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EFFECTS OF SUBSCAPULARIS MUSCLE SOFT TISSUE MOBILIZATION ON PAIN AND FUNCTIONALITY IN SHOULDER DYSFUNCTION

ORIGINAL ARTICLE

ABSTRACT

Purpose: Tightness of the subscapularis muscle causes glenohumeral external rotation limitation and difficulties in over-head activities. This study aimed to determine the effects of soft tissue mobilization applied to the subscapularis muscle on pain and functionality in shoulder dysfunctions.

Methods: The 48 patients with shoulder pain and limitation were included in the study. They were randomly divided into conventional physiotherapy program (CPP) group (n=25) and soft tissue mobilization (STM) group (n=23). The first group received CPP and the second group received STM. All patients had treatment at a physiotherapy clinic for 15 sessions. The pain was evaluated using Visual Analogue Scale (VAS), shoulder joint movements were measured using a goniometer and overhead reach test, and functionality was evaluated using the Shoulder Pain and Disability Index (SPADI). The patients were assessed before, immediately after, and three weeks after the treatment.

Results: Statistically significant improvements were found in VAS, shoulder flexion and external rotation range of motion, and overhead reach test in both groups immediately after treatment and at the end of the 3rd week ($p<0.05$). When groups were compared after three weeks, statistically significant improvements were found in VAS, external rotation range of motion, and overhead reach test in the STM group ($p<0.05$). There was a statistically significant improvement in SPADI in both groups after the treatment ($p<0.05$). There was no significant difference in SPADI score between the groups ($p>0.05$).

Conclusion: The STM was more effective on pain, range of motion, and functionality than CPP. STM of subscapularis muscle might be an alternative treatment of the shoulder dysfunction.

Key Words: Manual Therapy; Pain; Shoulder; Subscapularis.

OMUZ DİSFONKSİYONUNDA SUBSKAPULARİS KASI YUMUŞAK DOKU MOBİLİZASYONUNUN AĞRI VE FONKSİYONELLİK ÜZERİNE ETKİLERİ

ARAŞTIRMA MAKALESİ

ÖZ

Amaç: Subskapularis kasının gerginliği omuz eksternal rotasyonunu kısıtlar ve baş üzeri aktivitelerin yapılmasında güçlüğe yol açar. Bu çalışmanın amacı, omuz disfonksiyonlarında subskapularis kasının yumuşak doku mobilizasyonunun ağrı ve fonksiyonellik üzerine etkilerini araştırmaktı.

Yöntem: Omuz ağrısı ve kısıtlılığı olan 48 hasta çalışmaya dahil edildi. Hastalar randomize olarak geleneksel fizyoterapi programı (GFP) grubuna (n=25) ve yumuşak doku mobilizasyonu (YDM) grubu (n=23) ayrıldılar. İlk gruba GFP, ikinci gruba YDM uygulandı. Tüm hastalar bir fizyoterapi kliniğinde 15 seans tedavi aldılar. Ağrı, Visual Analog Skalası (VAS), omuz eklem hareketleri gonyometre ve baş üstü uzanma testi ve fonksiyonellik Omuz Ağrısı ve Yeti Yitimi İndeksi (SPADI) ile değerlendirildi. Hastalar tedaviden önce, tedaviden hemen sonra ve tedaviden üç hafta sonra değerlendirildi.

Sonuçlar: Tedaviden hemen sonra ve üçüncü hafta sonunda yapılan değerlendirmelerde, GFF ve YDM grubunda VAS, omuz fleksiyon ve eksternal rotasyon eklem hareket açıklığında ve baş üstü uzanma seviyelerinde istatistiksel olarak anlamlı iyileşme bulundu ($p<0,05$). Gruplar karşılaştırıldığında ise, VAS, eksternal rotasyon eklem hareket açıklığı ve baş üstü uzanma seviyesi YDM grubunda istatistiksel olarak anlamlı iyileşme bulundu ($p<0,05$). Her iki grupta SPADI skorunda tedavi sonrası istatistiksel olarak anlamlı iyileşme bulundu ($p<0,05$). Gruplar arası karşılaştırmada ise SPADI skoru açısından anlamlı fark görülmedi ($p>0,05$).

Tartışma: Yumuşak doku mobilizasyonunun ağrı, hareket açıklığı ve fonksiyonellik üzerinde geleneksel omuz rehabilitasyonuna göre daha etkili olduğu bulundu. Subskapularis yumuşak doku mobilizasyonu, omuz fonksiyon bozukluğunun tedavisinde bir alternatif olabilir.

Anahtar Kelimeler: Manuel Terapi; Ağrı; Omuz; Subskapularis.

