ASSESSMENT OF THE PROGRESS OF TREATMENT REHABILITATION OF PATIENTS WITH SHOULDER JOINT DISEASES

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Abstract Introduction: Damage to soft tissue in the shoulder area causes significant impairment in the biomechanics of the joint, causing severe pain, inflammation and consequently leading to restricted mobility and functional capacity. The shoulder impingement syndrome is a multifaceted disease entity of diverse etiology. It is assumed that this syndrome is responsible for 44–60% of all ailments in the area of the pectoral girdle. Pathologies of soft tissues in the area of the glenohumeral joint affect 1/3 of the population. The aim of this study was to evaluate the functional capacity of patients with the shoulder area disorder undergoing sanatorium treatment.

Materials and Methods: In the study 30 patients were diagnosed with diseases within the shoulder joint before and after rehabilitation treatment. The clinical examination included kinematic measurement of the range of motion (ROM) and the muscle strength of the shoulder joint. Furthermore, the pain intensity was assessed using the VAS.

Results: The examination of the range of motion of the affected upper limb demonstrated considerable limitations and statistically significant differences before and after rehabilitation treatment for all the assessed movements. Moreover, the difference between the level of pain according to the VAS before (mean = 6.2) and after physiotherapeutic treatment (mean = 3.7) was demonstrated. The evaluation of linear relationships showed a significant correlation between the VAS and shoulder abduction, shoulder horizontal abduction and muscle strength for internal and external rotation after sanatorium treatment.

Conclusions: Progressive changes in the soft tissues of the shoulder joint cause a significant limitation of functional capacity of patients and severe pain. Rehabilitation treatment significantly increases active participation in daily life and improve patient quality of life.

Key words shoulder joint, shoulder impingement syndrome, soft tissue damage, rehabilitation, manual therapy

Introduction

Dysfunctions within the shoulder joint are one of the most common causes of pain in the musculoskeletal system. It is estimated that the diseases in the shoulder area affect 21% of older people. In the United States, rotator cuff tendinopathy accounts for approximately 4.5 million annual physician visits, with treatment and management reaching an estimated USD 3 billion annually. If we include indirect costs, such as lost time from work, this number is even larger (Judge, Murphy, Maxwell, Arden, Car, 2014). Pain and impaired motor function may have a significant impact on coping with activities of daily living and consequently lead to disability and reduced quality of life. Therefore, maintaining the independence and efficiency of older people should be the primary objective in planning effective physiotherapy (Bennell et al., 2010; Romero et al., 2015).

Shoulder impingement syndrome is a multifaceted disease entity of diverse etiology (Rotter, Mosiejczuk, Żugaj, Ptak, Lubińska, 2015). Its most common causes are injuries of the rotator cuff, occurring in 4% of adults aged 40–60 years to as much as 54% of people above 60 years of age (Chen, Peng, Zhang, Peng, Xing, 2015). Subsequently, there is synovitis, tendonitis, joint instability, pressure overload and micro trauma to soft tissues and fractures, degenerative changes (Haik, Albuquerque-Sendin, Moreira, Pires, Camargo, 2016). Other causes can include damage to the brachial plexus, discopathy and spondylosis, compression neuropathies and thoracic outlet syndrome (Piskorz, Iłżecka, Wójcik, Kozak-Putowska, 2014). The first symptom appearing in the damaged shoulder area is pain radiating to the outside of the shoulder in the direction of the neck and shoulders. In addition, there are disorders of proprioception and a reduction in joint movement, particularly in abduction, rotation movements and bending. Muscle strength is weakening, causing muscular atrophy within the arm and shoulder. Disorders occurring in proper functioning of the shoulder area result in taking pain relief positions. Due to the circumstances mentioned above, patients often report limiting of activities of daily living and reduced participation in social life (Gutierrez, Thompson, Kemp, Mulroy, 2007; Kuciel-Lewandowska, Wierzchowska, Paprocka-Borowicz, Kierzak, Pozowski, 2010).

