THE EFFECT OF DEEP ELECTROMAGNETIC STIMULATION ON THE RELIEF OF KNEE JOINT PAIN CAUSED BY THE DEGENERATIVE JOINT DISEASE.

Wpływ głębokiej stymulacji elektromagnetycznej na zmniejszenie dolegliwości bólowych stawów kolanowych spowodowanych chorobą zwyrodnieniową.

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Słowa kluczowe: choroba zwyrodnieniowa stawów kolanowych, ból, głęboka stymulacja elektromagnetyczna.

Abstract

Introduction. *Pain associated with a degenerative knee joint disease is medical and social problem. Electromagnetic field is one of physical factors used in the treatment.*
Therapy with deep electromagnetic stimulation (DEMS) of the frequency from 1 to 50 Hz and magnetic induction maximum 2,5T was the subject of the carried out investigations.
The aim of the study was to evaluate the efficacy of the treatment of pain syndromes caused by degenerative knee joint disease using deep electromagnetic stimulation.
Material and methods. *The study included 32 patients with degenerative knee joint disease. The patients were subjected to 10 DEMS procedures using Salus-Talent apparatus (BTL). To evaluate the results, the patients were examined before and after the series of stimulations. The examination also included pain evaluation using VAS and Laitinen scale, evaluation of the range of movement in the knee joint and the subjective assessment of the result of the therapy according to the Tapper scale.*
Results. *Laitinen and VAS scale assessment demonstrated statistically significant relief of pain. Before the applied therapy 65,6% of the patients took analgesics at different frequency, whereas after the therapy only 21,9% took the medications on short-term basis or at reduced doses. In the investigated group a statistically significant difference was observed between the range of knee flexion before and after the stimulation. On the basis of the patients' subjective assessment acc. to the Tapper scale, there were noted 24 very good and good.*
Conclusions. *DEMS therapy results in pain relief, limitation of analgesic consumption and increase of the range of knee movement in patients with chronic joint pain. In the patient's subjective assessment, the therapy with the use of Salus-Talent apparatus is an effective method for the treatment of knee pain.*

Streszczenie

Wstęp. *Ból towarzyszący chorobie zwyrodnieniowej stawów kolanowych jest problemem medycznym i społecznym. W pracy przedstawiono wyniki wstępne terapii głęboką stymulacją elektromagnetyczną.*
Celem pracy *jest ocena skuteczności leczenia zespołów bólowych spowodowanych chorobą zwyrodnieniową stawów kolanowych głęboką stymulacją elektromagnetyczną.*
Materiał i metody. *Badania przeprowadzono na grupie 32 pacjentów z chorobą zwyrodnieniową stawów kolanowych, których poddano serii 10 zabiegów głębokiej stymulacji elektromagnetycznej.*

Ocenę efektywności i skuteczności zastosowanej terapii przeprowadzono na podstawie skali VAS, skali Laitinena, zakresu ruchu w stawie kolanowym. Subiektywna ocena wyniku leczenia pacjenta dokonana została przy użyciu skali Tappera. Otrzymane wyniki poddano analizie statystycznej.
Wyniki. *Oceniając natężenie bólu skalą Laitinena i skalą VAS w obu przypadkach stwierdzamy istotne statystycznie zmniejszenie nasilenia dolegliwości bólowych. W badanej grupie występuje istotna statystycznie różnica między zakresem ruchu zgięcia przed i po zabiegach. Na podstawie oceny subiektywnej dokonanej przez pacjentów wg skali Tappera odnotowano 24 wyniki bardzo dobre i dobre.*
Wnioski. *Zastosowanie terapii głęboką stymulacją elektromagnetyczną u pacjentów z chorobą zwyrodnieniową stawów kolanowych ma istotny wpływ na zmniejszenie bólu, ograniczenie przyjmowania leków przeciwbólowych i zwiększenie zakresu ruchu.*

Introduction.

The specific location of the knee joint in the lower limb kinematic chain means that it is exposed to static and dynamic overloads that cause degeneration of the joint.

