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COMPARATIVE STUDY OF THE EFFECTS OF CONVENTIONAL PHYSIOTHERAPEUTIC COMPLEX AND HIGH-ENERGY LASER IN PATIENTS WITH GLENOHUMERAL JOINT PERITENDINITIS

AUTOREFERAT

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CONTENTS

List of abbreviation

TENS - transcutaneous electrical nerve stimulation
VAS – visual-analog scale
Abd - Abduction
ER - External rotation
F - Flexion
MLS - Multiwave Locked System
SPADI - Shoulder Pain and Disability Index

Relevance of the problem

Tendon pain associated with reduced function has historically been described as tendinitis (Debruner, 1996).

Glenohumeral joint peritendinitis is among the most common shoulder pathologies (van der Windt, 1995; Vecchio, 1995). The problem affects people who practice sports, as well as people whose occupation or everyday activities are associated with frequent and monotonous repetitive movements of the upper extremities (Cools, 2008). The prevalence of peritendinitis of the rotator cuff muscles increases with age (Tempelhof, 1999), and it affects more than 80% of people aged over 80 (Milgrom, 1995; Hopkins, 2016). The epidemiological data show conflicting information over the years about the distribution of people affected according to gender. The dominant hand is affected more often in people working with physical overexertion (Tekavec, 2012; Yamamoto, 2010).

Approximately 40% of the patients with rotator cuff tendinopathy don't have success responding to conservative treatment (Brox, 1999; Holmgren, 2012; Ludewig, 2003), and more than half of the patients report long-term recurring and constant pain (Vecchio, 1995). Rotator cuff tendinopathy presents a considerable socioeconomic burden due to loss of work and treatment expenses (Smith, 2000; Hopkins, 2016). The psychological approach to these patients is important (Chul-Hyun, 2013).

The disease presents a therapeutic challenge for physical medicine, especially in its acute phase when the majority of physical factors can be applied in low doses and used in combination or as monotherapy, they often produce an unsatisfactory therapeutic effect (Milgrom, 1995; Palmer, 2002).

Chapter 1. Purpose, objectives, and hypotheses

Purpose

The main purpose of the present study is to evaluate and compare the efficacy of the MLS® laser therapy and the combined therapy of microwave diathermy and interferential current in the treatment of peritendinitis of the glenohumeral joint with regard to reduction of pain and improvement of the joint mobility and function.

Objectives

1. Study, follow up, and comparison, at three moments, of the clinical efficacy of the MLS laser treatment as monotherapy, as well as of the combined therapy of microwave diathermy and interferential current in patients with peritendinitis of the glenohumeral joint.

2. Evaluation and comparison of the results of Shoulder Pain and Disability Index (SPADI) in % for evaluation of the functional status and pain at three moments examined for the patients of both groups.

3. Evaluation and comparison of the subjective sensation of spontaneous and palpatory pain according to the Visual Analogue Scale (VAS), at three moments examined, for the patients in both groups.

4. Evaluation and comparison of the impact of the therapy applied in both therapeutic groups on the indicators of the functional status – anglemetry of flexion, abduction, and external rotation of the shoulder joint, at the three moments examined.

5. Analysis and comparison of the short-term and long-term effects of the treatment in both therapeutic groups using six measurement indicators.

Hypotheses

1. We assume that the patients in therapeutic group A will improve according to the results from the six indicators measured at the end of the therapeutic course, as well as on the 45th day from starting the treatment.

2. We assume that the patients in therapeutic group B will improve according to the results from the six indicators measured at the end of the therapeutic course, as well as on the 45th day from starting the treatment.

32. We assume that the patients in therapeutic group A will have better clinical and functional recuperation than the patients in therapeutic group B, both after the end of treatment and on the 45th day from starting the treatment.

Chapter 2. Materials and methods

2.1. Population of the study

For the purpose of the study, 76 patients with acute peritendinitis of the glenohumeral joint were studied.

2.2. Design of the study

- Prospective - for 11 months from 26.11.2020 until 31.10.2021;
- Randomised - an online-generated sequence for random distribution, **GraphPad;**
- Parallel study - group A or group B, in 1:1 ratio;
- In the Clinic of Physical and Rehabilitation Medicine of UMHAT St. Marina - Varna and the Department of Rehabilitation in hotel Estreya Residence in the resort Sts. Constantine and Helena;
- Permission from the Commission for Scientific Research Ethics, appointed at MU Varna - record № 98/26.11.2020;
- Sample size of around 32 patients in each group.

The inclusion criteria were:

- Age from 20 to 55 years old;
- Patients with peritendinitis of the glenohumeral joint with clinical manifestations;
- Duration of symptoms no more than 7 days;
- Consulted by an orthopaedist;
- No treatment received;
- Skin type from I to IV according to the Fitzpatrick scale (Fitzpatrick, 1988);
- Declaration of Informed Consent.

The exclusion criteria were:

- Age below 20 or above 55 years old;
- Patients with bone fractures or a shoulder-complex tendon rupture, a condition that requires surgical intervention, or previous surgical interventions;
- Complaints lasting more than a week or chronic recurring complaints;
- Application of corticosteroid drugs or other medicaments after the start of pain;
- Contraindications;
- Skin type - V and VI on the Fitzpatrick scale (Fitzpatrick, 1988);
- Refusal to sign the informed consent form;

2.3. Methods for following up on the indicators

- Primary methods for follow up

We used **SPADI** to assess the functional status and pain during the follow up. The total score is measured as a percentage.

- Secondary methods for follow up

In order to objectively measure the functional improvement, **anglemetry** of the glenohumeral joint was used: flexion (F), abduction (Abd), and external rotation (ER) in the glenohumeral joint.

The assessment of the spontaneous and palpatory pain according to **VAS** was followed up. We chose the insertion site of m. supraspinatus as a place for palpation, due to its high recurrence rate.

2.4. Conducting and organisation of the study

All patients were described in detail according to gender, age, whether the left or right shoulder was affected, profession, and results from the physical examination (anglemetry, VAS, and

SPADI). The condition was followed up at three different moments: at baseline level, before the start of treatment (T0), after the completion of the therapeutic course (T1), and on the 45th day from the baseline (T2).

The MLS® M6 (ASA srl) device was used for the **therapeutic method applied in group A.** Each therapeutic procedure consists of two stages: scanning of the anterior and the dorsal shoulder areas of 93 cm^2 each with a robotized multidiodic head and treating the trigger points with the manual handpiece applicator with 7 points of 3.14 cm^2 each, with a total area of 21.98 cm^2. The therapeutic course consists of a total of 8 procedures spread over 2 work weeks as follows: first week - 1 procedure a day, daily, for a total of 5 procedures and second work week - 1 procedure a day, every other day, for a total of 3 procedures.

The therapeutic method for group B consists of 10 procedure days spread over two work weeks as follows: once-daily application of each of the factors - microwave electromagnetic field and interferential current. The microwave electromagnetic field was used with the following settings of the parameters: wavelength of 12.6 cm and frequency of 2375 MHz, microwave intensity of 0.56 W/cm^2, power of 40-70 W or less, procedure duration of 10-15 minutes, and subjective dosage - athermic with a gradual increase up to oligothermic which is felt as a very slight heat. A four-pole method was used for the interferential current therapy, with the following parameters: alternating current, sinusoid impulse, bearing frequency of 4000 Hz, alternating frequency of 90-100 Hz, procedure duration of 15 min, and subjective dosage - until a sensation of running current is felt.

2.5. Statistical methods

Descriptive methods:

- Alternative analysis - it presents the structural distribution of the qualitative variable values.
- Analysis of Variance - mean values (Mean), Minimum, Maximum, standard error of the mean (Sdt. Error Mean), and standard deviation (Std. Deviation) of each of the indicators (variables) are presented.
- Graphical methods for comparison and visualisation of the statistical data.

Methods for statistical evaluation:

95% confidence intervals for mean values and relative shares were determined.

Methods of hypothesis testing

The significance level of the null hypothesis was chosen as p=0.05.

- One-Sample Kolmogorov-Smirnov Test;
- Parametric methods - Student's Paired Samples t-test and Independent Samples t-test;
- Nonparametric methods - in paired samples (Friedman Test, Wilcoxon Signed Ranks Test, and Based on positive ranks) and in independent samples (Mann-Whitney Test);
- Cohen's D (standardized mean difference).

The data from the study was organised in **MS Office Excel 2016**, and the statistical software **SPSS Statistics for Window v. 23.0** was used for their analysis.

Chapter 3. Results

3.1. Sociodemographic profile of the studied people

For the purpose of the study, 76 patients with acute peritendinitis of the glenohumeral joint were studied. The average age of the patients studied was 45,7±10,2 years old. The prevalence rate of the disease according to age is the following: 9% in the 20-29 years old range, 13% in the 30-39 years old age range, 30% are in the 40-49 years old age range, and 48% are in the 50-55 years old range (Figure 1).

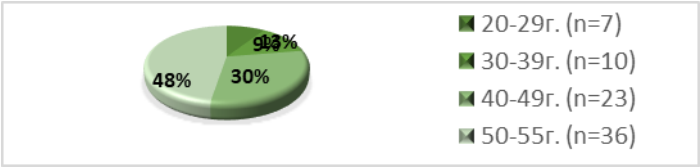

Figure 1. Age distribution.