According to recent studies that evaluated the efficacy of exercise or manual therapy in the setting of rotator cuff disease, and concluded that no clinical benefit exists for such interventions over placebo or other treatments (Khan, Warner, 2017). In our opinion further investigations are needed because it is very difficult and important topic to discuss. An effective therapy is based on the understanding of aging and major age-related changes both in the joints and muscles. The intervention of physiotherapy is often the first choice solution in the conservative treatment. The terminology of the shoulder impingement syndrome is imprecise and cannot provide a definitive diagnosis and therefore, it is extremely important to make a detailed diagnosis based on a careful history and physical examination in order to ascertain the actual cause of discomfort within the shoulder joint. This will result in selecting appropriate therapeutic methods in order to target at the damaged structure and thus completely restore lost functions (Chester, Shepstone, Lewis, Jerosch-Herold, 2013; Koh, Jae-Young, 2013; Romero et al., 2015).

To the best of our knowledge, ours is the first study investigating functional assessment of shoulder girdle. The aim of the study was to assess the change in the functional capacity of patients undergoing sanatorium treatment for shoulder pain.

Material and methods

The study involved 30 patients diagnosed with the shoulder impingement syndrome before and after a rehabilitation treatment. The study was performed according to the Helsinki declaration. A group of women comprised 20 patients (66.7%) at the age of 63.1 years (SD = 10.6), while a group of men consisted of 10 patients (33.3%) at the age of 61.7 years (SD = 6.6). The characteristics of the studied groups are presented in Table 1.

Table 1. Characteristics of the studied group

Variable		n	%
Gender	female	20	66.7
	male	10	33.3
Age	≤60	10	33.3
	>60	20	66.7

The inclusion criteria comprised pain and disease diagnosis (diagnosed by general practitioner, considering x-ray pictures and physical examination) within one shoulder joint, as well as participation in a 3-week rehabilitation including targeted manual therapy. The examination of the second upper limb should reveal advanced lesions. The exclusion criterion was the shoulder joint pain as a secondary symptom of pain caused by structures not directly in the shoulder. We excluded patients with previous surgeries, cancer, rheumatoid arthritis and fibromyalgia. The subjects gave their conscious and voluntary consent to participate in the research.

There is a large number of instruments that assess symptoms and function of the shoulder. More than 30 different tools can be found by entering "shoulder" and "assessment" into MEDLINE and conducting a review of the ≥3,000 retrieved references. We decided to use the most widespread and best-tested and characterized instrument for shoulder assessment. Diagnostic labels are commonly applied to patients with shoulder pain, such as capsulitis, bursitis and subacromial impingement syndrome (May, Chance-Larsen, Littlewood, Lomas, Saad, 2010). Our approach is to analyse the patient's current state not focusing on labels. The rehabilitation protocol was set up individually for each patient and was adapted to its current state. The therapist used PNF techniques, deep tissue massage, as well as selected mobilization techniques for the shoulder joint. One session with the therapist lasted from 45 to 60 minutes. The clinical examination included the measurement of kinematic range of motion (ROM) and strength of shoulder joint muscles. In order to record the results the SFTR method (*S – sagittal, F – frontal, T – transverse, R – rotation*), developed by ISOM (*International Standard Orthopedic Measurements*), was used. The muscle strength for shoulder abduction, external and internal rotation were examined using the MRC modified scale (*Medical Research Council*), in which 0 is no muscle contraction, 1 – perceptible movement when attempting to contract, 2 – ability to move only if the resistance of gravity is removed, 3 – ability to perform a movement in the current scope against the force of gravity, 4 – the ability to perform an active movement with extra resistance, 5 – correct muscle strength. The scale of the MRC is the preferred research tool because of the high rate of compatibility assessment and strong relevancy (Paternostro-Sluga, Grim-Stieger, Posch, Schuhfried, Vacariu, 2008). Furthermore, the degree of pain was measured using the VAS. The Visual Analogue Scale pain assessment is a tool to determine the intensity of pain. The scale consists of a 10 cm horizontal line. The respondent indicates

a point on the line, where 0 – means no pain, and 10 – the strongest pain imaginable (Hawker, Mian, Kendzerska, French, 2011).

