



National Sports Academy

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**DEPARTMENT OF THEORY AND METHODS OF THE
KINESITHERAPY**

FATON DADI

**EXAMINATION OF THE EFFECT OF MANUAL THERAPY IN
IMPINGEMENT SYNDROME OF THE SHOULDER JOINT**

ABSTRACT

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The dissertation contains 147 pages of standard type-written pages. It is presented through 13 figures, 21 tables and 11 graphics. There are 2 appendixes.

The dissertation was selected, discussed, and directed for official defense at a meeting of the Department of Theory and Methods of the Kinesitherapy, NSA "Vasil Levski".

The public defense of the dissertation will take place on.... , 2022, of NSA "Vasil Levski".

The materials for the official defense are published on the website of the NSA "Vasil Levski" - www.nsa.bg and are available in the library of the NSA "Vasil Levski".

THESIS INTRODUCTION

Shoulder joint disorders are common. Between 7% and 34% of adults have experienced shoulder pain at some point in their lives (Reilingh, et al., 2008). The problem of their treatment is current and socially significant. Impingement syndrome is one of the most common health problems related to the workplace, household activities and sports.

In the researched available literary sources – articles in periodicals in Bulgarian, Russian and Latin for a period of the last 10-20 years, databases Medline, Embase, Cochrane Library, ACP journal Club, HealthSTAR databases, PubMed Central, Google Scholar, Physiotherapy Evidence Database (PEDro), textbooks, monographs, and dissertations, information has been published primarily on the causes of shoulder pain, biomechanics, and treatment of subacromial impingement syndrome. The opinion is formed that if no improvement is observed after three to six months of non-operative treatment, surgical treatment can be switched to.

During the analysis of the studied sources, we found some insufficiently researched questions:

- There is a wide variety of interventions and methods in studies on the effect of non-operative treatment (study population, factors monitored, duration of follow-up, etc.), which makes them difficult to compare.
- There is no unified algorithm created and put into practice regarding functional research methods.
- Some basic directions and tasks of kinesitherapy have been described, but there is no consensus regarding the content of the therapeutic course, the dosage, the course of treatment, specific techniques of manual therapy and therapeutic exercises for this contingent of patients.
- There is a lack of data on late functional outcomes after physiotherapy for subacromial impingement syndrome.

Future research on the issue is needed.

The development of modern orthopedics and traumatology, the change in the clinical approach require the creation of science-based methods of kinesitherapy related to specific symptoms. This motivated us to choose the problem of kinesitherapy in subacromial impingement syndrome as the topic of our dissertation.

1. WORKING HYPOTHESIS

Based on the literary sources studied and our experience in this field, we formulated the following ***working hypothesis***:

The creation of a *complex, scientifically justified, specialized physiotherapeutic methodology*, including manual therapeutic techniques and its application to patients with subacromial impingement syndrome, would lead to more effective functional recovery compared to traditional treatment.

2.THESIS PURPOSE AND GOALS

PURPOSE OF THE DISSERTATION WORK

The purpose of the dissertation work is to develop, implement and study the effect of the application of physiotherapeutic methodology, including manual therapeutic techniques in patients with subacromial impingement syndrome.

GOALS OF THE DISSERTATION WORK

1. To make a critical analysis of the literature on the application of manual therapy in subacromial impingement syndrome.
2. To specify the criteria for inclusion and exclusion from the study and select an appropriate contingent for research.
3. To develop a methodology for functional examination in this contingent of patients.
4. To develop an author's methodology of kinesitherapy, including manual therapeutic techniques.
5. To apply the methodology to a statistically reliable contingent of patients with subacromial impingement syndrome.
6. To analyze the obtained results regarding the changes in the functional capabilities of the patients under the influence of the applied kinesitherapy.
7. To formulate conclusions and recommendations on practice.

3. ORGANIZATION AND CONTINGENT OF THE RESEARCH

Contingent of the research

For the period 2020 – 2022, in the hospital „Villa Alba“, physiotherapy practice „Faton Daci“, Durres, Albania, 168 patients with shoulder complaints were assessed for eligibility. Of them were excluded 88 patients. Reasons: criteria not fulfilled (n=52); patient refused (n=28); other reasons (n=8) – 3 moved; 2 got no prescription for PT; 3 could not fulfil the treatment schedule.

At the end **eighty subjects** diagnosed with primary shoulder impingement were randomly assigned to one of two groups: control group (CG) – supervised exercise only (40 patients) and experimental group (EG) – supervised exercise with manual therapy techniques (40 patients). All subjects signed consent forms approved by the Department of Theory and Methods of Physiotherapy, NSA, Sofia, Bulgaria and physiotherapy practice „Faton Daci“, Durres, Albania.