Osteoarthritis of the knee is a chronic process, inevitably progressive and irreversible. It develops gradually causing pain, reduced range of motion, decreased muscle mass and strength. Impairment of the knee leads to a reduction of physical activity and poor quality of life the patient (Dieppe and associates, 2005).

The pain associated with osteoarthritis of forcing doctors and physiotherapists to search for new and effective therapies.

One of the newest methods of the ongoing physical therapy is deep electromagnetic stimulation (Deep Electro-Magnetic Stimulation - DEMS). It uses an alternating magnetic field at frequencies from 1 to 50 Hz and magnetic flux density up to 2.5 T.

The field of such parameters generated by the camera Salus-TALENT manufactured by BTL. The device is programmed four automatic and 4 manual modes of operation (Poděbradský and associates 2011). Described magnetic field therapy distinguishes clearly felt tingling and vibration of tissue during surgery.

Immediately after the procedure is to reduce the temperature of tissues by an average of 2-3°C, as shown in Figure 1.

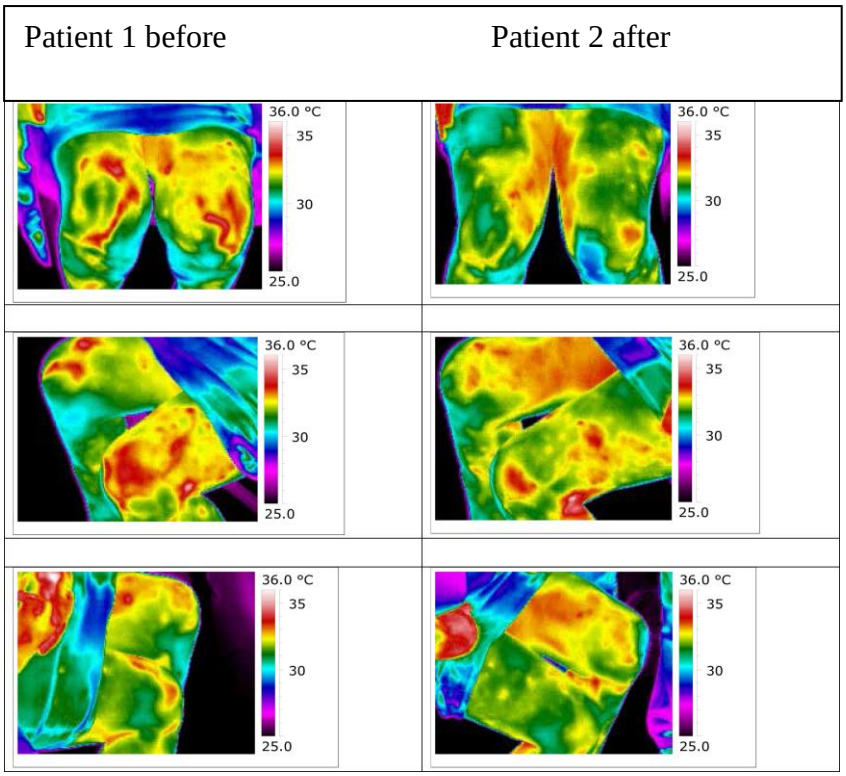

Figure 1. Image left knee made infrared camera before and after surgery.

The mechanism of action of electromagnetic DBS has not yet been fully elucidated. No known about its effects on the human body has led the authors to undertake research.

The aim of the work is:

1. Evaluation and comparison of pain measured by VAS and Laitinen before and after treatment.
2. Assessment of range of motion in the knee joint before and after a series of treatments.
3. Subjective assessment of treatment efficacy deep electromagnetic stimulation done by the patients.

Material and methods.

The research was conducted in the Department of Clinical Rehabilitation, University Hospital Post Traumatic them. WAM – CSW in Łódź. The material consisted of 32 patients (24 women and 8 men) aged from 33 to 79 years an average of 56.25 ± 11.59 years, with knee pain, diagnosed with osteoarthritis. The average duration of pain was 3.66 ± 5.06 years. The shortest time is declared two months and the longest 20 years (Table 1).

Exclusion criteria were: pain in the acute phase and the use of other physical treatments in the last three months.