The results were subjected to a statistical analysis in Statistica 12 PL. The level of statistical significance was set at α = 0.05. Average values with standard deviation were used in order to describe the statistical analyses of the examined quantitative variables. The differences between variables before and after rehabilitation treatment: the VAS, range of motion and muscle strength were compared using the Wilcoxon test. The dimensional relationship between the study variables was examined using the Spearman's rank correlation.

Results

More than half of the study group (56.7%) experience shoulder joint pain lasting for less than two years. On the other hand, among 16.7% of patients the pain lasts from two to five years. The diagnosis on the medical examination referral was the shoulder impingement syndrome. The most common location of pain among the patients was shoulder pain radiating to the elbow (33.3%) and arm (30%), as well as the pain located at the top of the shoulder (23.3%) (Table 2).

Table 2. Characteristics of the examined variables

	Variable	n	%
Location of pain	shoulder pain radiating to elbow	10	33.3
	upper back-of-shoulder	4	13.3
	top of shoulder	7	23.3
	shoulder pain radiating to elbow	9	30.0
When pain began	<2 years	17	56.7
	from 2 to 5 years	5	16.7
	from 5 to10 years	4	13.3
	>10years	4	13.3

The average value of the VAS before treatment and rehabilitation was 6.2 (SD = 2.1), and after treatment decreased almost twice – 3.7 (SD = 2.3). Statistical analysis of the distribution of the VAS in the group of subjects showed significant differences before and after a manual therapy ($p < 0.001$) (Table 3).

Table 3. Results of the VAS before and after rehabilitation therapy

Variable	Visual Analogue Scale						
	N	mean	SD	Q1	Me	Q3	p
Before rehabilitation therapy	30	6.2	2.1	4	6	8	<0.001*
After rehabilitation therapy	30	3.7	2.3	2	3	5	

* $p < 0.05$ statistically significant value compared with the score after treatment and rehabilitation; the Wilcoxon for paired samples.

The examination of mobility of the upper limb with lesions around the shoulder joint showed significant differences before and after treatment for movements of extension ($p = 0.001$), flexion ($p < 0.001$) abduction ($p < 0.001$), horizontal abduction ($p = 0.003$), horizontal adduction ($p = 0.011$), external rotation ($p = 0.005$) and

internal rotation (p = 0.04). The biggest differences in the ranges could be seen for flexion. Before the treatment, the mean range of flexion was 139.5°; after the treatment it was increased to 154.8°. In the case of abduction the difference is more than 18°. For horizontal adduction the average value of the range before the rehabilitation was over 105 degrees, but after three weeks, the mean range of motion, which the patients achieved, was 114° (Table 4).

Table 4. The results of the measurement range of motion of the upper limb before and after rehabilitation treatment

Movement (°)	Before rehabilitation						After rehabilitation						p
	N	mean	SD	Q1	Me	Q3	N	mean	SD	Q1	Me	Q3	
Extension	30	41.20	11.6	40	45.0	50	30	46.3	8.3	50	50	50	0.001*
Flexion	30	139.50	38.6	120	155.0	170	30	154.8	27.4	155	170	170	<0.001*
Abduction	30	115.00	44.9	80	120.0	150	30	133.3	39.3	100	150	170	<0.001*
Horizontal abduction	30	18.17	11.3	10	20.0	30	30	22.8	10.2	20	30	30	0.003*
Horizontal adduction	30	105.80	45.0	100	127.5	135	30	114.2	40.4	110	135	135	0.011*
External rotation	30	50.50	13.5	45	60.0	60	30	54.7	10.7	50	60	60	0.005*
Internal rotation	30	59.00	23.5	70	70.0	70	30	60.5	20.8	70	70	70	0.040*

* p < 0.05 statistically significant value compared with the score after treatment and rehabilitation; the Wilcoxon for paired samples.