INTRODUCTION

Shoulder pain is the third most common musculoskeletal condition, with substantial social-economic costs, resulting from a significant effect on the patient's ability to work and perform activities of daily living (1). Several therapeutic interventions have been used, including pharmacological therapies, physiotherapy modalities, acupuncture, suprascapular nerve blocks, joint distension, manipulation under anesthesia, and capsular release in later stages (2). In the physiotherapy of patients with shoulder impairments, recuperating enough glenohumeral external rotation is necessary to repair the skill (3). Some researchers spied out that in most cases glenohumeral external rotation is more restricted when compared with all the other shoulder movements especially in conditions that shorten the capsule such as arthritic or frozen shoulder cases (4,5). However, even the acute conditions affecting only the synovium, e.g. ligamentous injury, cause a capsular limitation of motion because of the muscular spasm protecting the capsule (6).

The glenohumeral capsule and the shoulder internal restrict the glenohumeral external rotation (3). Cadaver works and consequences of subscapular operation results showed that reduction of subscapularis muscle elasticity is liable for glenohumeral external rotation restrictions in the subordinate sequences of shoulder abduction. Capsular restriction becomes more than 900 of the shoulder abduction (4).

Physiotherapy in shoulder pain and dysfunction aims to provide stability and a pain-free range of motion in the shoulder. Many physiotherapy methods are used to increase range of motion and decrease the pain as early as possible, such as conventional physiotherapy, manual therapy, exercises, soft tissue mobilization, and scapular mobilization in treating shoulder pain and dysfunction (3). All these techniques minimize the inflammation, edema, and pain by improving the blood circulation and releasing the adhesions. They also help to reduce voluntary and reflex joint stiffness of the patients (7). Soft tissue injuries may keep outcome improperly in a scar genesis with randomly directed collagen fibers, which may bullet to upward infirmity, chronicity, and pain. Soft tissue mobilization supports changes in the myofascial, allowing for elongation of shortened the structures (8).

To date, no studies have investigated the initial and 3-week effects of soft tissue mobilization compare to conventional physiotherapy in a patient with shoulder pain and dysfunction. Thus, this study aimed to determine the effects of soft tissue mobilization applied to the subscapularis muscle on pain and functionality in shoulder dysfunction.

METHODS

Participants

This study was administered between June 2018 and December 2018 at Başkent University Hospital Physical Medicine and Rehabilitation Outpatient Clinic. The study was carried out with the Declaration of Helsinki of 2013, and the study protocol was assigned by the Human Research Ethics Committee of Başkent University (Approval Date: 09.07.2018 and Approval Number: 62310886-600). All patients gave a written informed consent form.

The 48 patients with shoulder pain and restriction were included in the study. The patients' inclusion criteria were aged between 30 and 75 years, had pain for last six months or longer, had 30% limitation in flexion and external rotation passive range of motion compared with the other extremity, had not active sports life. Patients were excluded if they undergone shoulder surgery, received injection treatment, medication for pain, and had psychiatric treatment.

Patients were randomly divided into two groups: conventional physiotherapy program (CPP) group (n=25, mean age: 55,40±13,20, Female gender: 52%) and soft tissue mobilization (STM) group (n=23, mean age: 48.70±12.50, Female gender: 73.9%) The closed envelope method was used for randomization. There were blue and red cards in the envelopes. Those who received the blue card were transferred to the STM group and received the red card to the CPP group. A physiotherapist treated the CPP group, and another physiotherapist treated the STM group. In addition to these applications, all patients were given a home exercise program (pectoral stretching, wand exercises, and theraband exercises for the infraspinatus and supraspinatus for strengthening). All patients were

evaluated before and after the treatment, and after three weeks by the same blinded physiotherapist.

Assessment

The patients' characteristics, including age, gender, body weight, height, body mass index (BMI), were recorded on the socio-demographic data form. The pain intensity, range of motion, and functionality were evaluated. The pain intensity was assessed using a Visual Analogue Scale (VAS). Glenohumeral flexion and external rotation range of motion were measured with a goniometer and overhead reach test. The Shoulder Pain and Disability Index (SPADI) was used for pain and functionality.

Visual Analogue Scale (VAS): Pain intensity was evaluated using the VAS. The patients were asked to show their pain intensity between 0- to 10-cm VAS, with 0 as no pain and 10 as the worst imaginable pain (9).

Goniometric measurement: A plastic, 41 cm universal goniometer (Baseline®, New York, USA), was used the measure the active pain-free range of motion of shoulder flexion and external rotation. Glenohumeral flexion and external rotation were measured with the patients lying in a supine position on a treatment table with a pillow under their knees. When measuring the flexion angle, the goniometer's pivot point was placed in center of the glenoid fossa. The goniometer's fixed arm is parallel to the trunk's lateral, and the movable arm follows the humerus. When measuring the external rotation angle, the goniometer's pivot point was placed in the ulna's styloid process. The goniometer's fixed arm was parallel to the trunk's lateral, and the movable arm follows the ulna (10).

Overhead Reach Test: It was measured with the patients in a standing position facing a wall, with the tips of their fingers collated with a pre-marked line on the floor 30.50 cm from the wall. Patients moved their fingers for all they could reach. Overhead reach was measured as the distance in cm from the floor to the middle finger's tip using a tape measure (4).