39 men and 37 women participated in the study, i.e., the distribution according to gender shows that both genders are almost equally affected, with a small prevalence of men, 51% of the total number of participants (Figure 2).

Figure 2. Gender distribution.

Of the 76 patients with acute peritendinitis of the glenohumeral joint, 46 patients (62%) had their right hand affected,

and 28 patients (38%) - their left hand affected. All patients who participated in the study had a dominant right hand (Figure 3).

Figure 3. Relative share of the affected shoulder joint at the subjects.

Of the 37 women studied, 20 (54%) had their left shoulder joint affected, and 17 (46%) - their right shoulder joint affected. Of the 39 men studied, 10 (26%) had their left shoulder joint affected, and 29 (74%) - their right shoulder joint affected (Figure 4).

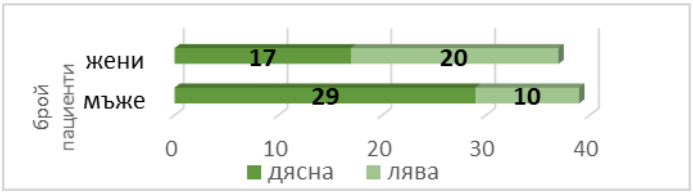

Figure 4. Distribution of the relative share of shoulder joint involvement in the studied men and women.

Taking into account the jobs and everyday activities as risk factors, it was found that all of the people studied work jobs and have everyday activities associated with physical overexertion. 51% of the patients studied are people who work in the manual labour sphere - drivers, builders, maids, field policemen, etc., 21% of the people studied are active athletes, 20% of the patients are in the intellectual labour sphere - physicians, teachers, IT specialists, accountants,

administrators, and only 8% of the people studied are young (students) (Figure 5).

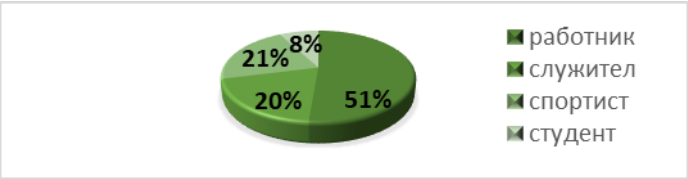

Figure 5. Distribution of patients by profession

The average age of the patients in group A is 48 ± 8.10 years old, and in group B, it is 43.5 ± 11.55 years old. Patients between the ages of 50 and 55 prevail in both groups. In group A, men and women are equally represented, 50% (n=19). In group B, men are 47% (n=18), women - 53% (n=20) (Table 1).

Table 1. Distribution by sex in group A and in group B.

	group A	(n=38)	group B	(n-38)
Gender	number	%	numver	%
man	19	50	18	47
woman	19	50	20	53

In group A, the patients who had their left shoulder joint affected are 42% (n=16), and those who had their right shoulder joint affected are 58% (n=22). In group B, the patients who had their left shoulder joint affected are 37% (n=14), and those who had their right shoulder joint affected are 63% (n=24). (Table 2)

Table 2. Distribution by the relative share of shoulder joint involvement in the subjects in group A and in group B.

	group A	(n=38)	group B	(n-38)
Shoulder joint	number	%	number	%
lefr	16	42	14	37
right	22	58	24	63

The distribution analysis according to profession in both groups - group A and group B - shows an exceptional similarity (Figure 6).

Figure 6. Distribution of the number of patients in group A and in group B.

3.2. Analysis of the initial values of the six indicators for tracking the efficacy of the treatment in both groups - group A and group B

The initial mean value of SPADI is 57.4%±22.6% for all patients studied (Figure 7).

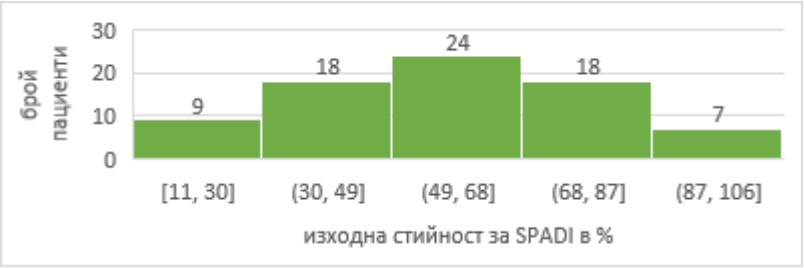

Figure 7. Distribution of the number of patients according to the reported baseline SPADI results in percentages for all patients studied.

In group A, the mean initial value of SPADI in % is 49.2 ± 20.8, and in group B - 65.5 ± 21.5.

The initial mean value of spontaneous pain according to VAS is 3.1±2.8 for all patients studied (Figure 8).

Figure 8. Distribution of the number of patients according to the reported baseline results of VAS_ spontaneously for all examined patients.

In group A, the mean initial value of VAS_spontaneous is 2.8 ± 3.0, and in group B - 3.4 ± 2.6.

The initial mean value of palpatory pain according to VAS is 4.8±2.0 for all patients studied (Figure 9).

Figure 9. Distribution of the number of patients according to the reported baseline results of VAS_palpathotically for all examined patients.

In group A, the mean initial value of VAS_palpatory is 4.5 ± 1.8, and in group B - 5.1 ± 2.2.

The initial mean value of the difference from the norm for anglemetry of flexion of the shoulder joint is 28°±24° for all patients studied (Figure 10)

Figure 10. Distribution of the number of patients according to the reported baseline results of the difference from the norm in angle flexion of shoulder joint flexion for all examined patients.

In group A, the mean initial value of the difference from the norm for anglemetry of flexion of the shoulder joint is 30 ± 26.6, and in group B - 26.5 ± 22.6.

The initial mean value of the difference from the norm for anglemetry (Figure 11).

Figure 11. Distribution of the number of patients according to the reported baseline results of the difference from the norm in the angiometry of abduction of the shoulder joint for all examined patients.

In group A, the mean initial value of the difference from the norm for anglemetry of abduction of the shoulder joint is 38.7 ± 33.2, and in group B - 26.3 ± 18.7.

The initial mean value of the difference from the norm for anglemetry of external rotation of the shoulder joint is 34°±27° for all patients studied (Figure 12).

Figure 12. Distribution of the number of patients according to the reported baseline results of the difference from the norm in the angiometry of external rotation of the shoulder joint for all examined patients.

In group A, the mean initial value of the difference from the norm for anglemetry of external rotation of the shoulder joint is 39.7 ± 28.0, and in group B - 28.7 ± 26.4.

There is no difference in the demographic indicators, the assessment for pain and functional status of the joint between the two groups which leads to mutual homogeneity (Table 3).

Table 3. Demographic, physical and pain variables at baseline.

	group A (n=38)	Group B (n=38)	*p-Value*
Age (years)	48 ± 8.10	43.5 ± 11.55	NS
Gender (man)	19 (50%)	20 (53%)	NS
Affected side (right)	22 (58%)	24 (56%)	NS
Job (physical overexertion)	70%	74%	NS
Angiometry of the shoulder joint (°)			
Fletion (F)	30 ± 26.6	26.5 ± 22.6	NS
Abduction (Abd)	38.7 ± 33.2	26.3 ± 18.7	NS
External rotation(ER)	39.7 ± 28.0	28.7 ± 26.4	NS
VAS (mm)			
VAS_ spontaneously	2.8 ± 3.0	3.4 ± 2.6	NS
VAS_palpathotically	4.5 ± 1.8	5.1 ± 2.2	NS
SPADI (%)	49.2 ± 20.8	65.5 ± 21.5	NS

Values ± are mean ± standard deviation (SD) or n (%)

3.3. Evaluation of the clinical efficacy of the two methods of treatment according to the six indicators in the three moments in time examined

This is achieved through comparison of the mean values of each of the six indicators in the three moments in time examined. The results from the intragroup statistical analysis for paired samples are presented. Hypothesis testing is performed.

Before starting therapy (T0), the following results were reported for SPADI in % for the patients from group A: mean value - 49.24, minimum - 12, maximum - 94. Immediately after the completion of treatment (T1), the results for SPADI in % are the following: mean value - 23.45, minimum - 1, maximum - 78. The results reported on the 45th day from the baseline level (T2) for SPADI in % are the following: mean value - 17.61, minimum - 0, maximum - 70 (Figure 13).

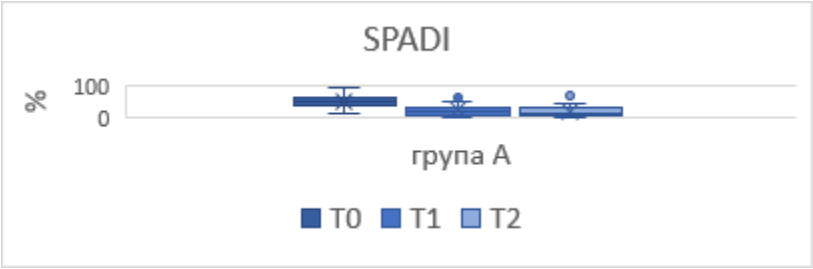

Figure 13. Mean values, minimum and maximum for SPADI in percentages estimated in the three considered coins for patients from group A.