Inclusion criteria were:

- 18-65 years old patients, both genders.
- Pain in the upper-lateral area of the shoulder.
- Presence of 3 out of 5 specific objective signs and symptoms:
 - o positive (painful) Neer's impingement test.
 - o positive (painful) Hawkins-Kennedy impingement test.
 - o pain-limited active elevation of the arm (flexion, abduction, scaption), sign of the "painful arc".
 - o pain and restriction of functional motor patterns - "hand behind the back", "hand behind the head".
 - o pain during resistive external rotation of the shoulder joint.

Exclusion criteria were:

Doctor's diagnosis of adhesive capsulitis.

- III degree rotator cuff tear.

- Traumatic luxation of the shoulder in the last 3 months.
- Calcifying tendonitis confirmed radiographically.
- Systemic or neurological disease.
- Cervical radiculopathy.
- Surgically treated disease of the shoulder joint.
- Administered corticosteroid injection applications to the shoulder in the past month.
- Applied physiotherapy treatment of the shoulder in the last 3 months.

During the study, patients who visited another place for similar therapies or other treatment, did not participate actively during the entire therapeutic course, or were indicated for surgical treatment on the recommendation of the orthopedist were excluded.

Patients were randomly assigned to one of two possible treatment groups: first group - therapeutic exercises, second group - therapeutic exercises and manual therapy.

4. METHODOLOGY OF THE SURVEY

Methods of functional research and evaluation

To objectify the functional results before and after a rehabilitation course of *12 procedures*, we applied the following methods of functional research (Dimitrova, E., 2006):

1. Anamnesis, examination, palpation, examination with movements.
2. Visual Analogue Scale (VAS) for pain.
3. Examination of muscle imbalance – tests for increased muscle tone and/or shortening, isometric test, manual muscle testing.
4. Measurement of the active range of motion of the shoulder joint.
5. Special clinical tests - Neer and Hawkins-Kennedy impingement test.
6. Complex Functional Assessment Test (Roach, et al., 1991) - Shoulder Pain and Disability Index (SPADI).

We have developed a functional study form.

Statistic and data management

We have processed the data from the applied tests statistically using the method of comparative, variation, alternative and correlation analysis (Сепетлиев, Д., 1976; Брогли, Я., 1983; Гигова, В., 1999; Калинов, К., 2013).

5. METHOD OF KINESITHERAPY IN PATIENTS WITH SUBACROMIAL IMPINGEMENT SYNDROME

5.1. Purpose of kinesitherapy

The goal of kinesitherapy was to maximally restore the function of the shoulder complex and the upper limb.

5.2. Tasks of kinesitherapy

- Pain reduction.
- Improvement of blood and lymph circulation around the shoulder joint.
- Restoring the range of motion of the shoulder complex.
- Restoring the elasticity of the joint capsule.

- Improve blade control.
- Strengthening of the stabilizer muscles of the scapula and rotator cuff.
- Normalization of the scapulo-humeral rhythm.
- Restoring the functional possibilities for carrying out the activities of daily life and professional activity.
- Posture correction, patient training in proper postural control and integration into daily life.

5.3. Means of kinesitherapy

In the **control group** (CG) patients, we applied a progressive program of active therapeutic exercises including pendulum exercises to reduce pain, stretching of the dorsal joint capsule, postural correction, range of motion exercises, resistance exercises for the rotator cuff muscles and control exercises and scapula stabilization.

In the **experimental group** (EG) patients, we applied the same program of therapeutic exercises as in CG patients and additionally included manual therapeutic techniques - ventral, dorsal and caudal glenohumeral joint mobilization, traction along the longitudinal axis of the humerus, Mulligan mobilizations with movements (MWM)

and manual muscle relaxation techniques. To achieve a comparable dosage effect in both groups of patients, we trained CG patients to perform auto PIR techniques for the respective muscles. In both groups of patients, we applied *patient education*.

5.4. Methodical instructions

In all patients (from EG and CG) we applied the following physiotherapy protocol:

- during the acute and subacute period of treatment, the duration of the physiotherapy procedure was about 30-40 minutes, 3 times a week for 2 weeks (6 procedures).
- during the functional recovery period of treatment, the duration of the physiotherapy procedure in both groups was 40-60 minutes, 2 times a week for 2 weeks (4 procedures) and 1 time a week for 2 weeks (2 procedures).

The duration of treatment was 6 weeks. The average number of procedures was a maximum of 12 in both groups of patients.

We trained the patients to perform *a complex of home rehabilitation exercises* that they had learned in the clinic under the supervision of the therapist.

We also educated patients about:

- the causes of subacromial pain
- the importance of maintaining proper posture and proper body mechanics
- the need to modify activities above the level of the shoulder girdle
- preferred positions of the shoulder during sleep, ADL, strenuous work, and sports.

