

The evaluation of the long-term influence of the Kinesio Taping method on the selected parameters in patients with rotator cuff lesions: a randomized controlled trial

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Abstract

Background

The aim of our study was to assess the influence of KT on the pain, range of motion and muscle strength of the rotator cuff during long-term rehabilitation process.

Methods

In pre post treatment randomized controlled trial took part sixty outpatients with the rotator cuff injury. Thirty participants were assigned into a researched group in which Kinesio Taping was combined with a six-week rehabilitation program and a control group (30 patients) in which only rehabilitation program was employed.

Patients underwent functional testing according to the protocol of Orthopaedic Medicine Cyriax and were subjected to the measurement of muscle strength using Biodex System 4 dynamometer.

Results

The therapy brought positive results in both groups when it comes to the increase of their muscle strength and the improvement of the upper limb functionality. Better effects were achieved by the therapy that used Kinesio Taping method, although the differences were not statistically significant.

Conclusions

The use of the Kinesio Taping method combined with the rehabilitation program gave the same results as the employment of the rehabilitation program alone in reference to the pain, range of motion and muscle strength of the rotator cuff.

Trail Registration

This study was registered prospectively in the Australian New Zealand Clinical Trials Registry (ANZCTR). ACTRN12617000624381.

<https://www.anzctr.org.au/ACTRN12617000624381>.

Background

The shoulder girdle due to wide range of motion and specific structure is very prone to overuse syndrome and injuries. In most of the cases it affects muscle tendons of the rotator cuff. Injuries to the rotator cuff significantly decrease the functional status of the patient and presents with greatly decreased range of motion and pain. This leads to decrease of quality of life in these patients, therefore the process of treatment and rehabilitation should be quick and should bring long-term relief. [1, 2]

In the recent years Kinesio Taping method (KT) has become very popular method of treatment of musculoskeletal system dysfunction. This method can augment and accelerate treatment of musculoskeletal system dysfunction. Some Authors claim that KT improves proprioception and therefore decreases risk of recurrent injuries. [1]

KT is widely used by physiotherapists. Across the years this method was studied by researches and clinicians. In literature there are many publications proving its effectiveness. [1,2,3,4,5,6] Many of them describes positive results in treatment of upper extremity emphasizing the shoulder complex including rotator cuff, however most of these studies are present short term results or studies are carried out on a small group of patients.

Currently this method is very popular and widely used in clinical practice therefore it is really important to conduct a research to assess the long term influence on treatment of the musculoskeletal system [7,8], so the aim of our study was to assess the influence of KT on the pain, range of motion and muscle strength of the rotator cuff during long-term (six-week) rehabilitation process.

Methods

Design

This pre post treatment trial was reported according to the recommendations of the Consolidated Standards of Reporting Trials (CONSORT) statement. [9]

Seventy patients participated in our study. Participants were randomly assigned equally to one of two groups: researched group and control group.

Qualification was based on the simple randomization (coin toss) performed by main Author. Patients assigned to the researched group underwent rehabilitation protocol including KT. The control group underwent the same protocol excluding KT.

Inclusion criteria:

- between 20 and 60 years of age
- subacromial bursitis
- tendinopathy of at least one of the rotator cuff muscle
- edema of the area of the attachment or tendon or muscle belly of at least one of the rotator cuff muscles
- signs of subacromial impingement.

Exclusion criteria:

- severe arthrosis

- complete rupture of one of the tendons of rotator cuff muscles
- injury to other muscles surrounding the shoulder (except rotator cuff)
- shoulder ligaments lesions
- surgery of the shoulder
- previous injuries to the glenohumeral joint
- injuries of the muscles surrounding shoulder joint
- neuromuscular abnormalities
- skin diseases
- drugs affecting musculoskeletal system, i.e.

Patients Written consent was obtained, and the rights of subjects were protected.

Measurements were carried out between 2017 and 2018 at the University of Physical Education in Faculty of Motor Rehabilitation, in collaboration with outpatient rehabilitation clinic.

Intervention

Rehabilitation protocol:

Rehabilitation protocol lasted 6 weeks with three 55 minutes sessions per week and was identical for both groups. Each session was conducted individually with the same physiotherapist. Each session consisted 3 parts:

Early phase (approx. 5 min.) consisted of warm up exercises, included free active exercises (with low intensity) of the upper extremities and corpus in closed kinematic chains.