The test of muscle strength according to the MRC scale showed significant differences before and after rehabilitation for abduction movements (p = 0.012), external rotation (p = 0.018) and internal rotation (p = 0.012). The difference between the average values of muscle strength in the six level scale (0–5) was small – 0.2. The lowest strength was observed for the abduction movement both before (mean = 3.6), and after rehabilitation (mean = 3.8). For external rotation the average muscle strength was 4.1 before the treatment and 4.3 after it. The largest muscle strength was demonstrated for internal rotation – 4.4 during the first test and 4.6 at the end of the treatment. The MRC scale results indicate that most patients had the ability to move actively under the load (Table 5).

Table 5. The results of the measurement of muscle strength (MRC) of the upper limb before and after a rehabilitation treatment

Muscle strength	Before rehabilitation						After rehabilitation						p
	N	Mean	SD	Q1	Me	Q3	N	Mean	SD	Q1	Me	Q3	
Abduction	30	3.6	0.65	3	3.5	4	30	3.8	0.75	3	4	4	0.012*
External rotation	30	4.1	0.58	4	4.0	4	30	4.3	0.70	4	4	5	0.018*
Internal rotation	30	4.4	0.76	4	5.0	5	30	4.6	0.72	5	5	5	0.012*

* p < 0.05 statistically significant value compared with the score after treatment and rehabilitation; the Wilcoxon for paired samples.

Table 6. Spearman correlation between two variables

After rehabilitation treatment			
Variable	N	rho	p
VAS vs. abduction	30	–0.39	0.003*
VAS vs. horizontal abduction	30	–0.43	0.019*
VAS vs. muscle strength for internal rotation	30	–0.47	0.008*
VAS vs. muscle strength for external rotation	30	–0.37	0.045*
Internal rotation vs. muscle strength for internal rotation	30	0.53	0.003*

* p < 0.05 statistically significant value.

A negative correlation was observed for mean score after a therapy between the VAS, abduction (rho = –0.39, p = 0.003) and horizontal abduction (rho = –0.43, p = 0.019), and between the VAS scale and MRC for the movement of external rotation (rho = –0.47, p = 0.008) and internal rotation (rho = –0.37, p = 0.045) (Table 6).

Moreover, the relationship between one-dimensional range of motion and muscle strength was assessed. A significant positive correlation was found between the rotation and the inner muscle strength corresponding to this movement after a rehabilitation treatment (rho = 0.53, p = 0.003) (Table 6).

Discussion

The shoulder impingement syndrome is still the most common diagnosis with which the patient comes to the therapist. This vague terminology, which refers to joint diseases, causes numerous inaccuracies and therapeutic problems. The shoulder joint is a fundamental part of the kinematic chain of the upper limb, and the pain within it is often long-lasting and difficult to treat. We confirmed our hypothesis. Our results compiled with data known from the literature. The search for effective forms of physiotherapy is based on the correct diagnosis, the use of targeted therapies and thereby accelerating the regeneration of damaged structures and improving patients' quality of life (Kuciel-Lewandowska et al., 2010).

In the self-examination the symptoms of each patients were diagnosed as the shoulder impingement syndrome. The survey showed, however, the diversity in the location of the pain, suggesting damage to the shoulder within a few structures and the need for further investigation in order to ascertain the cause of the ailment.

The absence of a diagnosis or its inaccuracy often results in implementing schematic and general rehabilitation, which does not produce the desired results and, consequently, also can worsen the current condition of the patient. A reliable and proper diagnosis is the basis of effective physiotherapy (Kuciel-Lewandowska et al., 2010).