The results for SPADI for the patients from group A are presented in Table 4. There is a statistically significant difference ($p<0.05$) in the mean values estimated according to the three points in time. There is a statistically significant improvement at the end of the treatment compared to the baseline condition (T1-T0). This tendency for improvement is also preserved when reading the results on the 45th day from the start of treatment, both regarding the end of treatment (T2-T1) and the baseline condition (T2-T0).

Table 4. Intra-group statistical analysis of the indicators for evaluation of SPADI in percentages used in the patients of group A in the three examined coins.

SPADI (%)	Mean	Std. Deviation	Sd. Error Mean	p-Value	Cohen's D	95% Confidence Interval of the Difference	
						Lower	Upper
T1-T0	25,789	15,995	2,595	,000	1,61	20,532	31,047
T2-T1	31,632	19,160	3,108	,000	1,65	25,334	37,929
T2-T0	5,842	8,976	1,456	,000	0,65	2,892	8,792

Before starting therapy (T0), the following results were reported for SPADI in % for the patients from group B: mean value - 65.53, minimum - 11, maximum - 99. Immediately after the completion of treatment (T1), the results for SPADI in % are the following: mean value - 35.89, minimum - 3, maximum - 69. The results reported on the 45th day from the baseline level (T2) for SPADI in % are the following: mean value - 31.39, minimum - 0, maximum - 70 (Figure 14).

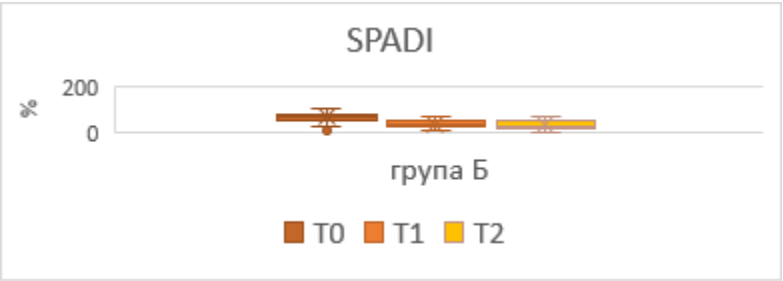

Figure 14. Mean values, minimum and maximum for SPADI in percentages estimated in the three considered coins for patients in group B.

The results for SPADI for the patients from group B are presented in Table 5. There is a statistically significant difference ($p<0.05$) in the mean values estimated according to the three points in time. There is a statistically significant improvement at the end of the treatment compared to the baseline condition (T1-T0). This tendency for improvement is also preserved when reading the results on the 45th day from the start of treatment, both regarding the end of treatment (T2-T1) and the baseline condition (T2-T0).

Table 5. Intra-group statistical analysis of the indicators for evaluation of SPADI in percentages used in the patients of group B in the three examined coins.

						95% Confidence Interval of the Difference	
SPADI (%)	Mean	Std. Deviation	Sd. Error Mean	p-Value	Cohen's D	Lower	Upper
T1-T0	29,632	16,287	2,642	0,000	1,82	24,278	34,985
T2-T1	34,132	21,104	3,423	0,000	1,62	27,195	41,068
T2-T0	4,500	13,677	2,219	0,000	0,33	0,004	8,996

Before starting therapy (T0), the following results were reported for spontaneous pain according to VAS for the patients from group A: mean value - 2.76, minimum - 0, maximum - 10. Immediately after the completion of treatment (T1), the results for spontaneous pain according to VAS are the following: mean value - 0.61, minimum - 0, maximum - 8. The results reported on the 45th day from the baseline level (T2) for spontaneous pain according to VAS are the following: mean value - 0.26, minimum - 0, maximum - 5 (Figure 15).

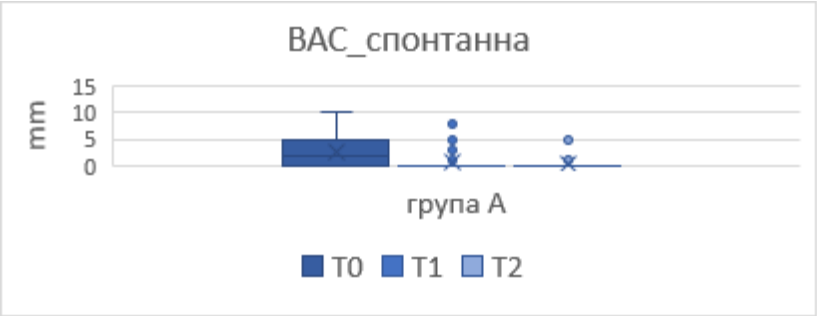

Figure 15. Mean values, minimum and maximum for spontaneous pain according to VAS evaluated in the three examined coins for patients from group A.

The results for spontaneous pain according to VAS for the patients from group A are presented in Table 6. There is a statistically significant difference ($p<0.05$) in the mean values estimated for T1-T0 and T2-T0. There is a statistically significant improvement at the end of the treatment (T1-T0) and on the 45th day from the start of treatment (T2-T0) compared to the baseline condition. Only the differences in spontaneous pain according to VAS, between the values after the completion of the therapeutic course (T1), and at a following visit, 45 days from the start of treatment (T2), are not statistically significant ($p=0.058$). It is sensible to examine this aspect, linked to an initial improvement to maximum, achieved by patients after the completion of the therapeutic course and the low initial mean value for spontaneous pain according to VAS (2.8 ± 3.0 cm).

Table 6. Intra-group statistical analysis of the indicators for assessment of spontaneous pain according to VAS, used in the patients from group A in the three examined coins

VAS spontaneous (mm)	Mean	Std. Deviation	Based on positive ranks	p-Value
T1-T0	2,76	2,990	-3,805	0,000
T2-T1	0,61	1,685	-1,897	0,058
T2-T0	0,26	0,921	-4,267	0,000

Before starting therapy (T0), the following results were reported for spontaneous pain according to VAS for the patients from group B: mean value - 3.42, minimum - 0, maximum - 10. Immediately after the completion of treatment (T1), the results for spontaneous pain according to VAS are the following: mean value - 1.05, minimum - 0, maximum - 6. The results reported on the 45th day from the baseline level (T2) for spontaneous pain according to VAS are the following: mean value - 0.66, minimum - 0, maximum - 5 (Figure 16).

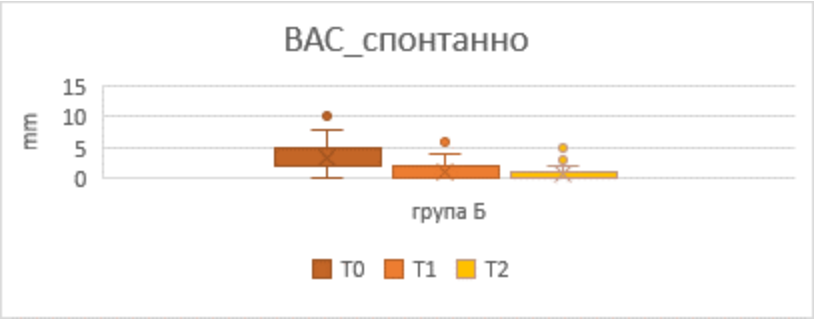

Figure 16. Mean values, minimum and maximum for spontaneous pain according to the VAS in the three considered coins for the patients from group B.

The results for the indicators for assessment of spontaneous pain according to VAS are presented in Table 7. For the patients from group B, there is a statistically significant difference ($p<0.05$) in the mean values estimated according to the three points in time. There is a statistically significant improvement at the end of the treatment compared to the baseline condition (T1-T0). This tendency for improvement is also preserved when reading the results on the 45th day from the start of treatment, both regarding the end of treatment (T2-T1) and the baseline condition (T2-T0).

Table 7. Intra-group statistical analysis of the indicators for assessment of spontaneous pain according to SAC, used in the patients from group B in the three examined coins.

VAS spontaneous (mm)	Mean	Std. Deviation	Based on positive ranks	p-Value
T1-T0	3,42	2,647	-4335	0,000
T2-T1	1,05	1,451	-3,066	0,002
T2-T0	,66	1,300	-4,592	0,000

Before starting therapy (T0), the following results for assessment of palpatory pain according to VAS were reported for the patients from group A: mean value - 4.50, minimum - 0, maximum - 7. Immediately after the completion of treatment (T1), the results for assessment of palpatory pain according to VAS are the following: mean value - 2.18, minimum - 0, maximum - 10. The results reported on the 45th day from the baseline level (T2) for assessment of palpatory pain according to VAS are the following: mean value - 1.05, minimum - 0, maximum - 5 (Figure 17).

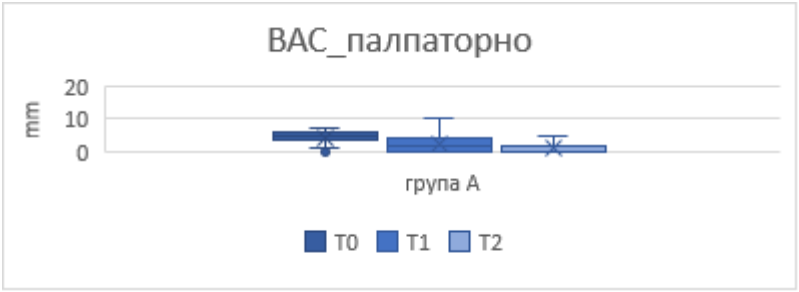

Figure 17. Mean values, minimum and maximum for VAS palpation pain estimated in the three examined coins for patients from group A.