We emphasized reducing the weight the patient carries with the affected arm, keeping heavy objects close to the body, and incorporating lumbar spine extension when lifting objects overhead. Adapting the home and workplace according to ergonomic requirements. We have described the PT methodology in detail in the acute, sub-acute and functional recovery period of treatment in the dissertation work. We have also described manual therapy techniques applied to the experimental group of patients. We have also developed an example scheme and complexes for PT.

6. RESULTS AND ANALYSIS

6.1. Analysis of data on contingent characteristics and data from history, palpation, and examination with movements.

Data from the statistical analysis at baseline on the characterization of contingents indicated that there was no statistically significant difference between the two groups in terms of demographic characteristics (gender, age), affected shoulder, and dominant upper extremity.

The mean age of patients in EG was 47.5 (14.3) and in CG it was 46.8 (12.9). There is a predominance of women with pain in the acromial region without previous trauma. The right shoulder is more commonly affected. In 62/80 (77.5%) of the patients, the occupation included a greater load on the injured arm or working on a computer. The duration of the injury was on average 4.3 months (range from 1 to 8 months). In 96.25% of the examined patients (Table 2. Diss.), the "painful arc" sign was positive at the beginning. We also found: pain and limitation of functional motor patterns - "hand behind the back", "hand behind the head"; pain-limited active elevation of the arm; disturbed scapulo-humeral rhythm; limited

accessory movements (caudal and dorsal sliding of the caput humeri); pain with resistive external rotation of the shoulder joint. Clinical examination before treatment also indicated the presence of pain and significant functional limitations (Table 3.).

Table 3. *Pre-treatment functional test data – mean (sd) for dependent variables in both treatment groups.*

Indicator	EG (n=40)	CG(n=40)	Sig.
VAS for pain	6.25 (1.5)	6.23 (1.4)	.07*
NEER	5.28 (3.46)	5.43 (3.99)	.17*
HK	4.85 (4.32)	5.05 (4.29)	.21*
Flexion	139.2 (22.2)	138.3 (21.4)	.19*
Abduction	143. (20.8)	142.3 (20.4)	.27*
SPADI	66.75 (21.4)	67.5 (24.4)	.02*

Abbreviations: VAS = visual analog pain scale; NEER = Neer impingement test; HK = Hawkins-Kennedy impingement test; SPADI = Shoulder Pain and Disability Index; *One-way ANOVA.

In the statistical analysis of the data before the rehabilitation course, no statistically significant difference was found between the two groups in terms of age, sex, affected shoulder, dominant upper limb, subjective sensation of pain (VAS, Neer test, Hawkins-Kennedy

test), pain and limitation of functional motor patterns ("arm behind the back", "arm behind the head"), pain-limited active elevation of the arm, impaired scapulohumeral rhythm, limited accessory movements, pain during resistive external rotation of the shoulder joint, pain-free active range of motion flexion and shoulder joint assessment and function (SPADI). Therefore, the groups are statistically comparable and the results can be objectively compared.

6.2. Analysis of Visual Analogue Scale (VAS) scores for pain.

Table 4. (dis.) and diagram 1. present the comparison of initial and final results of the VAS pain study in the experimental (EG) and control group (CG). The analysis of the obtained results shows that at the beginning there is no statistically significant difference between the groups, and at the end the pain significantly decreases in both groups of patients. The change in the indicator is statistically reliable ($\alpha \leq 0.001$). This confirms the effectiveness of the applied therapeutic exercises in both groups of patients with subacromial pain. Our results confirm those of other authors (Bang & Deyle, 2000; Conroy & Hayes, 1998; Kuhn, 2009; Lombardi, et al., 2008; Ludewig & Borstad, 2003; Michener, et al., 2004; Senbursa, et al., 2007; Taheriazam, et al., 2005).

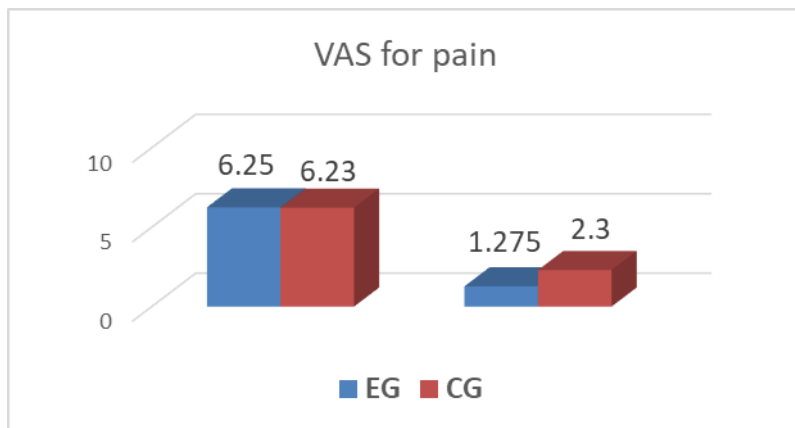


Diagram 1. *Comparison of initial and final results of the VAS pain study in the experimental and control groups.*

The comparison of the data after the rehabilitation course shows a statistically significant difference between the two groups of patients (at $\alpha \leq 0.001$) in favor of EG, which we associate with the application of specialized manual techniques in them. In the process of work, we found a visible immediate effect of pain reduction after the application of the joint mobilization techniques. The analgesic effect of joint mobilization techniques is associated with their

neurophysiological and trophic effect (Popov, 2018; Kaltenborn, et al., 2009; Levit, 2010; Maitland, 1991).