Pain is the dominant symptom in damage to the structures of the shoulder joint, limiting the activities of daily living (combing hair, reaching behind the back, dressing) (Wroński, 2013). Our study showed significant differences before and after the treatment in the level of pain. The average degree of the VAS was 6 degrees and decreased almost twice following the treatment. Chronic pain has a serious impact on the functional abilities of patients. There was a significant correlation between the VAS and range of abduction and horizontal abduction as well as muscle strength in the MRC scale for rotary movements.

Park, Choi, Lee, Kim (2013) showed a reduction in pain in the VAS for patients with shoulder impingement who had undergone stabilization exercises compared to the patients who had been treated with basic forms of physiotherapy. Shakeri, Keshavarz, Arab, Ebrahimi (2013) in their study used the Kinesio ® Taping Method in the research group and neutral application (placebo) in the control group. Significant differences between in the level of night pain and when moving were observed in the research group. The authors suggest that the application of the Kinesio ® Taping Method causes an immediate reduction in movement pain in patients with the shoulder impingement syndrome. The reduction of pain was also observed by Garrido, Vas, Lopez (2016) who used the research group acupuncture for shoulder impingement, paying attention to the safety and clinical efficacy of the method. The effectiveness of these therapies proves that the source of emerging problems within the shoulder is soft tissue damage and thus eliminates the suspected causes of joint.

Damage to structures within the shoulder joint causes severe pain. As a result, patients take a pain relief position, disrupting the normal biomechanics of the upper limb. The consequence of this is a reduction in range of motion, muscle weakness and atrophy of muscles around the arm and shoulder (Rotter et al., 2015).

The average range of motion in the shoulder joint was below the standards adopted by the ISOM. The study of mobility of the upper limb with lesions showed significant differences before and after a treatment for all movements. Similar results have been shown for muscle strength in the MRC scale for abduction, external rotation, and internal rotation. The analysed parameters were higher after an individual treatment.

Similar results were obtained by Rotter et al. (2015), showing an improvement in the range of motion and muscle strength after the rehabilitation. The group who underwent the PNF treatment achieved better results. The PNF method was also used by Sipko, Mraz, Demchuk-Wlodarczyk, Miażdżyk (2005), reaching comparable results in patients with the shoulder impingement syndrome. On the other hand, Kokosz, Sodel, Saulicz, Wolny, Knapik (2009) compared the standard method of kinesiotherapy with the Mulligan concept. The research group obtained better results in the ROM and in relieving pain. Galace de Freitas, Marcondes, Monteiro, Rosa, de Moraes Baros Fucs, Fukunda (2014) assessed the function of the shoulder joint and the degree of pain comparing the effectiveness of exercise for the patients with a 3-week session of low-frequency magnetic field and in the patients who received placebo. It has been shown that a combination of kinesiotherapy with physiotherapy effectively increases the function and strength of rotation movement as well as pain relief.

These results support the use of physiotherapy with particular emphasis on individually adjusted manual techniques supplemented with physiotherapy that will effectively improve the biological functions of the shoulder joint. The diagnosis which is too general significantly prolongs effective physiotherapy and recovery (Rotter et al., 2015).

A limitation of our study is certainly too small number of subjects and the lack of a control group. Perhaps it is also worth to use a more detailed diagnostic based on the analysis of the activity of weakened muscles using surface electromyography (sEMG). Further studies are needed to assess the effectiveness of various physiotherapeutic methods, including combination with pharmacological treatment. This would allow us to evaluate the benefits of taking therapy to improve function of the joint and moreover reduce pain in the various stages of symptoms.

Conclusions

1. Changes in the soft tissues of the shoulder joint and pain significantly impairs patients' functioning.
2. The individually adjusted rehabilitation has a significant impact on improving the condition of patients and their quality of life.
3. The results support taking action towards the implementation of a detailed history and physical examination to identify the real cause of ailments.

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