The research was approved by the Committee on Bioethics no RNN/768/12/KB of Łódź, 20.11.12.

All patients were informed about the experimental basis, have signed a written consent to the use of treatment and inclusion in the study. Patients were 10 treatments using electromagnetic stimulation deep Salus-camera talent BTL. The therapy used in accordance with the manufacturer's instructions, automatically programmed mode A3.

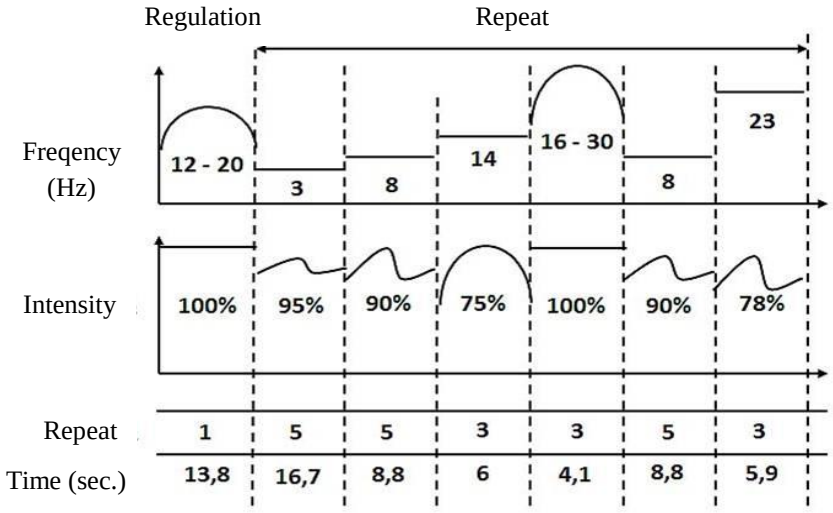

Figure 2. Modulation mode A3[6] – modified.

A3 pacing mode to a low frequency in the range from 3 to 30 Hz. and amplitude modulation (Poděbradský and association 2011).

Treatments were performed daily. Applicator at the time of surgery was placed in contact with the treated area. Parameters field strength depended on the subjective feelings of the patient. In order to evaluate the results of patients were examined according to a set protocol testing before and after a series of treatments. The study included an evaluation of the range of motion of the knee, pain assessment scale VAS and Laitinen and subjective assessment of outcome scale Tapper. The data were statistically analyzed.

The calculations were performed using the statistical package STATISTICA PL ver. 9.0.

For qualitative variables, given the number of observations of a given variant features (N) and the corresponding percentage (%). Quantitative variables were described giving descriptive characteristics: mean, median, maximum and minimum value (min and max), quartile I (Q25) and the third quartile (Q75) and standard deviation (SD). To compare the severity of pain before and after treatment were used nonparametric Wilcoxon test (for categorical variables) and test the independence of the chi-square and McNemar's test (for categorical variables). To assess the association between variables used Spearman's rank correlation coefficient. For the results were considered statistically significant at $p < 0.05$.

Results.

Variable	Average	Median	Min.	Max.	Q25	Q75	SD
Age	56,25	58,5	33	79	48	65	11,59
BMI	27,75	26,5	21,63	34,29	24,79	31,23	3,71
Time symptoms (years)	3,66	1	0,17	20	0,46	5	5,06

Table 1. Patient characteristics by age, duration of pain and body mass index.

The average BMI of the patients was equal to 27.75 ± 3.71.

The lowest BMI and the highest was 21.63 - 34.29. Half of the patients had a BMI greater than 26.5. 50% of patients were those with a BMI of 24.79 to 31.23 (Table 1).

Among the patients in nine cases (28.125%) were normal weight. Overweight involved 14 patients (43.75%). Obesity was present in 9 patients (28.125%).

Variable		Average	Median	Min.	Max.	Q25	Q75	SD	Level [p]
Range of flexion	**Before surgery**	104,84	110	60	150	90	120	20,81	0,0010
	After surgery	109,53	110	70	150	100	120	17,48	

Table. 2. Characteristics of patients because of the range of flexion before and after surgery.