Mulligan manual mobilization with movements techniques also had a positive immediate effect on pain and joint mobility. According to Mulligan (1999), the reduction of pain can be associated with overcoming an existing 'positional error' in the joint. Modern studies have significantly expanded the mechanisms of pain influence after the application of Mulligan mobilization with movements. The data on immediate pain reduction in our patients confirm the impact of the described physiological mechanisms and the data published by Dimitrova (2002, 2003).

We also found a good pain-relieving effect from the application of myorelaxation techniques. We associate possible physiological mechanisms with improvement of local trophic, muscle function, balance and motor pattern, as well as a positive neuromuscular effect based on the gate-control theory of pain (Bowsher, 1988). Our results are comparable and better than those of other authors (Tate et al., 2010; Boudreau et al., 2019; Dominguez-Romero et al., 2021; Lafrance et al., 2021; Lefèvre-Colau et al., 2018; Pieters et al., 2020; Powell & Lewis, 2021).

6.3. Analysis of muscle imbalance test results - tests for increased muscle tone and/or shortening, manual muscle testing

Test results for increased muscle tone/shortening

At baseline, we found increased muscle tone/shortening in the following muscles: m. pectoralis major, m. pectoralis minor, m. latissimus dorsi, m. teres major, m. subscapularis, m. levator scapulae, m. trapezius pars descendens.

Table 6 presents the muscles in which we found the highest number (%) of patients, with evidence of increased muscle tone and/or shortening, in both treatment groups. The beginning-end change is reliable in both groups of patients – more pronounced in EG and smaller in CG patients. As pain decreases, muscle spasm and hyperactivity decreases.

After the applied rehabilitation course, we found a positive tendency towards *restoring the normal tone and elasticity of the muscles in both groups of patients*, more pronounced in the experimental group. We associate these changes with applied manual relaxation and stretching techniques. We trained the CG patients to perform auto-relaxation and stretching exercises, but apparently they were less effective.

Table 6. *Muscles with increased tone - number of patients (%).*

	EГ (n=40)		KГ (n=40)	
Hypertonic muscles	Before treatment n (%)	After treatment n (%)	Before treatment n (%)	After treatment n (%)
m. trapezius – pars descendens	29 (72.5)	3 (7.5)	31 (77.5)	5 (12.5)
m. levator scapulae	22 (55.0)	10 (25.0)	23 (57.5)	12 (30.0)
m. pectoralis major	23 (57.5)	5 (12.5)	22 (55.0)	9 (22.5)
m. pectoralis minor	29 (72.5)	6 (15.0)	25 (62.5)	8 (20.0)
m. latissimus dorsi	32 (80.0)	11 (27.5)	33 (82.5)	13 (32.5)

Possible therapeutic mechanisms from the application of manual muscle relaxation and stretching techniques include relaxation of reflex muscle guard and spasm, improvement of local metabolism, reduction of pain, improvement of mechanics, and placebo effect.

Manual Muscle Testing (MMT) Results

We applied MMT to the studied muscles in the possible pain-free range of motion, due to the induction of pain symptoms in the final range of motion.

We found the most pronounced inhibition and weakness in the following muscles: the external rotators of the shoulder joint (m. infraspinatus and m. teres minor); the shoulder joint abductors (m. supraspinatus and m. deltoideus); the stabilizers of the scapula (mm rhomboidei, m. trapezius – pars transversa and pars ascendens, m. serratus anterior).

At baseline, reported data ranged between 2 and 4 on MMT. Results were influenced by pain inhibition, limited range of motion, and reflex muscle guarding. After pain reduction, the score varied between 3 and 5.

For the rest of the muscle groups, the scores varied between 4 and 5 according to MMT. With them, another research method needs to be used to assess muscle strength.

The data from our studies confirm the hypothesis of Janda (1993) that subacromial impingement syndrome is associated with a specific pattern of muscle imbalance involving weakness of the

lower and middle parts of mm trapezius, serratus anterior, infraspinatus and m. deltoideus associated with tension on the upper part of m. trapezius, mm pectorales and m. levator scapulae, as part of the "Upper Cross Syndrome". Other authors also support Janda's hypothesis (Cools, et al., 2004, 2007; Page et al., 2010).