The results for palpatory pain according to VAS are presented in Table 8. For the patients from group A, there is a statistically significant difference ($p<0.05$) in the mean values estimated according to the three points in time. There is a statistically significant improvement at the end of the treatment compared to the baseline condition (T1-T0). This tendency for improvement is also preserved when reading the results on the 45th day from the start of treatment, both regarding the end of treatment (T2-T1) and the baseline condition (T2-T0).

Table 8. Intra-group statistical analysis of the indicators for assessment of palpatory pain according to the VAS in the three examined coins.

VAS palpatory (mm)	Mean	Std. Deviation	Sd. Error Mean	p-Value	Cohen's D	95% Confidence Interval of the Difference	
						Lower	Upper
T1-T0	2,316	2,672	0,433	0,000	0,87	1,437	3,194
T2-T1	3,447	2,262	0,367	0,000	1,52	2,704	4,191
T2-T0	1,132	1,436	0,233	0,000	0,79	0,659	1,604

Before starting therapy (T0), the following results for assessment of palpatory pain according to VAS were reported for the patients from group B: mean value - 5.11, minimum - 0, maximum - 10. Immediately after the completion of treatment (T1), the results for assessment of palpatory pain according to VAS are the following: mean value - 3.68, minimum - 0, maximum - 7. The results reported on the 45th day from the baseline level (T2) for assessment of palpatory pain according to VAS are the following: mean value - 3.34, minimum - 0, maximum - 7 (Figure 18).

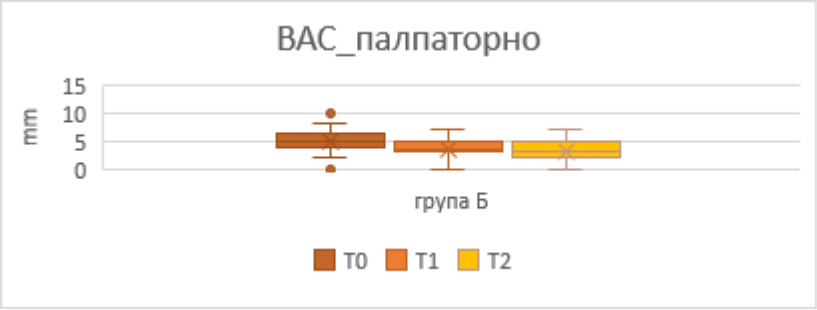

Figure 18. Mean values, minimum and maximum for palpable pain according to the VAS evaluated in the three examined coins for the patients from group B.

The results for assessment of palpatory pain according to VAS are presented in Table 9. For the patients from group B, there is a statistically significant difference ($p<0.05$) in the mean values estimated according to the three points in time. There is a statistically significant improvement at the end of the treatment compared to the baseline condition (T1-T0). This tendency for improvement is also preserved when reading the results on the 45th day from the start of treatment, both regarding the end of treatment (T2-T1) and the baseline condition (T2-T0).

Table 9. Intra-group statistical analysis of the indicators for assessment of palpatory pain according to SAC, used in the patients of group B in the three examined coins.

VAS palpatory (mm)	Mean	Std. Deviation	Sd. Error Mean	p-Value	Cohen's D	95% Confidence Interval of the Difference	
						Lower	Upper
T1-T0	1,421	1,765	0,286	0,000	0,81	0,841	2,001
T2-T1	1,868	2,171	0,352	0,000	0,86	1,155	2,582
T2-T0	0,447	1,201	0,195	0,027	0,37	0,053	0,842

Evaluation and comparison of the impact of the therapy applied in both therapeutic groups on the indicators of the functional status – anglemetry of flexion, abduction, and external rotation of the shoulder joint at the three moments examined.

Before starting therapy (T0), the following results were reported for F for the patients from group A: mean value - 30, minimum - 0, maximum - 100. Immediately after the completion of treatment (T1), the results for F are the following: mean value - 9.34, minimum - 0, maximum - 90. The results reported on the 45th day from the baseline level (T2) of F are the following: mean value - 5.92, minimum - 0, maximum - 70 (Figure 19).

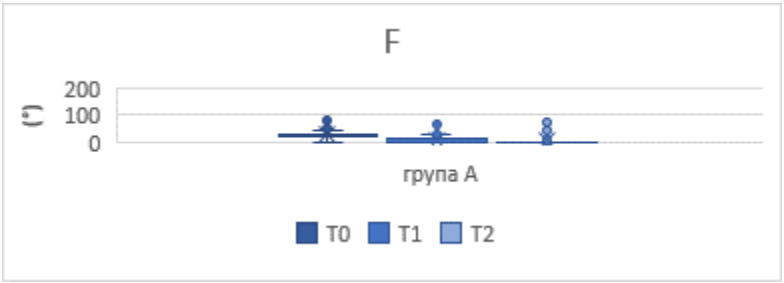

Figure 19. Mean values, minimum and maximum of the difference from the norm in the angle of geometry of flexion of the shoulder joint estimated in the three considered coins for patients from group A.

The results from the evaluation of F are presented in Table 10. For the patients from group A, there is a statistically significant difference ($p<0.05$) in the mean values estimated according to the three points in time. There is a statistically significant improvement at the end of the treatment compared to the baseline condition (T1-T0). This tendency for improvement is also preserved when reading the results on the 45th day from the start of treatment, both regarding the end of treatment (T2-T1) and the baseline condition (T2-T0).

Table 10. Intra-group statistical analysis of the indicators of the difference from the norm in the angle of geometry of flexion of the shoulder joint, used in the patients of group A in the three examined coins.

F (°)	Mean	Std. Deviation	Based on positive ranks	p-Value
T1-T0	30,00	26,610	-5,214	0,000
T2-T1	9,34	21,784	-2,988	0,003
T2-T0	5,92	17,000	-5,309	0,000

Before starting therapy (T0), the following results were reported for F for the patients from group B: mean value - 26.45, minimum - 0, maximum - 90. Immediately after the completion of treatment (T1), the results for F are the following: mean value - 8.68, minimum - 0, maximum - 70. The results reported on the 45th day from the baseline level (T2) of F are the following: mean value - 8.29, minimum - 0, maximum - 70 (Figure 20).

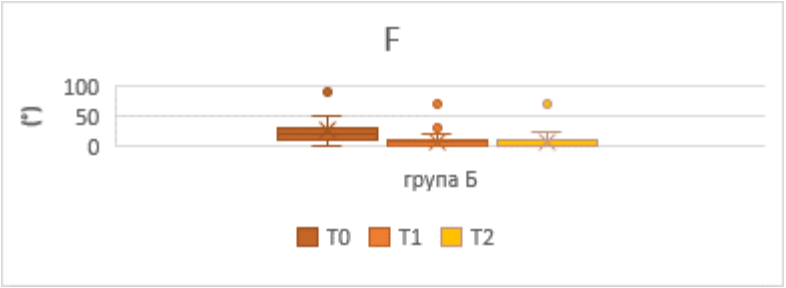

Figure 20. Mean values, minimum and maximum of the difference from the norm in the angle of geometry of flexion of the shoulder joint estimated in the three considered coins for patients in group B.

The results for the evaluation of F are presented in Table 11. For the patients from group B, there is a statistically significant difference ($p<0.05$) in the mean values estimated for T1-T0 and T2-T0. There is a statistically significant improvement at the end of the treatment (T1-T0) and on the 45th day from the start of treatment (T2-T0) compared to the baseline condition. Only the differences in F, between the values after the completion of the therapeutic course (T1), and at a following visit, 45 days after the start of treatment (T2), are not statistically significant ($p=0.658$).

Table 11. Intra-group statistical analysis of the evaluation indicators for F used in the patients of group B in the three considered coins.

F (°)	Mean	Std. Deviation	Based on positive ranks	p-Value
T1-T0	26,45	22,145	-4,987	0,000
T2-T1	8,68	13,032	-0,443	0,658
T2-T0	8,29	13,011	-4,746	0,000

Before starting therapy (T0), the following results were reported for Abd for the patients from group A: mean value - 38.68,

minimum - 10, maximum - 150. Immediately after the completion of treatment (T1), the results for Abd are the following: mean value - 12.63, minimum - 0, maximum - 110. The results reported on the 45th day from the baseline level (T2) of Abd are the following: mean value - 7.76, minimum - 0, maximum - 80 (Figure 21).

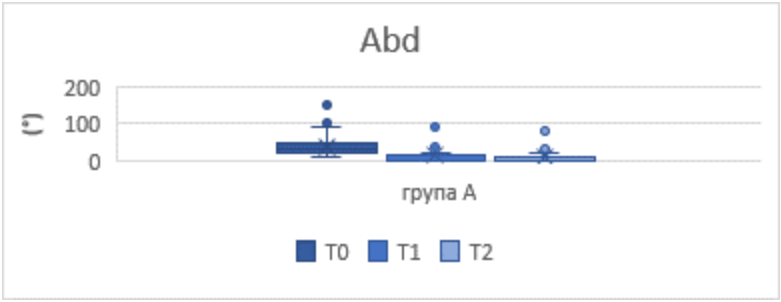

Figure 21. Mean values, minimum and maximum of the difference from the norm in the angiometry of abduction of the shoulder joint evaluated in the three considered coins for the patients from group A.