Before surgery, the average range of knee flexion was equal to 104.84° ± 20.81° and 109.53 after the surgery º ± 17.48º. Half of the patients before and after treatment was flexion range no greater than 110°.

There is a statistically significant (p = 0.001) difference in terms of flexion before and after surgery.

The use of analgesics are presented in Table 3.

Medication	Before surgery		After surgery	
	N	%	N	%
Lack	11	34,38	25	78,13
Ad hoc	16	50	5	15,62
Low dose, still	4	12,50	2	6,25
High dose, still	1	3,12	0	0,00

Table 3. Intake of analgesics.

Statistically significant (p <0.001) reduction of pain medication after a series of treatments. Pain scores before and after treatment are shown in Table 4 and Figure 2 and 3.

Rating complaints		Median	Min.	Max.	Q25	Q75	Level [p]
Laitinen Scale	**Before treatment**	6	3	13	4,5	8,5	<0,001
	After treatment	3	0	9	2	4	
VAS Scale	**Before treatment**	6	3	9	4	7	<0,001
	After treatment	3	0	7	1,75	5	

Table 4. Characteristics of patients because of the pain assessment (measurement position).

Assessing pain Laitinen scale before treatment least its severity was 3 and the highest 13 Half of the patients reported pain intensity of at most 6 Pain in severity between 4.5 and 8.5 were reported in 50% of patients (Table 4).

However, post-treatment pain intensity was the smallest and the largest 90 Half of the patients reported pain intensity of at most 3 Pain in severity between 2 and 4 was reported by 50% of patients (Table 4).

The smallest pain intensity measured by VAS before treatment was 3 and the ninth largest Half of the patients reported pain intensity of at most 6 Pain ranging from 4 to 7 was reported by 50% of patients (Table 4). The smallest pain intensity after treatment was 0 and the highest 7 Half of the patients reported pain intensity of at most 3 Pain in severity between 1.75 and 5 were reported in 50% of patients (Table 4).

Assessing pain intensity Laitinen scale and VAS, in both cases we find a statistically significant reduction in pain intensity.

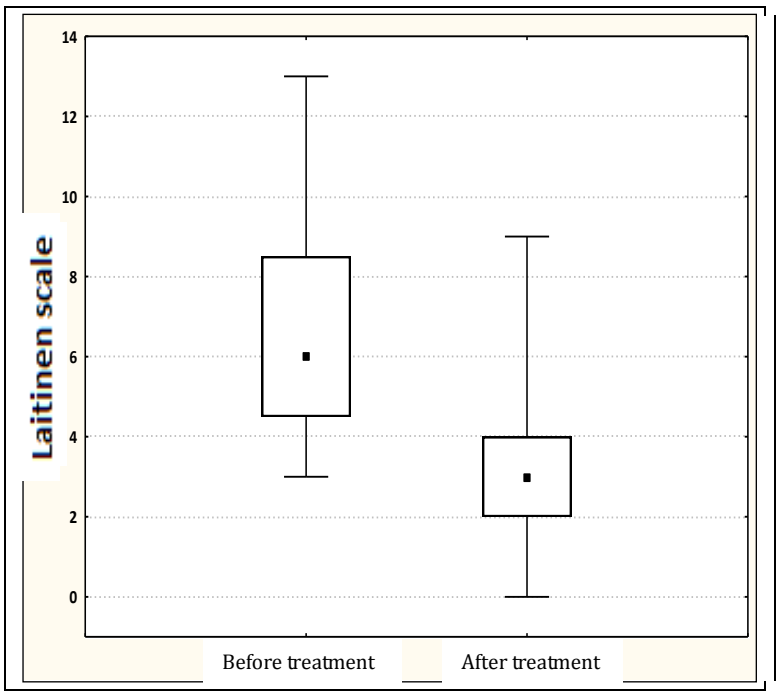

Figure 3. Severity Laitinen scale before and after treatment.