Many authors have published data on increased EMG activity of the upper part of m. trapezius, combined with reduced EMG activity of the middle and lower part of m. trapezius and m. serratus anterior (Cools, et al., 2002, 2003, 2004, 2007; Ludewig & Cook, 2000; Moraes, et al., 2008). Through MMT, we found that muscles with reduced EMG activity, according to the mentioned authors, demonstrate the presence of muscle weakness. The muscles with increased EMG activity fell into the group of muscles with increased muscle tone in the patients studied by us.

After the applied rehabilitation course, we found a positive trend towards restoring the normal balance of the muscles in both groups of patients. We associate this more pronounced positive trend in EG patients with the application of postisometric relaxation techniques for muscles with increased tone and with exercises for analytical recovery of weakened muscle strength.

In the analysis of MMT results, we found statistically significantly better results in EG patients, regardless of the fact that the methodology we applied did not include techniques specifically aimed at strength training.

The manual techniques we apply lead to improved trophicity of the surrounding articular tissues and muscles in the shoulder complex, the earlier mobilization of patients in greater range of movement and the presence of more painless movements.

All these factors lead to an increase in the opportunities for active use in daily activities of the injured limb and, accordingly, recovery of muscle strength.

6.2. Analysis of the results of measuring the range of motion of the shoulder joint.

The dynamics of the recovery of the range of motion indicates a better recovery with EG, mainly in terms of the range of flexion, extension, abduction and external rotation (table 14 and diagram 9.). Comparison of pre-treatment data indicated a lack of statistically significant differences between groups in all movements examined, with the exception of range of motion internal rotation.

Table 14. *Range of motion in the shoulder joint (in degrees °)*

Movement	Measure ment	EG \bar{X}_1	CG \bar{X}_2	ΔX	S1	S2	t	α
Flexion	Baseline	139.2	138.25	0.95°	22.21	21.35	0.19	-
	End	166.5	159.3	7.2°	9.14	16.85	2.39	0.05
Extension	Baseline	41.5	39.75	1.75	8.71	8.62	0.90	-
	End	56.75	53.25	3.5	3.85	6.26	3.01	0.01
Abduction	Baseline	143.5	142.25	1.25	20.82	20.44	0.27	-
	End	171.5	155.75	15.75	7.61	17.38	5.25	0.001
External R	Baseline (F0°)	46.37	47.75	1.375	8.76	8.69	0.70	-
	End (F90°)	73.87	66.5	7.375	12.98	10.93	2.74	0.01
Internal R	Baseline (F0°)	39.75	47.75	8	8.83	8.69	4.08	0.001
	End (F90°)	69.25	63.75	5.5	12.01	12.28	2.02	0.05

In the control group of patients, we found a significantly greater range of internal rotation movement at the beginning and a statistically significantly smaller volume of movement at the end, compared to EG patients. In 25/80 (31.25%) of the patients, we found a typical capsular pattern of movement restriction. The analysis of the results obtained after the applied treatment shows a significant increase in the volume of movement in all planes in both groups of patients. The change in the indicator is statistically reliable (at $\alpha \leq 0.001$). The dynamics of change in results confirm our initial research and pathokinesiology analysis.

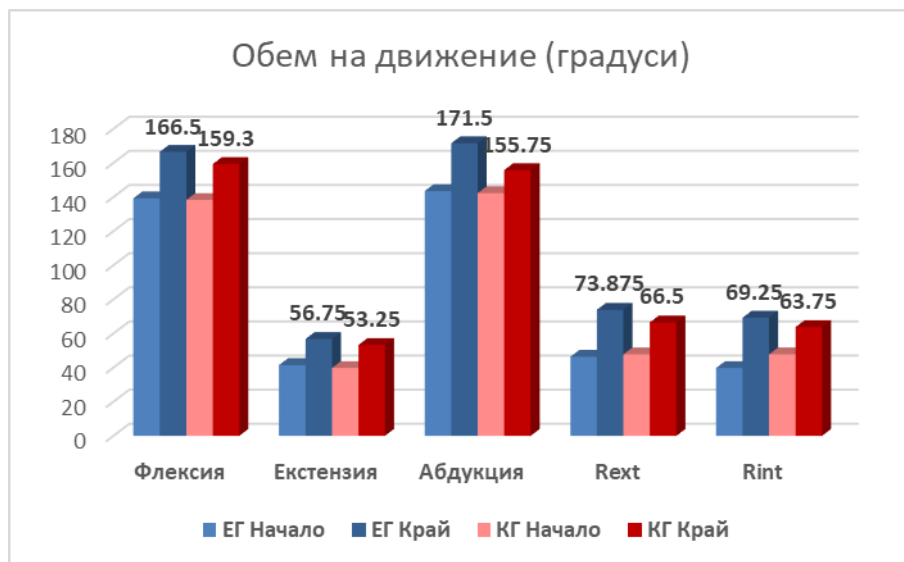


Diagram 9. *Range of movement of RS (in degrees)*

After the rehabilitation course, we found statistically reliably better results in EG patients compared to CG patients.