The results from the evaluation of Abd are presented in Table 12. For the patients from group A, there is a statistically significant difference ($p<0.05$) in the mean values estimated according to the three points in time. There is a statistically significant improvement at the end of the treatment compared to the baseline condition (T1-T0). This tendency for improvement is also preserved when reading the results on the 45th day from the start of treatment, both regarding the end of treatment (T2-T1) and the baseline condition (T2-T0).

Table 12. Intra-group statistical analysis of the indicators of the difference from the norm in the angiometry of abduction of the shoulder joint, used in the patients of group A in the three examined coins.

Abd (°)	Mean	Std. Deviation	Based on positive ranks	p-Value
T1-T0	38,68	33,058	-5,353	0,000
T2-T1	12,63	25,087	-2,690	0,007
T2-T0	7,76	18,984	-5,410	0,000

Before starting therapy (T0), the following results were reported for Abd for the patients from group B: mean value - 26.32, minimum - 10, maximum - 100. Immediately after the completion of treatment (T1), the results for Abd are the following: mean value - 18.16, minimum - 0, maximum - 60. The results reported on the 45th day from the baseline level (T2) of Abd are the following: mean value - 7.11, minimum - 0, maximum - 60 (Figure 22).

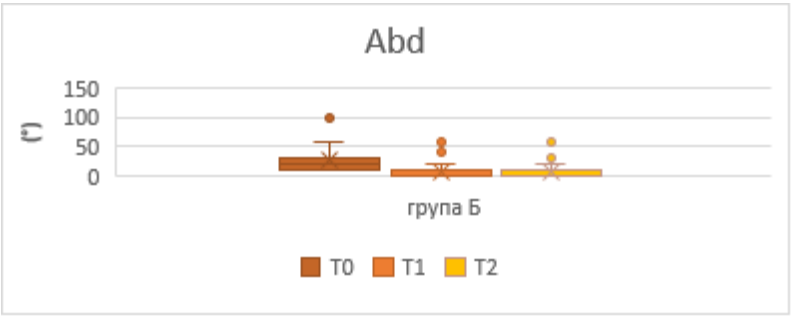

Figure 22. Mean values, minimum and maximum of the difference from the norm in the angle of abduction of the shoulder joint were estimated in the three examined coins for the patients from group B.

The results from the evaluation of Abd are presented in Table 13. For the patients from group B, there is a statistically significant difference ($p<0.05$) in the mean values estimated for T1-T0 and T2-T0. There is a statistically significant improvement at the end of the treatment (T1-T0) and on the 45th day from the start of

treatment (T2-T0) compared to the baseline condition. Only the differences in F, between the values after the completion of the therapeutic course (T1), and at a following visit, 45 days after the start of treatment (T2), are not statistically significant (p=0.658). It is sensible to examine this aspect, linked to the initial improvement to maximum, achieved by patients after the completion of the therapeutic course.

Table 13. Intra-group statistical analysis of the indicators of the difference from the norm in the angiometry of abduction of the shoulder joint, used in the patients of group B in the three examined coins.

Abd (°)	Mean	Std. Deviation	Based on positive ranks	p-Value
T1-T0	26,32	18,661	-5,179	0,000
T2-T1	8,16	12,489	-1,069	0,285
T2-T0	7,11	12,715	-5,065	0,000

Before starting therapy (T0), the following results were reported for ER for the patients from group A: mean value - 39.74, minimum - 0, maximum - 90. Immediately after the completion of treatment (T1), the results for ER are the following: mean value - 12.84, minimum - 0, maximum - 80. The results reported on the 45th day from the baseline level (T2) of ER are the following: mean value - 8.82, minimum - 0, maximum - 60 (Figure 23).

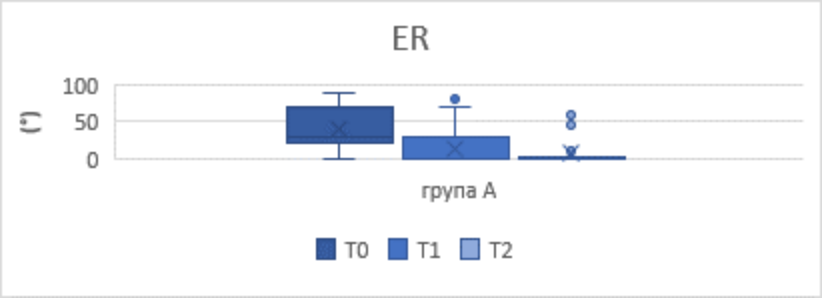

Figure 23. Mean values, minimum and maximum of the difference from the norm in the agglomeration of external rotation of the shoulder joint evaluated in the three considered coins for the patients from group A.

The results from the evaluation of ER are presented in Table 14. For the patients from group A, there is a statistically significant difference ($p<0.05$) in the mean values estimated according to the three points in time. There is a statistically significant improvement at the end of the treatment compared to the baseline condition (T1-T0). This tendency for improvement is also preserved when reading the results on the 45th day from the start of treatment, both regarding the end of treatment (T2-T1) and the baseline condition (T2-T0).

Table 14. Intra-group statistical analysis of the indicators of the difference from the norm in the angle of geometry of external rotation of the shoulder joint, used in the patients of group A in the three examined coins.

ER (°)	Mean	Std. Deviation	Based on positive ranks	p-Value
T1-T0	39,74	28,043	-4,968	0,000
T2-T1	12,84	21,913	-2,333	0,002
T2-T0	8,82	18,433	-5,032	0,000

Before starting therapy (T0), the following results were reported for ER for the patients from group B:

mean value - 28.68, minimum - 0, maximum - 90. Immediately after the completion of treatment (T1), the results for ER are the following: mean value - 11.32, minimum - 0, maximum - 75. The results reported on the 45th day from the baseline level (T2) of ER are the following: mean value - 9.61, minimum - 0, maximum - 75 (Figure 24).

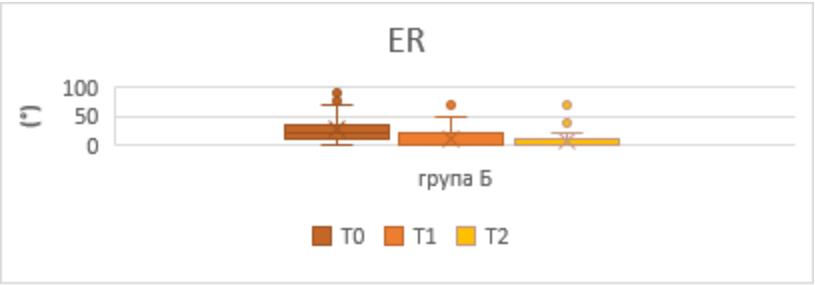

Figure 24. Mean values, minimum and maximum of the difference from the norm in the agglomeration of external rotation of the shoulder joint evaluated in the three examined coins for the patients from group B.

The results for the evaluation of ER are presented in Table 15. For the patients from group B, there is a statistically significant difference ($p<0.05$) in the mean values estimated for T1-T0 and T2-T0. There is a statistically significant improvement at the end of the treatment (T1-T0) and on the 45th day from the start of treatment (T2-T0) compared to the baseline condition. Only the differences in ER, between the values after the completion of the therapeutic course (T1), and at a following visit, 45 days after the start of treatment (T2), are not statistically significant ($p=0.166$). It is sensible to examine this aspect, linked to the initial improvement to maximum, achieved by patients after the completion of the therapeutic course.

Table 15. Intra-group statistical analysis of the indicators of the difference from the norm in the angle of geometry of external rotation of the shoulder joint, used in the patients of group B in the three examined coins.

ER (°)	Mean	Std. Deviation	Based on positive ranks	p-Value
T1-T0	28,68	26,398	-5,086	0,000
T2-T1	11,32	20,191	-1,387	0,166
T2-T0	9,61	18,613	-4,994	0,000

3.4. Comparison and analysis of the short-term and long-term clinical efficacy of the two methods of treatment according to the six indicators in the three moments in time examined

As shown in the analysis of the indicators for assessment of the functional status and pain, for SPADI in %, there is a statistically significant difference in the mean values in favour of the method of treatment used in group A (Figure 25).

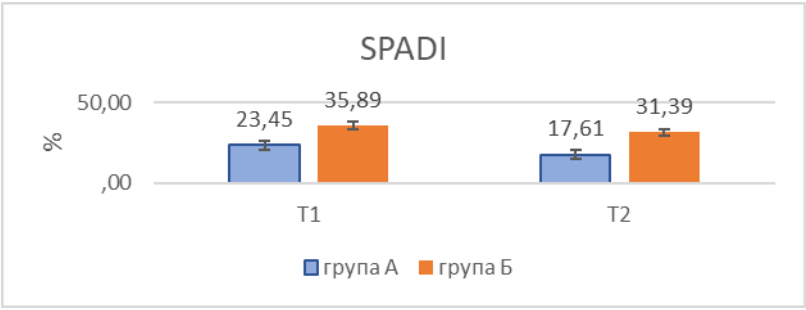

Figure 25. Mean values with 95% confidence interval (CI) of SPADI results in percentages and comparison between group A and group B.