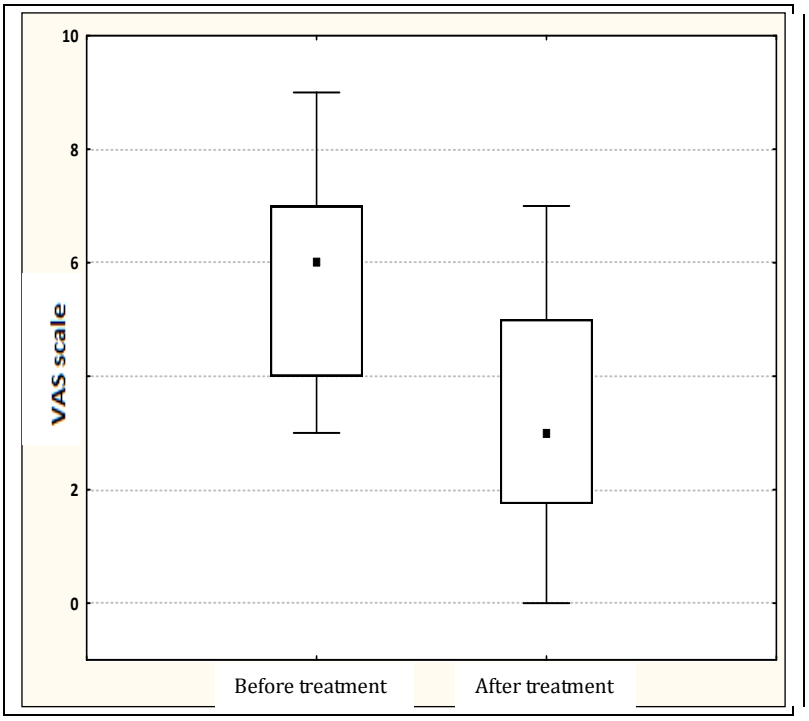

Figure 4. The severity of symptoms by VAS scale before and after treatment.

Assessment of the impact of pain on physical activity limitations before and after treatment are shown in Figure 5.

Before starting the treatment, most patients (84.38%) reported varying degrees of restriction of physical activity, of which 21.87% of the patients the pain made it impossible to work. After a series of treatments, a statistically significant improvement (p = 0.0033) - reduction of activity was observed in 65.62% of patients, of which only 6.55% were unable to work.

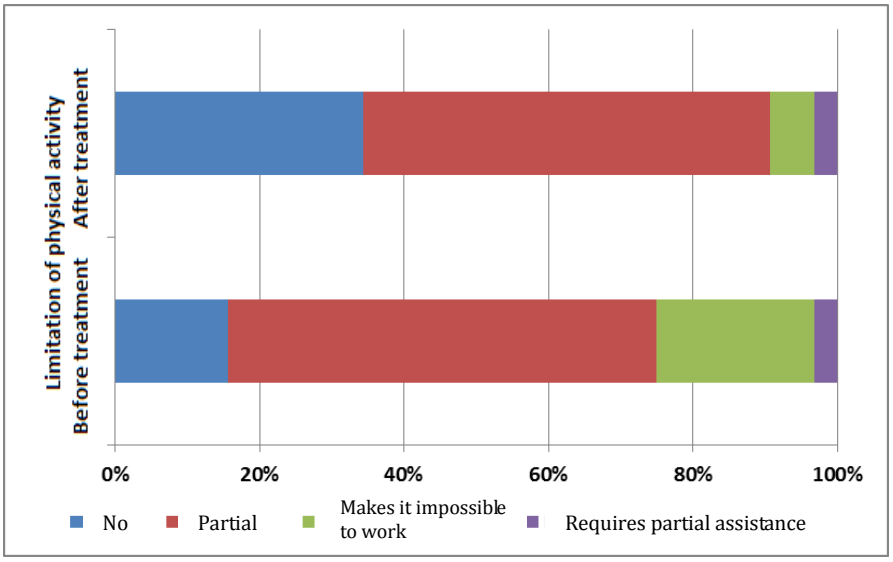

Figure. 5. Characteristics of patients due to reduced activity mobility before and after treatment.

There were no statistically significant relationship between age, BMI (Body Mass Index), duration of pain and pain relief assessed by the Laitinen scale and VAS scale.