Main phase (approx. 35 min.) consisted exercises in lying, sitting and standing position, included isometrics, active exercises without external force applied, active with the external exercises, sensomotoric exercises, and Proprioceptive Neuromuscular Facilitation (PNF) exercises.

The last phase (approx. 5 min.) consisted stretching and relaxing exercises.

Methodology of Kinesio Taping method application

Patients from the researched group underwent standard rehabilitation protocol with conjunction of KT. The tapes were applied to relief tendons that had lesions. All of these patients had tapes applied to deltoid muscle. The tapes were changed every 4 days for the period of six weeks. The first application of tapes was done right after examination of the patient with Biodex System 4 dynamometer.

The technique of applying a V-shaped tape over the deltoid muscle, infraspinatus muscle and subscapularis muscle was used. The technique of applying an "I" tape to the supraspinatus muscle and teres minor muscle was used. [10]

Outcome measures

In all participants (researched and control group) the measurement of muscle force was checked twice using with Biodex System 4 dynamometer, and the clinical examination according to Cyriax protocol was also performed twice, before and at the end of rehabilitation protocol. [11]

Primary outcome: during Biodex System 4 dynamometer examination the measurements were taken in external and internal rotation, abduction and adduction in the setting of isokinetic contraction. We applied concentric – concentric protocol with the following angular velocities: 120, 180, and 240 degrees per second. During every tryout Peak Torque (PT) and ROM were measured.

During functional Cyriax examination the estimation of the degree of pain was divided into three parts and was measured using Visual Analog Scale (VAS). [12] In the first part we estimated all anatomical parts of the shoulder (three global tests). In the second part passive examination of the scapula glenoid joint was performed (three passive tests). In the last phase we performed six active test with resistance to check all the muscles of the shoulder girdle. Additionally, the measurement of three dimensional range of motion (ROM) of the shoulder joint was performed using goniometer. [13]

Statistical Analysis

Statistical analysis of the gathered data was analyzed using Statistica 10.0 (StatSoft). The total sample size was estimated through an a-priori power analysis. Following parameters were used: mean average, median, minimal and maximal values and standard deviation in relation to body mass, body weight and age of the patients. Normal values were verified with Shapiro-Wilk test. For statistical analysis we used t – Student test and U Mann – Whitney test. In all of the test the level of significance was set as $p < 0.05$.

Results

Seventy patients were qualified for the study. 65 patients fulfilled inclusion criteria and one of the patients did not consent to participate in the research. Participants were assigned randomly to researched and control group. At the end there were two groups, 30 patients each in the age of 25-60. Table 1. outlines the process of qualification for the study.