The results for SPADI in % are presented in Table 16. There is a statistically significant difference ($p<0.05$) in the mean values in favour of the method of treatment used in group A, both after the completion of the therapeutic course (T1) ($p=0.003$) and in the long term - 45 days from the start of treatment (T2) ($p=0.000$).

Table 16 Intergroup statistical analysis to compare the results for SPADI in percentages in both groups at the end of treatment (T1) and on day 45 of treatment (T2).

	groupA	Group B	
	mean (SD)	*mean (SD)*	*p-Value*
SPADI (%)			
T1	23.5 (20.5)	35.9 (18.7)	0.003
T2	17.6 (18.2)	31.4 (20.2)	0.000

As shown in the analysis of the indicators for assessment of spontaneous pain according to VAS, there is a statistically significant difference in the mean values in favour of the method of treatment used in group A after the completion of the therapeutic course (T1), and there is no statistically significant difference in the long term - 45 days from the start of treatment (T2) (Figure 26).

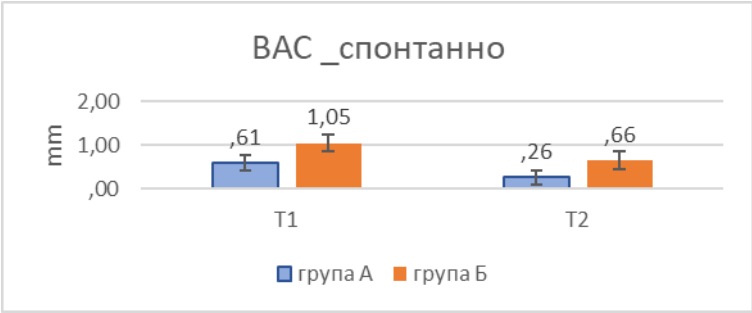

Figure 26. Mean values with 95% confidence interval (CI) of spontaneous BAC pain results and comparison between group A and group B.

The results for spontaneous pain according to VAS are presented in Table 17. There is a statistically significant difference ($p<0.05$) in the mean values in favour of the method of treatment used in group A after the completion of the therapeutic course (T1) ($p=0.016$). There is no statistically significant difference ($p<0.05$) in the mean values in the long term - 45 days from the start of treatment (T2) ($p=0.077$).

Table 17. Intergroup statistical analysis comparing the results of spontaneous VAS pain in both groups at the end of treatment (T1) and on day 45 of treatment (T2).

	group A	Group B	
	mean (SD)	*mean (SD)*	*p-Value*
VAS spontaneous (mm)			
T1	0.6 (1.7)	1.1 (1.5)	0.016
T2	0.2 (0.9)	0.7 (1.3)	0.077

As shown in the analysis of the indicators for palpatory pain according to VAS, there is a statistically significant difference in the mean values in favour of the method of treatment used in group A (Figure 27).

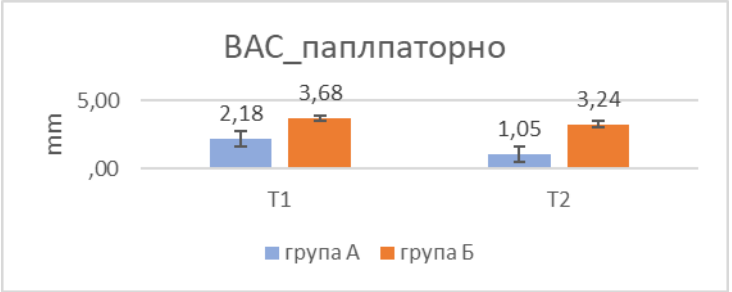

Figure 27. Mean values with 95% confidence interval (CI) of BAC palpation pain results and comparison between group A and group B.

The results for palpatory pain according to VAS are presented in Table 18. There is a statistically significant difference ($p<0.05$) in the mean values in favour of the method of treatment used in group A, both after the completion of the therapeutic course (T1) ($p=0.000$) and in the long term - 45 days from the start of treatment (T2) ($p=0.000$).

Table 18. Intergroup statistical analysis comparing the results of BAC palpation pain in both groups at the end of treatment (T1) and on day 45 of treatment (T2).

	Група А	Група Б	
	mean (SD)	*mean (SD)*	*p-Value*
VAS palpation (mm)			
T1	2.2 (2.2)	3.7 (1.8)	0.000
T2	1.1 (1.5)	3.2 (1.8)	0.000

As shown in the analysis of the indicators for assessment of the difference from the norm in anglemetry of flexion of the shoulder joint (F), there is no statistically significant difference in the mean values after the completion of the therapeutic course (T1), and there is a statistically significant difference in favour of the method of

treatment used in group A in the long term - 45 days from the start of treatment (T2) (Figure 28).

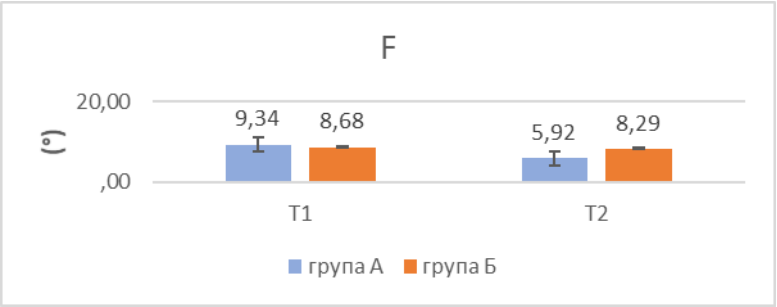

Figure 28. Mean values with 95% confidence interval (CI) of the results of the difference from the norm in the flexion angle of the shoulder joint and comparison between group A and group B.

The results for the difference from the norm for anglemetry of flexion of the shoulder joint are presented in Table 19. The differences are due to coincidence after the completion of the therapeutic course (T1) (p=0.110). There is a statistically significant difference (p<0.05) in the mean values for F in favour of the method of treatment used in group A in the long term - 45 days from the start of treatment (T2) (p=0.009).

Table 19. Intergroup statistical analysis for comparison of the results of the difference from the norm in the anglemetry of flexion of the shoulder joint in both groups at the end of treatment (T1) and on the 45th day from the beginning of treatment (T2).

	group A	Group B	
	mean (SD)	*mean (SD)*	*p-Value*
F (°)			
T1	9.3 (21.8)	8.68 (13.0)	0.110
T2	5.9 (17)	8.29 (13.0)	0.009

As shown in the analysis of the indicators for assessment of the difference from the norm in anglemetry of abduction of the shoulder joint (Abd), there is no statistically significant difference in the mean values after the completion of the therapeutic course (T1), nor in the long term - 45 days from the start of treatment (T2) (Figure 29).

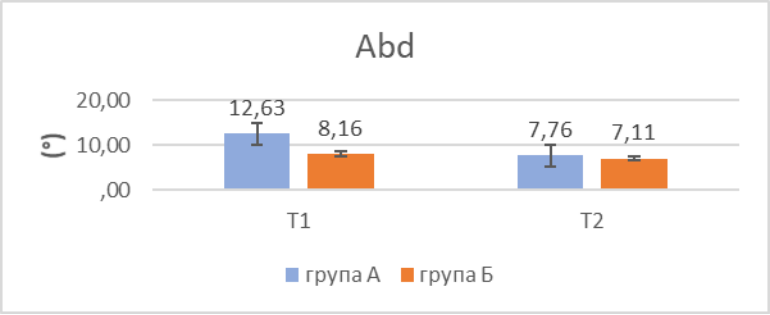

Figure 29. Mean values with 95% confidence interval (CI) of the results of the difference from the norm in the angle of abduction of the shoulder joint and comparison between group A and group B.

The results for Abd are presented in Table 20. The differences are due to coincidence after the completion of the therapeutic course (T1) (p=0.709) and in the long term - 45 days from the start of treatment (T2) (p=0.355).

Table 20. Intergroup statistical analysis for comparison of the difference from the norm in the angle of abduction of the shoulder joint in both groups at the end of treatment (T1) and on the 45th day from the beginning of treatment (T2).

	group A	Group B	
	mean (SD)	*mean (SD)*	*p-Value*
Abd (°)			
T1	12.6 (25.1)	8.2 (12.5)	0.709
T2	7.8 (19.0)	7.1 (12.7)	0.355

As shown in the analysis of the indicators for assessment of the difference from the norm in anglemetry of external rotation of the shoulder joint (ER), there is no statistically significant difference in the mean values after the completion of the therapeutic course (T1), nor in the long term - 45 days from the start of treatment (T2) (Figure 30).

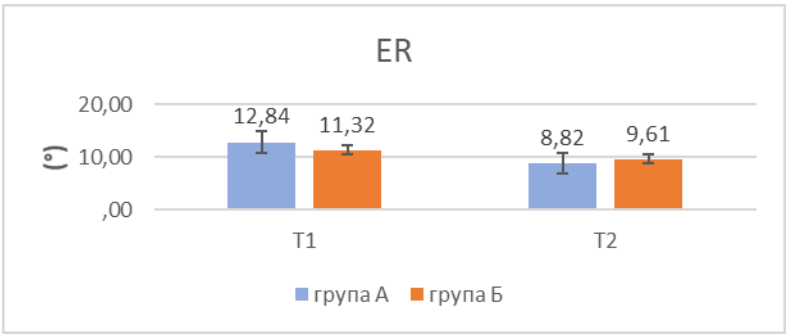

Figure 30. Mean values with 95% confidence interval (CI) of the results of the difference from the norm in the agglomeration of external rotation of the shoulder joint and comparison between group A and group B.

