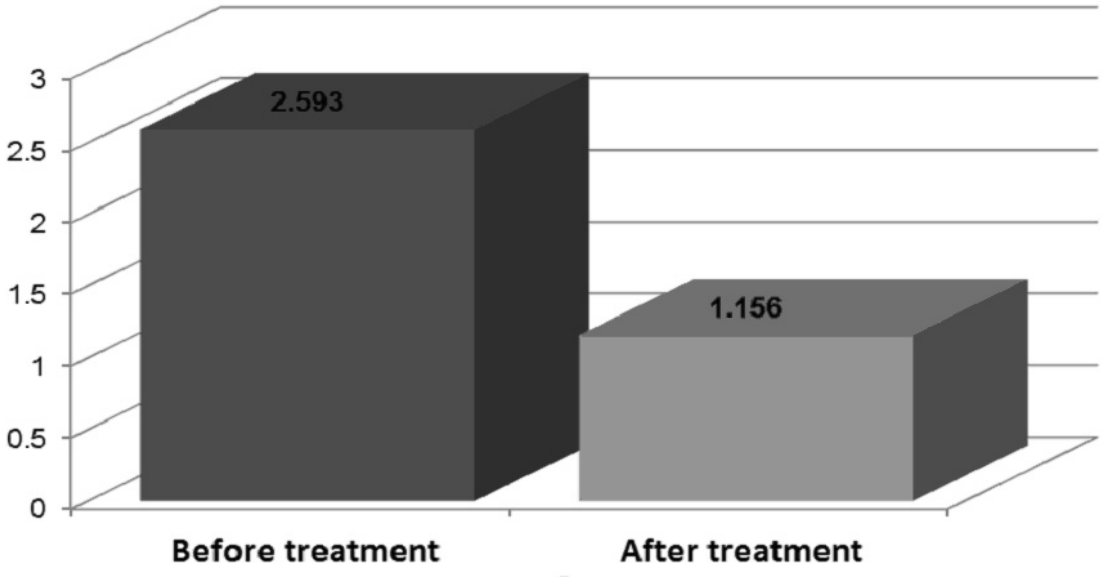

Fig. 3. Mean values of the frequency of pain occurrence in subjects according to the Laitinen scale

The mean value of the frequency of pain occurrence before treatment was 2.593 ±1.043 and 1.156 ±0.883 after treatment. The presented results of research testify an improvement after treatments in all subjects. The frequency of pain occurrence according to the Laitinen scale gives a statistically significant result ($p < 0.000$).

Table 4. Analysis of variance for measurements - variable: frequency of pain occurrence according to the Laitinen scale

Variable	SS	df	MS	F	p
Frequency of pain occurrence before treatment	20.504	3	6.835	14.482	0.000
Frequency of pain occurrence after treatment	14.486	3	4.929	13.893	0.000

A comparison of results of pain assessment conducted directly after treatment and a month after its completion

Table 5. Statistics of the mean and standard deviation of particular components of pain ailments in subjects directly after treatment and a month after its completion

Variable	Directly after treatment	A month after treatment
	x ±s	x ±s
Pain ailments according to the VAS scale	3.281 ±1.971	2.750 ±2.300
Intensity of pain according to the Laitinen scale	1.125 ±0.751	1.000 ±0.842
Frequency of pain occurrence according to the Laitinen scale	1.156 ±0.884	1.093 ±1.027

Figure 4 presents a comparison of mean values of pain ailments directly after treatment and a month after its completion. It may be concluded from the graph that the mean value of pain ailments was 3.281 ±1.971; however, after a month it decreased to 2.750 ±2.300.

By analysing the information, it may be stated that the applied method of treatment gave a positive result in the form of a decrease in pain ailments among the patients.