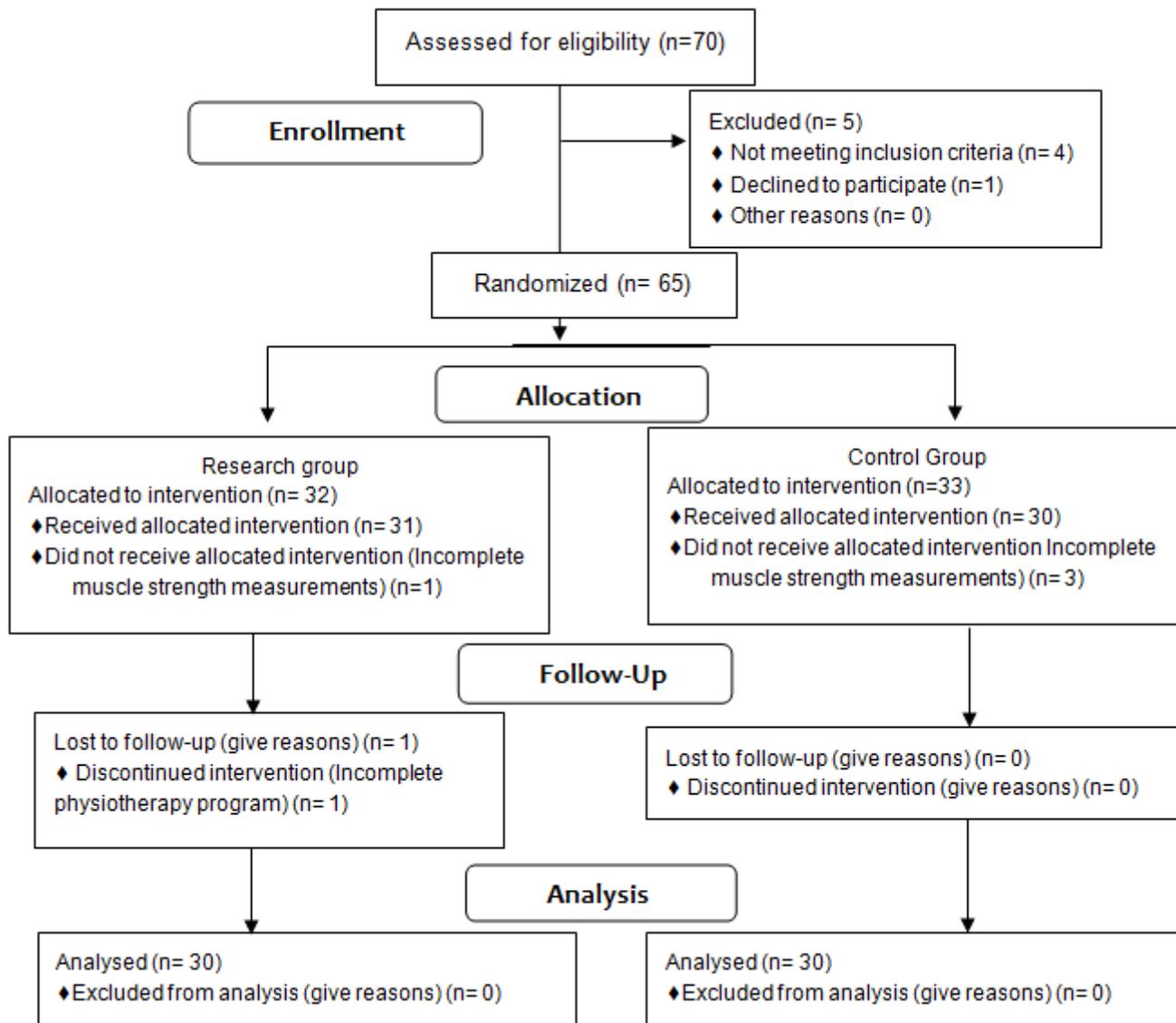
In the study participated 32 women (53.3%) and 28 men (46.7%). In the researched group there were 15 women and 15 men (50% each) and in the control group there were 17 women (56.7%) and 13 men (43.3). The sex was not significant differentiating factor in our study ($p = 0.604$). The specific characteristics of the groups are outlined in the Table 2.

Table 1. Characteristics of the participants.

	Age [yrs]								
	N	Me	Min.	Max.	Q1	Q3	SD	p	
Research group	30	45.67	49.00	25.00	60.00	37.00	52.00	9.29	0.273
Control group	30	48.17	50.50	28.00	60.00	45.00	56.00	10.35	
Total	60	46.92	49.00	25.00	60.00	38.50	55.00	9.83	
	Height [cm]								
	N	Me	Min.	Max.	Q1	Q3	SD	p	
Research group	30	171.07	170.50	158.00	185.00	164.00	176.00	7.71	0.109
Control group	30	167.83	166.50	155.00	187.00	163.00	172.00	7.71	
Total	60	169.45	170.00	155.00	187.00	164.00	175.50	7.81	
	Weight [kg]								
	N	Me	Min.	Max.	Q1	Q3	SD	p	
Research group	30	82.43	81.50	53.00	128.00	71.00	90.00	17.27	0.540
Control group	30	79.87	78.00	55.00	105.00	72.00	91.00	14.97	
Total	60	81.15	80.00	53.00	128.00	71.50	90.50	16.07	

p<0.05

Table 2. Flow diagram.



Muscle strength measurement with Biodex dynamometer

Based on the statistical analysis of the acquired results from the examination of the muscle strength with the Biodex dynamometer before and after rehabilitation therapy statistically significant differences were observed among some of the measured parameters. These parameters markedly increased after the therapy (Table 3).

Table 3. Statistical analysis of the results obtained before and after rehabilitation measured with Biodex System 4.