The results for Abd are presented in Table 21. The differences are due to coincidence after the completion of the

therapeutic course (T1) (p=0.709) and in the long term - 45 days from the start of treatment (T2) (p=0.355).

Table 21. Intergroup statistical analysis for comparison of the difference from the norm in angle of abduction of the shoulder abduction in both groups at the end of treatment (T1) and on the 45th day from the beginning of treatment (T2).

	group A	Group B	
	mean (SD)	*mean (SD)*	*p-Value*
ER (°)			
T1	12.8 (21.9)	11.3 (20.2)	0.985
T2	8.8 (18.4)	9.6 (18.6)	0.289

Chapter 4. Discussion

The demographic profile of the patients examined in the present study matches the data cited in the literature. Age correlates with tendinopathy, having a negative effect on the properties of the tendons. The average age of the patients studied was 45.7±10.2 years old. The people in the 50-55 years old age range are the highest percentage - 48% of the people studied, while both genders are almost equally affected: men - 51%, women - 49%. The epidemiological data in the literature review show conflicting information over the years about the distribution of people affected according to gender. The dominant hand is affected more often than the nondominant one, and people working with physical overexertion are affected more often than employees. Of all the patients studied, 46 patients (62%) had their right hand affected, and 28 patients (38%) - their left hand affected, and all the patients who participated in the study had a dominant right hand. The risk factors reflected in the literature review, such as work and daily activities associated with physical overexertion, frequent and monotonous repetitive movements of the upper extremities, movements including raising

the upper extremity above the head, as well as, in people who practise sports professionally - movements with forced flexion and abduction in the shoulder joint. Most of the patients studied practice professions or hobbies in their free time associated with overexertion of the glenohumeral joint - 51% - workers and 21% - athletes. There is no difference in the demographic indicators, the assessment for pain and functional status of the joint between the patients studied in the two groups which leads to their mutual homogeneity. This is an important condition for reliability of the results from the comparative analysis which is an objective of the present study.

Pain is the main symptom in acute peritendinitis of the glenohumeral joint. It manifests during certain movements in the shoulder joint - flexion, abduction, and external rotation. Apart from painful, these movements are severely limited. As a result of the main symptoms, the function of the glenohumeral joint is impaired, and professional and daily activities are made difficult. There have been plenty of questionnaires over the years, studying both pain and functional impairment. We used SPADI as a primary method for assessment of the functional state and of pain during the follow up, since it combines questions not just about the main symptoms but also their effect on the quality of life of the patient with peritendinitis of the glenohumeral joint. SPADI demonstrated good validity and considerable correlation with other questionnaires about the shoulder. The initial mean value of SPADI is 57.4%±22.6% for all patients studied, and it correlates with the one from the available studies examined in the literature.

We chose the insertion site of m. supraspinatus as a place for palpation for the assessment of palpatory (VAS_palpatory) pain according to VAS due to its high recurrence rate. The initial mean value of spontaneous pain according to VAS is 3.1±2.8 for all patients studied. These low initial results are expected since spontaneous pain is not common in patients with acute peritendinitis

of the glenohumeral joint. This symptom is more often encountered with chronification of the process. The initial mean value of palpatory pain according to VAS is 4.8±2.0 for all patients studied which correlates with the scientific data from the literature.

Flexion, abduction, and external rotation are most severely affected in peritendinitis of the glenohumeral joint. The reported initial mean values of the difference from the norm for anglemetry of the shoulder joint are 28°±24° for flexion, 32°±27° for abduction, and 34°±27° for external rotation. They match the results reported in scientific studies.

The analysis of the results for SPADI shows that there is a statistically significant improvement at the end of the treatment compared to the baseline condition for the patients in both groups. This tendency for improvement is also preserved when reading the results on the 45th day from the start of treatment, both regarding the end of treatment and the baseline condition. The analysis of the results from SPADI proves the hypothesis that the patients in therapeutic group A and those in group B improve at the end of the therapeutic course, as well as on the 45th from starting the treatment. It is extremely important to guarantee the tendency for complex improvement because of the treatment applied in order to improve the quality of life and work capacity of the patients. These results are expected because the therapeutic effects of MLS laser therapy, of microwave diathermy, and of interferential current therapy are all known.

A number of scientific publications associated with the application of MLS lasers prove a considerable reduction of pain. Several theoretical physiological mechanisms, such as increased circulation, reduction of pain, nerve conduction block, and placebo have been proposed in the literature in support of the analgesic effects of interferential current therapy. The efficacy of interferential

current is expected to be potentiated when combined with microwave diathermy.

For the patients from group A, there is a statistically significant improvement for the results for spontaneous pain according to VAS ($p=0.000$) at the end of treatment and on the 45th day from the start of treatment compared to the baseline condition, but not between the values after the completion of the therapeutic course and at a following visit, 45 days from the start of treatment ($p=0.058$). It is sensible to examine this aspect, linked to an initial improvement to maximum, achieved by patients after the completion of the therapeutic course and the low initial mean value for spontaneous pain according to VAS (2.8 ± 3.0 cm). There is a statistically significant improvement for the patients from group B ($p<0.05$) in the mean values estimated according to the three points in time. The results from the analysis of the results for palpatory pain according to VAS are presented. There is a statistically significant difference ($p<0.05$) in the mean values estimated according to the three points in time, both for the patients from group A and for those from group B. This is due to the higher mean values of the baseline level reported in both groups (group A - 4.5 ± 1.8 and group B - 5.1 ± 2.2). We can assume that the hypothesis has been proved - that patients in therapeutic group A and in group B will improve according to the results for spontaneous and palpatory pain according to VAS at the end of the therapeutic course, as well as on the 45th from starting the treatment. This situation remains the same with regards to VAS_spontaneous when maximum improvement (mean value - 0.66) is achieved after the treatment course with an MLS laser.

A number of scientific publications regarding administered MLS laser treatment prove an increase in mobility in the treated area. These results from the therapeutic effects give great hopes for

reducing the limited mobility in the glenohumeral joint in patients with peritendinitis.

Evaluation and comparison of the impact of the therapy applied in both therapeutic groups on the indicators of anglemetry of flexion of the shoulder joint at the three moments examined.

The results from the evaluation of F for the patients from group A presented show that there is a statistically significant difference ($p<0.05$) in the mean values estimated according to the three points in time. There is a statistically significant improvement at the end of the treatment compared to the baseline condition. This tendency for improvement is also preserved when reading the results on the 45th day from the start of treatment, both regarding the end of treatment and the baseline condition. For the patients from group B, there is a statistically significant improvement at the end of treatment and on the 45th day from the start of treatment compared to the baseline condition, but not between the values after the completion of the therapeutic course and on the 45th day from the start of treatment ($p=0.658$). In this case, the patients have not achieved maximum improvement at the end of the therapeutic course. The improvement after the end of the therapeutic course has persisted long-term without regression. The results prove the hypothesis that the patients in therapeutic group A improve according to the results from the anglemetry of flexion of the shoulder joint at the end of the therapeutic course, as well as on the 45th day from starting the treatment. The hypothesis that the patients in therapeutic group B improve according to the results from the anglemetry of flexion of the shoulder joint at the end of the therapeutic course is confirmed, but not on the 45th day from starting the treatment.

The results from the indicators for assessment of Abd presented for the patients from group A show that there is a statistically significant difference ($p<0.05$) in the mean values estimated according to the three points in time. There is a statistically

significant improvement at the end of the treatment compared to the baseline condition. This tendency for improvement is also preserved when reading the results on the 45th day from the start of treatment, both regarding the end of treatment and the baseline condition. For the patients from group B, there is a statistically significant improvement at the end of treatment and on the 45th day from the start of treatment compared to the baseline condition, but not between the values after the completion of the therapeutic course and on the 45th day from the start of treatment ($p=0.285$). In this case, the patients have not achieved maximum improvement at the end of the therapeutic course. There is long-term improvement, but it is not statistically significant.

The results from the indicators for assessment of ER presented for the patients from group A show that there is a statistically significant difference ($p<0.05$) in the mean values estimated according to the three points in time. There is a statistically significant improvement at the end of the treatment compared to the baseline condition. This tendency for improvement is also preserved when reading the results on the 45th day from the start of treatment, both regarding the end of treatment and the baseline condition. For the patients from group B, there is a statistically significant improvement at the end of treatment and on the 45th day from the start of treatment compared to the baseline condition, but not between the values after the completion of the therapeutic course and on the 45th day from the start of treatment ($p=0.166$). In this case, the patients have not achieved maximum improvement at the end of the therapeutic course. There is long-term improvement, but it is not statistically significant.

The results prove the hypothesis that the patients in therapeutic group A improve according to the results from the anglemetry of flexion, abduction, and external rotation of the shoulder joint at the end of the therapeutic course, as well as on the

45th day from starting the treatment. The hypothesis that the patients in therapeutic group B improve according to the results from the anglemetry of flexion, abduction, and external rotation of the shoulder joint at the end of the therapeutic course is confirmed, but not on the 45th day from starting the treatment.