Outcome evaluation was performed according to a subjective scale Tapper. The results are shown in Figure 6.

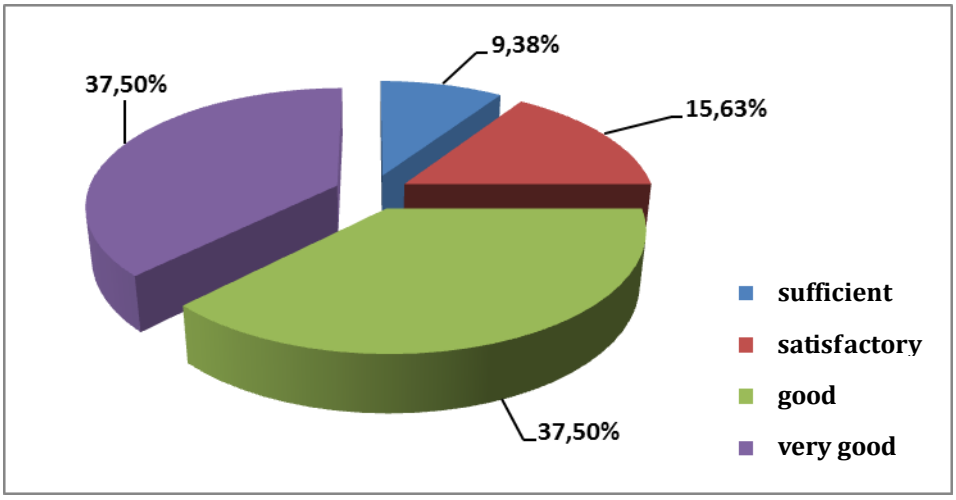

Figure 6. Outcome evaluation Tapper scale.

Discussion.

Assess the effectiveness of magnetic field therapy in the treatment of pain caused by osteoarthritis is the subject of many reports (Jankowska and associates, 2000; Mokronowska and associates, 2002; Woldańska-Okońska and associates, 2004; Łukowicz and associates, 2011).

So far, the magneto used an alternating magnetic field with a frequency of 0.5 to 50 Hz and a magnetic flux density of 0.1 to 20 mT, and magneto extremely low frequency magnetic field of 1 pT to 100 μT and frequencies from a few hundred to a few thousand Hz (Sieroń and associates, 2000; Sieroń and associates, 2010).

Today, more and more interest is the treatment DEMS field induction of 2.5 T. The mechanism of its action has not yet been fully elucidated. There are no reports on the effects of deep brain stimulation on the human body electromagnetic tends to take the test and verification. Based on the experiment, it can be concluded that the use of deep brain stimulation electromagnetic therapy is an effective method of pain caused by knee osteoarthritis. The majority of patients was apparent analgesic effect lasting for about two hours after the first treatment. The image of the infrared camera made before and after treatment showed a reduction in tissue temperature.
Pain assessment by Laitinen scale and VAS scale performed before and after treatment indicates a reduction in pain. The therapy has limited the taking painkillers.

Poděbradský and associates (2011), Wasilewski and associates (2011) and Przedborska and associates (2012) researching the effectiveness of deep brain stimulation electromagnetic therapy in patients with osteoarthritis also drew attention to the significant reduction in pain intensity.

The therapy is able to provide improved physical activity although patients who did not undergo any further exercise.

Changing the severity and nature of the pain is one of the main criteria for clinical improvement of the patient's perspective. Subjective assessment of outcome made based on the scale Tapper shows that 75% considered treatment outcome as very good and good. Satisfactory result reported 15.62% of the respondents, and sufficient 9.38%.

Surely presented clinical material is too small to draw firm conclusions, and requires further study.However, due to unsatisfactory therapeutic results obtained in the experiment, this method can be a valuable addition to physiotherapy in the treatment of knee osteoarthritis.

Conclusions.

1. Electromagnetic Deep brain stimulation has a significant impact on reducing pain and reducing the amount of drugs taken because of knee problems.
2. The therapy significantly improved the range of motion and performance of activities of daily living.
3. The patients' subjective assessment of therapy using the device Salus Talent is an effective treatment for knee pain.

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