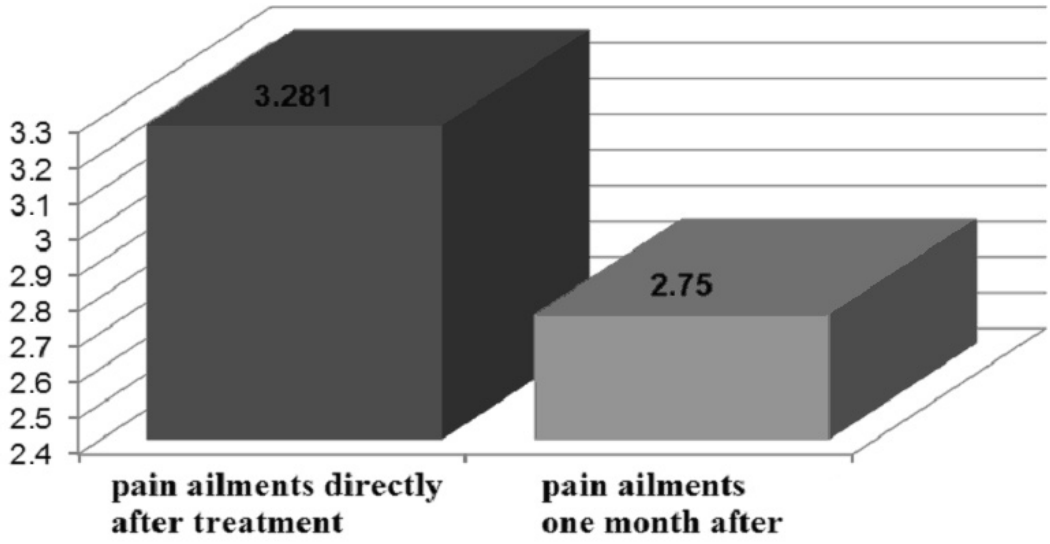

Fig. 4. Comparison of mean values of pain ailments directly after treatment and a month after completion according to the VAS scale

Figure 5 presents a comparison of mean values of pain ailments directly after treatment and a month after its completion according to the Laitinen scale. It follows from analysis of the results that mean values of pain intensity measured directly after treatment – 1.125 ±0.751 decreased after a month to the value of 1.000 ±0.842. Moreover, no case of an increase of pain intensity was noted after a month of treatment. The applied method of treatment brought a positive effect in all subjects.

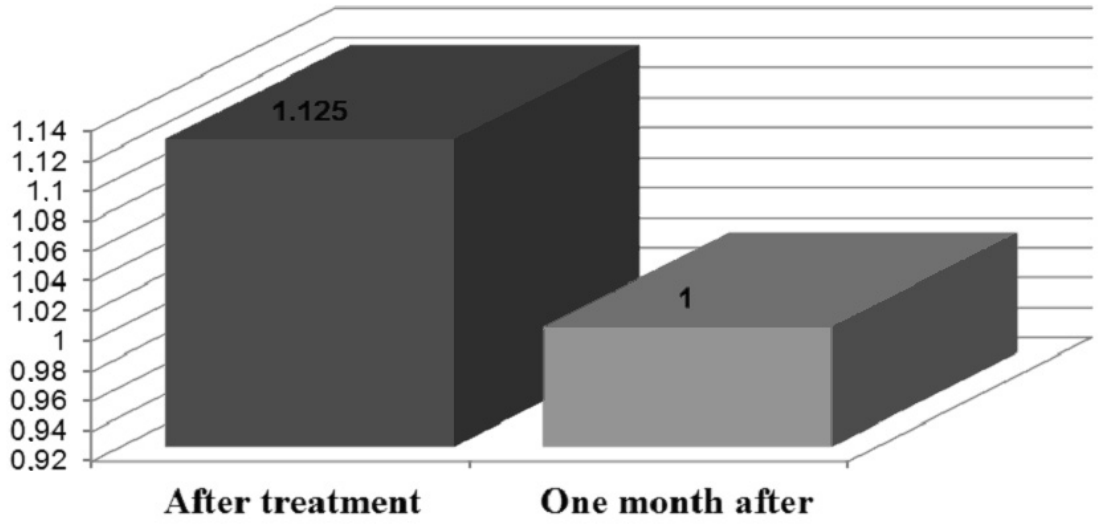

Fig. 5. Comparison of mean values of pain intensity directly after treatment and a month after its completion according to the Laitinen scale

Figure 6 illustrates a comparison of mean values of the frequency of pain occurrence directly after treatment and a month after its completion on the Laitinen scale. After direct treatment, the mean value of pain frequency in the group of subjects was 1.156 ±0.884; however, a month after finishing treatment this value decreased to 1.093 ±1.027.