Angular velocity	Research group (before and after therapy)			Control group (before and after therapy)		
	d	t/Z	p	d	t/Z	p
120°/s PT ER [Nm]	0.04	-4.56	<0.001	0.01	1.68	0.091
120°/s PT IR	0.05	-2.36	0.025	0.03	2.33	0.019
180°/s PT ER	0.02	-1.49	0.144	0.00	0.99	0.318
180°/ s PT IR	0.04	-1.76	0.088	0.00	-0.11	0.908
240°/ s PT ER	0.01	1.67	0.093	0.01	-0.94	0.352
240°/ s PT IR	0.03	-1.30	0.203	-0.00	0.05	0.957
120°/s ROM	14.24	3.65	<0.001	11.39	-3.97	<0.001
180°/s ROM	14.57	3.63	<0.001	11.52	-3.99	<0.001
240°/s ROM	15.21	3.71	<0.001	11.53	-3.97	<0.001
120°/s PT Abd	0.07	-3.21	0.003	0.04	-2.26	0.031
120°/s PT Add	0.21	-4.73	<0.001	0.16	4.39	<0.001
180°/ s PT Abd	0.03	-1.41	0.168	-0.02	0.14	0.888
180°/ s PT Add	0.16	3.26	0.001	0.08	2.74	0.006
240°/ s PT Abd	0.04	-1.22	0.231	-0.00	0.08	0.935
240°/ s PT Add	0.15	-2.79	0.009	0.05	-1.30	0.132
120°/s ROM	33.48	4.76	<0.001	24.55	3.75	<0.001
180°/s ROM	31.28	4.76	<0.001	23.82	-5.22	<0.001
240°/s ROM	32.53	4.76	<0.001	24.47	-5.33	<0.001

PT ER – peak torque in external rotation, PT IR – peak torque in internal rotation, PT ROM – peak torque in range of motion, PT Abd – peak torque in abduction, PT Add – peak torque in adduction, p<0.05

The results of Biodex System 4 was compared before and after rehabilitation therapy for both control and researched groups. Statistically significant difference was observed only in regards to parameter 120 degrees per second PT ER (p=0,042). Other parameters did not result in significant difference in between them.

Functional examination according to Cyriax protocol.

The intensity of pain was estimated during different type of motion in different planes and directions. It was done before and after rehabilitation protocol. In both research and control group statistically significant differences in pain intensity before and after rehabilitation were observed only for specific movements. For these type of movements the pain intensity decreased after rehabilitation (Table 4.). In the VAS scale no statistically significant difference between different movements before and after rehabilitation was observed.

Table 4. Statistical analysis of the pain intensity before and after rehabilitation according to Cyriax protocol.

	Researched group (before and after therapy)			Control group (before and after therapy)		
	d	t/Z	p	d	t/Z	p
Active elevation	-2.93	6.59	<0.001	-2.33	4.12	<0.001
Passive elevation	-4.00	9.90	<0.001	-3.50	4.29	<0.001
Active abduction	-3.03	4.37	<0.001	-2.57	4.70	<0.001
Passive abduction	-3.30	6.61	<0.001	-2.57	3.56	<0.001
Passive external rotation	-2.60	3.82	<0.001	-1.67	2.62	0.008
Passive internal rotation	-2.93	5.54	<0.001	-2.50	2.85	0.004
Resisting adduction	-1.13	2.58	0.009	-0.83	2.31	0.020
Resisting abduction	-2.60	3.91	<0.001	-2.07	2.53	0.016
Resisting external rotation	-1.93	3.60	<0.001	-1.60	2.87	0.004
Resisting internal rotation	-2.03	3.80	<0.001	-1.87	3.62	<0.001
Resisting elbow flexion	-1.53	3.41	<0.001	-1.07	2.37	0.017
Resisting elbow extension	-0.67	1.57	0.115	-1.07	2.38	0.017

p<0.05

Tridimensional range of motion in glenohumeral joint.

The measurement was taken before and after rehabilitation during movement in different planes and directions. In both, study and control group we noted statistically significant differences for all types of movements before and after rehabilitation. In both groups the range of motion increased after therapy (Table 5.).

Table 5. Statistical analysis of ROM measurement in glenohumeral joint before and after therapy.

	Researched group (before and after therapy)			Control group (before and after therapy)		
	d	t/Z	p	d	t/Z	p
Flexion	28.10	-7.94	<0.001	26.77	4.43	<0.001
Extension	13.40	4.70	<0.001	10.20	-6.43	<0.001
Abduction	34.93	-7.68	<0.001	30.20	4.43	<0.001
External rotation	17.27	-5.04	<0.001	11.17	3.57	<0.001
Internal rotation	7.37	-3.53	0.001	5.37	-3.04	0.004
Horizontal flexion	15.03	3.97	<0.001	14.70	3.39	<0.001
Horizontal extension	9.27	-8.24	<0.001	9.33	3.74	<0.001
Horizontal external rotation	10.93	3.49	<0.001	14.53	3.43	<0.001
Horizontal internal rotation	15.40	-4.86	<0.001	11.50	3.58	<0.001

p<0.05

The results of obtained range of motion for both groups before and after therapy were also compared. There were no statistically significant differences for all types of movements before and after rehabilitation in both groups.