In our opinion, the application of manual joint mobilization techniques initially helps to reduce pain and, accordingly, release the range of motion limited due to the muscle guard.

In the functional recovery period, the application of the III-IV degree of joint mobilization, at the end of the possible range of motion, has a

pronounced mechanical effect to restore the range of motion. This study proved the immediate effect of the application of Mulligan MWM treatment techniques in shoulder impingement syndrome and confirmed the opinion of their creator that there is such an immediate effect (Mulligan 1999).

We found a rapid increase in shoulder abduction and flexion range of motion and an immediate reduction in pain, leading to an improvement in overall functional scores as measured by the SPADI test. Analytical stretching techniques applied in the subacute phase also, in our opinion, contributed to the restoration of near-normal limits of the range of motion in the patients of the experimental group.

6.3. Analysis of the results of the special clinical tests of Hawkins-Kennedy and Neer

Diagrams 10 and 11 present the results of the Neer and Hawkins-Kennedy clinical tests as a relative part - number of patients (%) with a positive test.

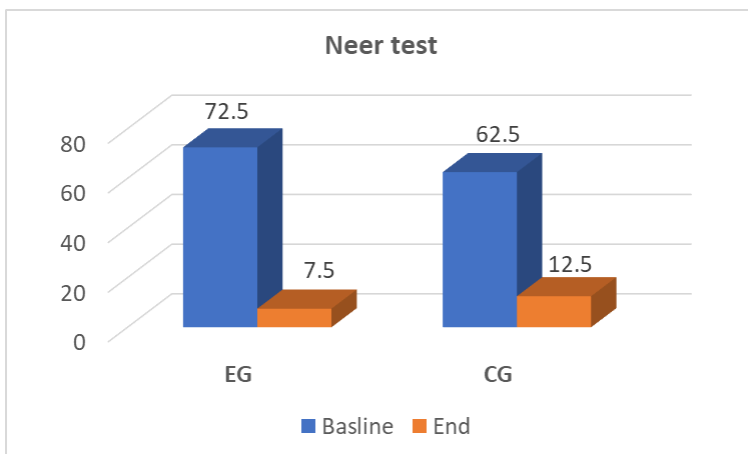


Diagram 10. *Relative part of patients with a positive Neer test*

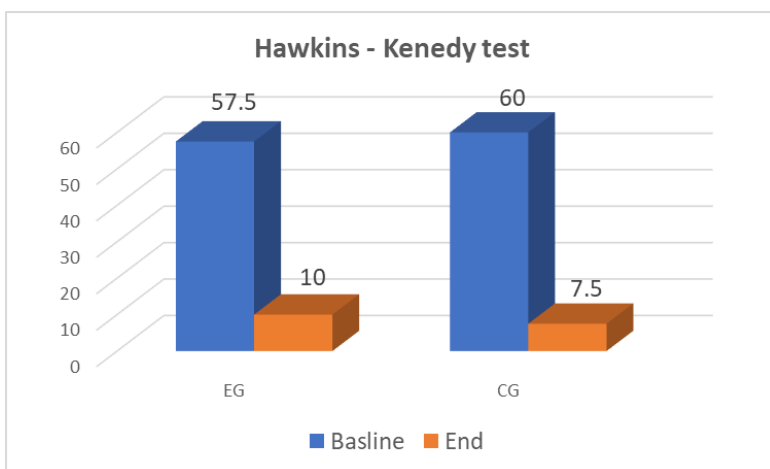


Diagram 10. *Relative part of patients with a positive Hawkin-Kenedy test*

After the applied rehabilitation course, the relative part of patients with a positive Hawkins-Kennedy and Neer test statistically significantly decreased in both groups of patients at $P\text{-value} < 0.001$. The effect of treatment was assessed based on the following dependent variables: maximum pain over the preceding 24-hour period graded by a 10-point visual analog scale (VAS) scale; pain intensity with the Neer test assessed by the same 10-point VAS scale; pain intensity with the Hawkins-Kennedy test via the 10-point VAS. The test results are presented in tables 16, 17, 18, 19 (dis). From the tables the change in the degree of pain from beginning to end is statistically significantly lower in both groups of patients ($\alpha \leq 0.001$).

This change is in analogous with the statistically significant decrease in the relative proportion of patients with a positive test after treatment and confirms the effectiveness of kinesitherapy.