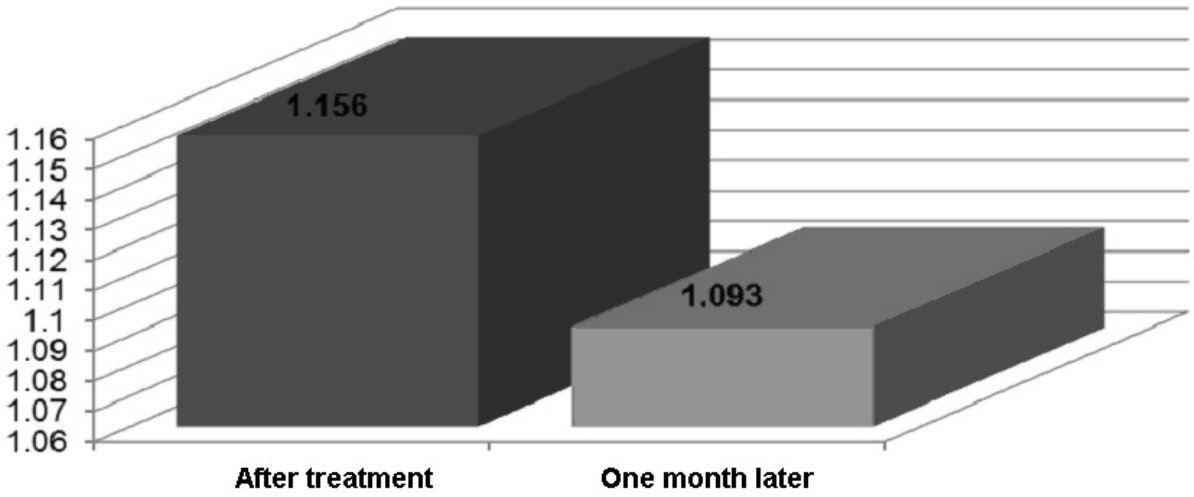

Fig. 6. Comparison of mean values of the frequency of pain occurrence directly after treatment and a month after its completion according to the Laitinen scale

It results from analysis of the information that the values of the frequency of pain occurrence a month after treatment decreased or were limited to a significant degree. The cases of an increase in the frequency of pain a month after treatment were not noted.

Table 6. Mean values of the assessment of pain intensity before and after treatments conducted directly after treatment and a month after its completion. In the last column values of testing functions (F) and testing probability (*p*) for planned comparison are given

No.	Variable	Mean	N	Planned comparison
1	Pain ailments directly after treatment according to the VAS scale	3.281	32	F= 5.253 p=0.002
	Pain ailments a month after treatment according to the VAS scale	2.750		F= 8.414 p=0.000
2	Intensity of pain directly after treatment according to the Laitinen scale	1.125	32	F=4.733 p=0.004
	Intensity of pain a month after treatment according to the Laitinen scale	1.000		F=2.783 p=0.004
3	Frequency of pain occurrence directly after treatment according to the Laitinen scale	1.156	32	F=13.893 p=0.000
	Frequency of pain occurrence a month after treatment according to the Laitinen scale	1.093		F=3.637 p=0.001

Discussion

The reason for many civilisation diseases is various structural anomalies in motor organs. This is most often connected with improper lifestyle, obesity as well as lack of movement; all of the above are the main causes of degenerative changes. Degenerative disease is characteristic of ageing society. Currently, it is a worldwide social and medical problem. Pain occurring in this ailment and, even worse, decreased joint mobility lead to disability which decreases the quality of a patient's life [22].

It is estimated that in Europe, degenerative joint disease occurs in about 4% of people at the age of 18-14 and in the eldest age group, it concerns 85% people. For people over 65 years of age it is the most frequently described change in a radiological assessment and in patients over 75, such a diagnosis is found in 80 % of patients.

According to the Central Statistical Office, elderly persons' participation in the total number of people by 2030 will have reached a level of about 24%, that is almost every fourth Pole will be at least 65 years old. The problem of prophylaxis, therapy and long-term rehabilitation in degenerative disease will be a serious challenge in the near future.

Physical medicine, developing for many years, may offer an effective method in pain management. The goal is served by a wide spectrum of physiotherapeutic treatments and, in particular, their skilful combination, e.g. application of infrared radiation with a use of a Sollux lamp and interference current [23], [24].