Discussion

Proper function of upper extremities is extremely important aspect of high quality of life of our patients. Malfunctioning of even one upper extremity has negative impact on daily activities and can negatively influence private life. Therefore, fast recovery is very important to every patient. Unfortunately, not always the result of the rehabilitation are satisfactory. That is the reason why physiotherapists constantly search for new solutions to improve current rehabilitation protocols, especially in regards to shoulder girdle. [14]

One of the most common dysfunctions of the shoulder are the rotator cuff pathologies out of which the most frequent is supraspinatus tear. [15] Current literature provides high amount of rehabilitation protocols of the conservative treatment of the rotator cuff lesions, however most of them present the results of tests carried out in a short time. [4,5,14,16,17] and none of them mention the long term influence of KT on muscle strength measured by objective research tools. According to available literature KT has positive effect on function of the upper extremity, however none of these studies provide long term results, therefore they cannot answer the question whether KT improves muscle strength and function of the shoulder girdle when added to rehabilitation protocol. Some of these studies do not analyze the effectiveness of KT in correlation with rehabilitation protocols or assess the effectiveness of the KT combined with the exercise program relative to other rehabilitation methods combined with the

exercise program. (e.g. KT + rehabilitation program versus rehabilitation program + manual therapy). [4] According to our knowledge this study is a first study assessing the influence of the KT combined with rehabilitation program in relation to rehabilitation program on the pain, range of motion and muscle strength measured with objective method in large group of patients with rotator cuff lesions after long-term therapy.

During rehabilitation process one of the key factor is, inter alia, return of the proper muscle strength. [10] Soo-Yong-Kim et al. [18] examined muscle strength in external and internal rotation with Biodex dynamometer in patients with rotator cuff tendinopathy. The results showed significant improvement of the muscle strength of the rotator cuff muscles but the time of observation was short, researched group consisted of only 13 persons and KT wasn't combine with any rehabilitation program. Similar results were achieved by Hsu et al. [19] Authors confirmed positive effect of KT in regards to increase strength and activity of the muscles of the shoulder girdle in 17 baseball players but the assessment time was very short – before and right after tape application. Jaraczewska and Long [20] as well as Śliwiński et al. [21] indicated improvement of the function of paralyzed upper extremity in 15 patients after stroke when the combined therapy was applied. In both cases the Authors showed increase of muscle strength and improvement of the muscle tension after rehabilitation, these studies presents short term results on small group of patients. Similar results were obtained in our research. In order to measure muscle strength we used Biodex System 4 dynamometer and we checked twelve parameters before and after therapy. The results after therapy were higher than the results before the therapy in the group where kinesiotaping was applied. However, even though there was an improvement in the muscle strength in both groups, there was no statistically significant difference between research and control groups in case of 11 out of 12 parameters.

Another important factor influencing function of the upper extremity is the pain. Thelen et al. [1] studied the influence of KT on the pain intensity in patients with tendinopathy of the rotator cuff assessed with SPADI scale and observed the positive influence on the range of motion of the shoulder complex, although the observation time was very short (6 days). On the other hand Kaya et al. [22] presented efficacy of 2 weeks therapy (KT in combination with physical medicine) in 60 patients with subacromial impingement syndrome (pain assessed with VAS). In both groups the sensation of pain notably decreased.

Also Djordjevic et al. [4] observed that KT combined with manual therapy more effectively reduces pain in patients with shoulder pain in comparison to the standard rehabilitation program after 10 days of therapy. Reverse results were obtained by Kul et al. [17], according to which the physiotherapy program with home exercises was more effective in reducing pain than KT in combination with home exercises after 15 days of therapy. In our own study the pain intensity was estimated in both groups using VAS. In the study group, in each of the twelve categories the pain intensity decreased and in eleven of them this difference was statistically significant. In the control group the statistically significant decrease of pain intensity was observed in all twelve categories. Despite this there was no significant difference between two groups in regards to measured parameters.