The results from SPADI present a statistically significant difference ($p<0.05$) in favour of the method of treatment used in group A, both after the completion of the therapeutic course ($p=0.003$) and in the long term - 45 days from the start of treatment ($p=0.000$). Proving the superiority, with respect to the results from SPADI, in favour of the treatment with an MLS laser over the combined therapy of microwave diathermy and interferential current is of extreme importance. The questionnaire presents elaborately the functional status of the glenohumeral joint, the strength of the pain, and the limitations in everyday life and work. These results speak comprehensively about the consequences for the psychoemotional state and the social life of the patient. The proof that the MLS laser therapy leads to long-term, lasting improvement in patients with peritendinitis of the glenohumeral joint gives definite hopes for reducing the chronic cases of the disease, reducing the complications and the need for surgical treatment. The results from the literature review about the superiority of the MLS laser therapy over other physiotherapy procedures are confirmed.

The results for spontaneous pain according to VAS from the intragroup analysis for comparison of the mean values of the application of the two methods present a statistically significant difference ($p<0.05$) in the mean values in favour of the method of treatment used in group A after the completion of the therapeutic course ($p=0.016$). There is no statistically significant difference ($p<0.05$) in the mean values in the long term - 45 days from the start of treatment ($p=0.077$). These results are expected and acceptable since the initial mean values in both groups are low. There is

improvement in both groups, immediately after the completion of the therapeutic course, with the one in the patients from group A being statistically significantly superior. Practically, positive dynamics are not expected in the long term for the maximum improvement. This is why the difference in the mean values in the two groups on the 45th day from the start of treatment is not statistically significant.

Palpatory pain in the insertion site of m. supraspinatus is a diagnostic sign for peritendinitis of the glenohumeral joint. It is indicative of definite improvement after treatment. Very frequently even asymptomatic patients get a positive result from that test. The results for palpatory pain according to VAS from the intragroup analysis for comparison of the mean values from the application of the two methods present a statistically significant difference ($p<0.05$) in the mean values in favour of the method of treatment used in group A, both after the completion of the therapeutic course ($p=0.000$) and in the long term - 45 days from the start of treatment ($p=0.000$). The proof of the superiority of the MLS laser therapy with regard to palpatory pain according to VAS is due to the direct therapeutic effect in the damaged structures themselves, as reported in the literature review. The strong analgesic effect of the MLS laser therapy is due to the direct application in the trigger points which are, by rule, painful.

The results for the difference from the norm in anglemetry of flexion of the shoulder joint from the intragroup analysis for comparison of the mean values from the application of the two methods are a coincidence after the completion of the therapeutic course (T1) ($p=0.110$). This is due to improvement immediately after the end of treatment with both methods. As reported in the scientific studies, so far the combination of microwave therapy and interferential current has analgesic, spasmolytic, and trophic effects on the affected tissues. There is a statistically significant difference ($p<0.05$) in the mean values for F in favour of the method of

treatment used in group A in the long term - 45 days from the start of treatment (p=0.009). The superiority of the MLS laser therapy in the long term with regards to the flexion in the glenohumeral joint is of great importance for the following kinesitherapy and the active participation of the shoulder being treated in work and everyday activities.

The results for the difference from the norm in anglemetry of abduction and external rotation of the shoulder joint from the intragroup analysis for comparison of the mean values from the application of the two methods are a coincidence after the completion of the therapeutic course (T1) (Abd p=0.709 and ER p=0.985) and in the long term - 45 days from the start of treatment (T2) (Abd p=0.355 and ER p=0.289). Both methods lead to improvement in the mobility of the joint, and there is no statistically significant difference.

The hypothesis that the patients in therapeutic group A have better clinical and functional recuperation than the patients in therapeutic group B, both after the end of treatment and on the 45th day from starting the treatment has been partially proved. The MLS therapy is categorically superior with regard to the results for SPADI and palpatory pain according to VAS, partially for spontaneous pain according to VAS and flexion, and there is no statistically significant difference for abduction and external rotation.

The effects of treatment with microwave diathermy and interferential current are well known. Both methods are widely available. The studies available for these monotherapeutic effects in patients with peritendinitis of the glenohumeral joint doesn't show conclusive results. For this reason, their use as a combined physiotherapeutic complex deserves in-depth research.

Despite the present scientific publications, additional research into MLS laser therapy in patients with peritendinitis of the glenohumeral joint is desirable. The research into the effect of MLS

lasers reported so far shows that they affect the pathogenesis of the disease and can be applied in each phase of the disease. This suggests early use of MLS laser therapy as a main variant in comparison to the rest of the physiotherapeutic factors. The research into the effects of MLS laser therapy applied with different settings (frequency, power, dosage), as well as the comparison between the MLS laser and other common physiotherapeutic factors could be of additional interest.

With the exception of patients who are contraindicated for treatment with laser therapy or with microwave diathermy and interferential current, the potential side effects for the participants are minimal. No severe adverse reactions were observed during the study in either group.

The limitation of the present study is that it is not blind, and further studies comparing placebo to MLS laser therapy could better prove the therapeutic effects of laser treatment. The other limitation is the 45-day follow up, since, in clinical practice, glenohumeral peritendinitis is known as a disease with a high recurrence percentage. A follow up of three or even six months will ensure a better reference for this topic. With respect to the methodology for assessment of the disease, an imaging method, such as sonography, which gives reliable information for the inflammatory response associated with peritendinitis, is missing from the present study. The ideal version of a future study, in order to avoid the potential sources of bias, would be a controlled, blind study, with a six-month follow up and with a method for assessing sonography.

Chapter 5. Conclusions

1. With the present study, follow up and comparison of the clinical efficacy of MLS laser radiation and of the combined therapy of microwave diathermy and interferential current in patients with

peritendinitis of the glenohumeral joint, we proved statistically significant improvement at three moments.

2. The results from SPADI, at three moments examined, showed short-term and long-term improvement for the patients in both groups.

3. The results for the subjective sensation of spontaneous and palpatory pain according to VAS, at three moments examined, proved short-term and long-term improvement for the patients in both groups. The long-term effect with regard to VAS_spontaneous in patients treated with the combined therapy is an exception. This result is acceptable because of the low mean values at the baseline level and the achievement of maximum therapeutic effect at the end of the therapeutic course.

4. The results from the impact of the therapy applied in both therapeutic groups on the indicators of functional status - anglemetry of flexion, abduction, and external rotation of the shoulder joint - proved short-term and long-term improvement for the patients treated with MLS laser radiation. A statistically significant improvement after the completion of the therapeutic course and preserving the effect in the long term was proved for the patients treated with the combination therapy after the completion of the therapeutic course, with no perspective for statistically significant improvement.

5. The study, follow up, and comparison of the clinical efficacy at three moments, conducted for the dissertation, prove the superiority of the MLS laser treatment as a monotherapy compared to the combined therapy of microwave diathermy and interferential current in patients with peritendinitis of the glenohumeral joint. The MLS laser therapy is categorically superior with regard to the results for SPADI and palpatory pain according to VAS, partially for spontaneous pain according to VAS and flexion of the glenohumeral joint, and there is no statistically significant difference for abduction

and external rotation of the glenohumeral joint. The evidence for the superiority of efficacy of MLS laser therapy in the short and long term is made absolute by the monotherapy which is economically and time-wise more advantageous than a combination of preformed factors.

Chapter 6. Contribution

A comparative study of the effects of a combined physiotherapeutic complex with a high-energy laser in patients with peritendinitis of the glenohumeral joint was conducted in Bulgaria for the first time.

The short-term and long-term efficacy of the treatment with an MLS laser and with a combined complex of microwave diathermy and interferential current was proved in patients with peritendinitis of the glenohumeral joint.

It was proved that the effects of MLS laser treatment are superior to the treatment with a combined complex of microwave diathermy and interferential treatment for most of the indicators for follow up in the patients studied.

The results obtained contribute to the preparation of protocols with proved efficacy for diagnostics and treatment with MLS laser radiation, as well as for treatment with combined therapy of microwave diathermy and interferential current of patients with peritendinitis of the glenohumeral joint.

Chapter 7. Publications and participation in scientific sessions in connection with the dissertation

Published articles in connection with the dissertation

1. Panayotova-Ovcharova L. The effects of local microwave diathermy and interference current in patients with peritendinitis of the glenohumeral joint - review. Varna Medical Forum, vol. 9, 2020, issue 2 MU-Varna
2. Panayotova-Ovcharova L, Yankov Ts, Todorov I. Efficacy of application of combination therapy with microwave diathermy and interference current in peritendinitis of glenohumeral joint. Varna Medical Forum, vol. 10, 2021, issue 2 MU-Varna
3. Panayotova L, Todorov I, Penev P. Efficacy of the application of high-energy laser in peritendinitis of glenohumeral joint. Physical Medicine, Rehabilitation and Health, 2021-2

Participation in scientific forums in connection with the dissertation

Participation in the National Conference on Physical and Rehabilitation Medicine, online - June 25-26, 2021 with a report on the topic: "Efficacy of high-energy laser in peritendinitis of glenohumeral joint - L. Panayotova-Ovcharova, I. Todorov, P. Penev