Comparison of the results between the two groups at the end of treatment indicated no statistically significant difference. The data analysis shows that in the experimental group of patients treated with a kinesitherapy program including manual therapy techniques, we found a more pronounced reduction in pain in all three investigated indicators (VAS, Neer test and Hawkins-Kennedy test) compared to the control group group of patients treated with therapeutic exercises.

Our results confirm the results of other authors (Bang & Deyle, 2000; Conroy & Hayes, 1998; Park, et al., 2020), who found a statistically significant more pronounced reduction in pain in patients treated with therapeutic exercises and joint mobilization techniques, compared to patients treated with therapeutic exercises alone.

6.4. Analysis of Shoulder Pain and Disability Index (SPADI) results

The results of the Shoulder Pain and Disability Index (SPADI) test are presented in Tables 20 and 21. The overall SPADI shoulder pain and disability index score at baseline was like that reported by other authors investigating complaints in the field on the shoulder (EG – 66.75 points, KG – 67.5 points). There was no statistically significant difference between the groups. Scores on the pain subscale were significantly higher than those on the functional limitations subscale.

In the patients observed by us, we found the greatest improvement in functional capabilities during the first two weeks of the treatment course.

Table 20. *Comparison of results of the comprehensive functional assessment test SPADI at the beginning and at the end of treatment*

	Baseline	End					
	average X1	average X2	ΔX	S1	S2	t	α
EG	66.75	8.75	58	21.35	7.32	16.25	0.001
CG	67.5	16.25	51.25	22.39	14.31	12.19	0.001

An overview of the activities chosen by the participants that are most difficult indicates that activities involving upward-directed movements are clearly the most disabled, followed activities related to dressing and undressing, and carrying heavy objects. After the first two weeks, improvement continued at a slower pace. We attribute this dynamic of improvement to the training of patients to avoid pain-provoking motor activities, as well as to the adaptation of a nervous system to short-term resistance exercises with applied effectiveness in daily life. Our results confirm the research of other authors (Griffin & Cafarelli, 2005).

Table 20 shows that after the applied treatment there is a statistically significant positive change in the functional capabilities of the patients from both groups ($\alpha \leq 0.001$).

Table 21. *Comparison of SPADI results between the two groups*

	EG	CG					
	average X1	average X2	ΔX	S1	S2	t	α
Baseline	66.75	67.5	0.75	21.35	22.39	0.15	-
End	8.75	16.25	7.5	7.32	14.31	2.95	0.01

The comparison of the results between the two groups at the end of the treatment (Table 21) indicates statistically significantly better results in EG patients compared to CG patients ($\alpha \leq 0.01$). Our results are close to and better than those of other authors (Park, et al., 2020; Cummins, et al., 2009; Tate, et al., 2010).

6.5. Correlation between results of different measurements

We found that there was a strong correlation between VAS scores for subjective pain assessment and the SPADI complex assessment of function test (0.95), SPADI test scores and abduction (0.87). A statistically significant but weak correlation existed between flexion and abduction (0.69), SPADI test scores and flexion (0.56), and between pain and flexion (-0.52). All correlations were statistically significant at the 0.01 level.

7. Discussion and general remarks of limitation

Statistical analysis of the data indicated that patients from both studied groups had a significant reduction in pain, normalization of muscle balance, significant improvement in function, and an increase in pain-free active range of motion. Therefore, time, therapeutic exercises, manual muscle techniques and joint mobilization techniques have a positive effect on recovery in patients with subacromial syndrome. Comparing the results obtained after the kinesitherapy course between EG and CG indicates statistically reliably better results on all indicators in EG patients.

The inclusion of manual therapy techniques in the rehabilitation program resulted in a greater percentage of pain intensity reduction (VAS, Neer's test and Hawkins-Kennedy test) compared to CG patients treated with therapeutic exercises. Conroy & Hayes (1998) and Bang & Deyle (2000) found a statistically significant greater reduction in pain in patients treated with therapeutic exercise and manual joint mobilization compared to therapeutic exercise alone. In our opinion, passive movements in manual techniques lead to pain reduction by activating mechanoreceptors inhibiting

nociceptive stimuli through the "gate-control" mechanism (Melzack & Wall, 1965; Wall, 1978) or by improving synovial nutrition (Threlkeld, 1992).

Mobilization with movement (MWM) techniques enhance the analgesic effect by stretching the joint capsule and/or restoring glenohumeral arthrokinematics.

We also found that EG patients had a better SPADI score than CG patients. The results obtained by us are comparable and better than the results published by other authors (Bang, Deyle, 2000).

According to Janda, subacromial impingement syndrome is associated with a specific pattern of muscle imbalance called "Upper Cruciate Syndrome" (Page et al., 2010). Our research confirms this pattern. Analytical impact for relaxation and stretching leads to its correction.

Limitations of the study

The present study lacked a long follow-up period of the patients. Future research could provide such information. No treatment control group was missing for ethical reasons.

8. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

1. The statistically significant reduction of pain and improvement of function at the end of the rehabilitation course confirms the positive effect of therapeutic exercises in both groups of patients.
2. The physiotherapeutic methodology developed and approved by us, including manual therapeutic techniques, leads to more effective functional recovery compared to traditionally applied therapeutic exercises.
3. The functional tests we use provide complete information about the motor capabilities of patients with impingement syndrome.
4. Data from the visual analog pain scale indicate statistically significantly more effective pain reduction in the experimental group compared to the control group.
5. The applied testing of the musculature indicates a statistically reliable better recovery of muscle balance in EG patients compared to the control group.

6. The results of the goniometry in the experimental group of patients are statistically significantly better regarding the increase in the pain-free active range of movement, compared to the control group.

7. An indicator of the effectiveness of the physiotherapeutic methodology is the improvement of the complex function of the upper extremity, more pronounced in the experimental group compared to the control group, assessed by the statistically significant change in the Shoulder Pain and Disability Index.

RECOMMENDATIONS

Based on the results of the conducted studies and the conclusions drawn after their analysis, the following recommendations can be made regarding physiotherapists and medical specialists working in the field of prevention and treatment of shoulder joint dysfunctions:

1. To achieve good treatment results, we recommend that accurate functional diagnosis is the basis of planning and an individual approach to treatment.
2. The results of the conducted research showed that the applied complex, scientifically based, specialized physiotherapeutic methodology, including manual-therapeutic techniques, has a positive impact on the functional state of the patients. This gives reason to recommend its application in the complex rehabilitation program of patients with impingement syndrome of the shoulder joint.
3. To recommend kinesitherapy programs for independent implementation by patients at home.

9. CONCLUSION

Based on the realized study and analysis of modern literary sources on the problem, rich practical experience, detailed functional studies with a sufficient contingent of patients, statistical processing of the data and analysis of the obtained results, we can draw the conclusion that the application of the physiotherapeutic methodology described by us, including manual therapy techniques, results in effective pain reduction and restoration of shoulder function in subacromial pain.

4.CONTRIBUTIONS OF THE DOCTORAL THESIS

1. Developed and tested in practice is a complex, scientifically based, specialized physiotherapeutic methodology, including manual therapy techniques for impingement syndrome of the shoulder joint.
2. For the first time in Albania, the application of manual therapy techniques was introduced in patients with subacromial impingement syndrome.
3. Modern methods for research and assessment of dysfunction in subacromial pain have been introduced and their informativeness in monitoring and treatment has been proven in practice.
4. A detailed, analytical, and critical review of modern literary data in the field under consideration was made.
5. For the first time in Albania, functional results of the application of specialized physiotherapy method were studied and analyzed in a statistically reliable number of patients with subacromial impingement syndrome.

LIST OF SCIENTIFIC PUBLICATIONS IN RELATION TO THE TOPIC OF THE DISSERTATION

1. Daci, F., Dimitrova, E. (2022). Functional assessment on the patients with shoulder impingement. INTERNATIONAL SCIENTIFIC CONGRESS “APPLIED SPORTS SCIENCES”, *Proceeding book*, ISBN (Online): 978-954-718-702-3 ISBN (Print): 978-954-718-701-6 Scientific Publishing House NSA Press, 2022, pp. 490-493.
2. Dimitrova, E., Daci, F. (2022). Comparison of two physiotherapy methods in patients with shoulder impingement. INTERNATIONAL SCIENTIFIC CONGRESS “APPLIED SPORTS SCIENCES”, *Proceeding book*, ISBN (Online): 978-954-718-702-3 ISBN (Print): 978-954-718-701-6 Scientific Publishing House NSA Press, 2022, pp. 485-489.

Conference Reports

1. Daci, F., Dimitrova, E. (2022). Functional assessment on the patients with shoulder impingement. INTERNATIONAL SCIENTIFIC CONGRESS “APPLIED SPORTS SCIENCES”, 2-3 December 2022, NSA, Sofia, Bulgaria, *Program*, p. 28.

2. Dimitrova, E., Daci, F. (2022). Comparison of two physiotherapy methods in patients with shoulder impingement. INTERNATIONAL SCIENTIFIC CONGRESS “APPLIED SPORTS SCIENCES”, 2-3 December 2022, NSA, Sofia, Bulgaria, *Program*, p. 28.
3. Daci, F., Dimitrova, E. (2022). The effect of manual therapy on impingement syndrome in young people under the age 30. ALBANIAN PHYSIOTHERAPY CONGRESS IV 2022. *Proceeding book*, ISBN (Online): 978-9928-267-53-5 CIP in the cataloging published by BK Tirana, Luis Print, 2022, pp. 52-53. (Abstract)