In the current literature we can also find articles that describe the influence of KT on range of motion. Thelen et al. [1] applied KT without any rehabilitation program only for 6 days in 42 patients with rotator cuff tendinopathy, but the authors observed the increase of range of motion of the upper extremity. Similar researched was performed by Hsu et al. [19] who studied 17 baseball player with painful shoulder. They also applied KT without any rehabilitation program and assessed patient before and right after the tape application and observed the improvement of the quality and the range of motion of the scapula. Śliwiński et al. [21] and Jaraczewska and Long [20] proved that neurological therapy with addition of combined therapy (PNF and KT) significantly improves function of the paralyzed upper extremity in the patients after stroke due to the increase of the range of motion. Dordjevic et al. [4] examined 20 people with rotator cuff injury, in whom they compared the effectiveness of KT combined with manual therapy in comparison with a traditional rehabilitation program. After 10 days, they observed an improvement in the range of motion in the shoulder joint. According to Kul et al. [17], who examined 40 patients with subacronial impingement syndrome, a 15-day home exercise program with KT compared to a rehabilitation program with home exercise brings the same results in terms of the range of motion. Similar results were obtained by Kaya et al. [23], who examined 54 people with subacronial impingement syndrome. Within 2 weeks they compared the effectiveness of the exercise program combined with KT in relation to the exercise program combined with manual therapy and did not observe differences in the results obtained between the examined groups. Cubała et al. [24] concluded that KT does not improve range of motion in the shoulder joint assessed with SFTR method. In our study we observed that the range of motion in both research and control group gradually increased for all of the parameters and these differences were statistically significant, but we did not notice statistically significant difference between research and control groups.

In the current literature the results of comparison of the combined therapy and KT to the rehabilitation program itself are not conclusive [1,15,25], which may result from a short intervention time, a small number of patients or a comparison of KT activities with a rehabilitation program to other physiotherapeutic methods combined with an exercise program. The results of the meta-analysis performed by Saragoulu et al. [14] show that KT can be helpful in reducing pain, improving the range of movement or muscle strength, especially at the initial stage of treatment, however, the authors believe that more research is needed to show whether KT it is also helpful during longer therapy. Our own study meets these expectations. We compared the efficacy of the combined therapy (rehabilitation program and KT) to therapy utilizing only rehabilitation without use of KT. The number of examined patients was high (60 persons) and the time of intervention was long (6 weeks). Vast majority of studied parameters did not show statistically significant difference between the effects of these to therapy regimens.

Study Limitations

This study is not without limitations. The method of rehabilitation should be selected according to the patient. Rehabilitation combined with the KT gives similar results as the rehabilitation itself. However the final selection of the method of therapy should be based on general status of the patient and his/her motivation and well-being. Based on the gathered results we observed that KT is a valid and effective

method that helps reduce pain symptoms and increase range of motion as well as strength of the rotator cuff muscles. However it is worth to mention that in the current literature there is paucity of articles stating that KT and placebo tapes give similar results. Therefore it is important to consider the psychological aspect this method. While selecting the appropriate therapy for the patient one should keep in mind that KT can be part of it, but should not be used as a single method in order to achieve best results and fast recovery.

Conclusions

The use of the KT combined with the rehabilitation program gave the same results as the employment of the rehabilitation program alone in reference to the pain, range of motion and muscle strength of the rotator cuff in patient with rotator cuff lesion.

Implications

1. The use of the KT combined with the rehabilitation program gave the same results as the rehabilitation program alone in reference to the pain, range of motion and muscle strength.
2. The KT has no long-term effect on the upper limb rehabilitation process in conservatively treated patients.

Abbreviations

KT – kinesio taping

Declarations

Ethics approval and consent to participate

The research project has obtained approval of the Ethical Committee of Regional Medical Chamber in Krakow (No. 41/KBL/OIL/2015) and participants provided written informed consent for participation in this study.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The author(s) declare no conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Authors' contributions

All Authors have read and approved the manuscript.

MW – research idea, research plan development, data collection, data analysis, literature search, manuscript writing, manuscript approval; **AB** – research idea, research plan development, data analysis, literature search, manuscript writing, manuscript approval; **KOC** – research idea, development of research plan, literature search, manuscript writing, manuscript approval; **MZ** – patient recruitment, data analysis, manuscript approval; **EM** – patient recruitment, data collection, manuscript approval; **ASC** – patient recruitment, research, manuscript approval.

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