According to Kar (1989), red colour light has been widely applied in speeding the process of recovery already since ancient times [25]. Val Robertson, Alex Ward, John Low, Ann Reed state that infrared as a stimulus causes such therapeutic effects as a decrease in pain ailments, a decrease in pathological muscle tension and an acceleration of regenerative processes [26]. An opinion about the confirmed effectiveness of the mentioned above therapeutic effects is widely applied and widely known. Hence, little research was conducted, even though the results of this research confirm the effectiveness of infrared in treating pain [27].

Masuda et al. (2005) conducted research on application of infrared radiation in patients with chronic pain. 46 people were examined; the pain level, taking medicine, concentration disturbances and disturbances of sleep were assessed on the VAS scale. The subjects were randomly divided into two groups. In the first group, an improvement of all parameters was noticed in comparison to the control group. Other scientific research also confirms that a series of treatment with application of infrared influences a decrease in pain [28].

After therapy, the subjects limited taking painkillers as a long-term effect. In own research, lowering of the amount of taken painkilling medicine was also observed. In the research conducted by Ting-Kai Leung, forty-eight participants with chronic pain of neck were divided into two groups: a control group and an experimental group subjected to infrared treatment for a week. The results of this research indicated that the treatment with application of infrared decreases stiffness of muscles and pain, which was measured by the VAS scale [29]. These changes were confirmed by the present research.

The aim of research conducted by Oosterveld et al. (2009) was to assess the influence of infrared sauna on a clinical state of RA and AS patients. The patients were treated for a period of 4 weeks, with a series of eight treatments. In both groups, a statistically significant decrease in the pain level and feeling of stiffness took place [30].

Kuciel-Lewandowska, Paprocka-Borowicz, Jagucka et al. (2012) assessed the effectiveness of physiotherapeutic treatment in therapy of pain in the course of degenerative disease of the neck. An influence of electrotherapy, laser therapy and irradiation with a Sollux lamp with a blue filter, applied separately and combined in therapeutic sets, was subjected to evaluation. 57 subjects were examined. After the therapy, a decrease in the pain level and an increase in functioning were stated. The results testify to anti-pain effectiveness of the above-mentioned treatments and indicate an increase in analgesic effect by means of a skilful combination of particular physical treatments [31].

Since recently, in scientific research attention has been drawn to analgesic effectiveness of interference currents, included into a group of stimulation current [11], [32], [31].

Johnson and Tabasam [33] conducted research whose goal was to assess an effectiveness of interference current in pain control in healthy people. This research confirmed the effectiveness of interference current in causing decreased sense of pain [22].

Analgesic effectiveness of physical treatment including interference current was researched by Szulkowska, Frączak, Szrajber, and Kujawa (2010). They conducted examinations on subjects with a chronic spinal pain complex of the lumbar-sacral section in the course of degenerative disease. The group consisted of 50 people; patients received 10 treatments with application of interference currents. The VAS scale was used for pain assessment. After application of the therapy, statistically significant results confirming the analgesic influence of interference currents were observed [32].

Boerner, Ratajczak et al. (2007) conducted research whose aim was to assess the effectiveness of interference currents and kinesiotherapy in patients with the knee joint pain. Patients (25 people) were subjected to treatments in 10 days. It was found that interference currents in combination with exercises directly after their application influence a decrease in the pain level and an increase in the range of motion [34]. Such effects were noted directly after finishing the treatment and after the following month. The above-mentioned authors indicate in their research analgesic effectiveness of the applied treatments, and at the same time they indicate an increase in the analgesic effect by a skilful combination of selected physical treatments.

Analysing our own research on the effectiveness of an analgesic effect in degenerative disease, achieved by application of infrared radiation and infrared currents, we should agree that these treatments indicate analgesic effect. They may form an alternative, or support for pharmacological treatment in case of degenerative changes in people over 65 years of age. They must be correctly administered and performed, not to pose any threat to the patient.

Conclusion

Application of therapy consisting of 10 treatments with application of Sollux lamps with a red filter for the period of 15 minutes and interference currents of frequency of 50-100 HZ during the period of 5 min and 90-100Hz during the period of 10 minutes in treatment of degenerative disease of the knee joint is effective in pain reduction, and the effects are long lasting. The complex treatment procedure presented in the paper may be safely applied in health care centres and a long-term analgesic therapy. It is suggested that similar research in the future should focus on the length of preserving analgesic results in people with degenerative diseases of joints. This could help in determining the period after which the analgesic therapy should be repeated.

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