Shoulder Pain and Disability Index (SPADI): The SPADI is a valid and reliable questionnaire evaluating shoulder pain and disability. The Turkish reliability and validity were studied in 2008 by Bumin et al. (11). The SPADI is a questionnaire answered by the patient and consists of two parts. In the first part, there are five questions regarding the severity of pain. In the second part, eight questions evaluate the functional activity level during daily life activities, especially in the upper extremity. While answering the questions, markings are made on a 10-centimeter VAS, and it takes about 5-10 minutes to complete this questionnaire. In scoring, the scores of each section are averaged (Total pain score (%) = Score A / 50x100; Total disability score (%) = Score D / 80x100; Total SPADI score (%) = (Score A + D) / 130x100). While this questionnaire's minimally measurable change is 13 points, the minimal clinical significance value is 18 points / 100 (12). The patients were evaluated before treatment and three weeks after treatment with SPADI. Turkish version of the scale was used in the study.

Interventions

All patients had physiotherapy five times in a week, 25 minutes in each session, and a total of 15 sessions. The CPP group (n=23) was applied hot pack for 20 minutes, conventional transcutaneous electrical nerve stimulation (TENS) (Enraf-Nonius B Delftechpark 39, 2600 AV, Delft, The Netherlands) was also applied for 20 minutes at 60-100 Hz and a 60-pulse duration with the intensity of patients' comfort feeling, and continuous therapeutic ultrasound (Enraf-Nonius-B Delftechpark 39; 1-MHz; 1.5 watts/cm2) for 5 minutes for totally 15 sessions.

The STM group (n=25) was applied soft tissue mobilization for 15 sessions. The patients were positioned with the humerus abducted to 45°. With the elbow flexed to 90°, the humerus was externally rotated to a mid-range position, typically about 20° to 25° of external rotation. The subscapularis was palpated in the axilla to identify areas of myofascial mobility limitations, taut bands, or trigger points. Determined restrictions were treated with STM utilizing a combination of sustained manual pressure, and slow deep strokes to the subscapularis myofascia for 7 minutes and a total of three repetitions.

In addition to these treatments, pectoral stretching, wand exercises, and theraband exercises for the infraspinatus and supraspinatus for strengthening were given to both groups as a home exer-

cise for both groups (10 repetitions, three times a day, five days in a week).

Statistical Analysis

The data were analyzed using the Statistical Package for the Social Sciences SPSS version 17 for Windows (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to analyze the patients' characteristics. Normal distribution of the data was checked using the Shapiro-Wilk test. As the outcome measures were normally distributed, parametric tests were used. Demographic comparisons of the two groups were conducted using Chi-square analysis for categorical variables. Pairwise comparisons were used to examine the difference between the baseline and follow-up periods by independent t-test. Analysis of variance (ANOVA) was used to compare variation between groups (before, after, and three weeks of follow-up treatment). Effect sizes (ES) were determined by calculating the differences in the means of the baseline and the follow-up data divided by the Standard deviation at the baseline; ES of 0.20, 0.50, and 0.80 were considered low, moderate, and large, respectively (13). The level of significance was set at $p<0.05$.

G* Power package software program (G* Power, Version 3.0.10, Franz Faul, Universität Kiel, Germany) was used to determine the study's sample size. The sample size was calculated as 16 per group with the data obtained from Godges et al. (2003) (4) study (95% power, d=1,229 effect size, α=0.05 type I error). However, an increased number of patients was included in each group, in the case of dropout. The actual power of this study was calculated as 95%.

RESULTS

The characteristic data of the patients are presented in Table 1. No significant differences were found between gender, body weight, BMI, and diseases related variables ($p>0.05$). There were significant differences in age and height ($p<0.05$). The patients in the CPP group were older and had higher BMI, but age and BMI covariates were not affected VAS and range of motion results, there was no statistically significant difference between groups in repeated measures define factors analysis ($p>0.05$).

The VAS, flexion and external rotation range of motion, overhead reach test, and SPADI disability parameters were similar between the groups before the study (Table 2 and Table 3). At the end of the treatment, statistically significant differences were observed only in the VAS scores in the intergroup evaluation ($p<0,05$). At the end of three weeks, statistically significant differences were observed in flexion and external rotation range of motion in favor of the CPP group compared to the groups ($p<0,05$). When the intergroup evaluations were

Table 1: Characteristics of the Patients.

Demographic Variables	CPP group (n=23)	STM group (n=25)	p
	Mean±SD	Mean±SD	
Age (years)	55.40±13.20	48.70±8.72	**0.040***$^{\phi}$
Body Weight (kg)	77.20±14.83	74.40±12.50	0.470$^{\phi}$
Height (cm)	161.90±8.90	169.70±8.60	**0.002***$^{\delta}$
BMI (kg/m²)	29.50±5.45	25.70±3.15	**0.005***$^{\phi}$
	n (%)	n (%)	
Female Gender	17 (73.9%)	13 (52%)	0.110†
Disease-Related Variables			
Impingement	10 (43.5%)	8 (32%)	0.130†
Adhesive Capsulitis	3 (13.0%)	8 (32%)	
Rotator Cuff Syndrome	6 (26.1%)	9 (36%)	
Shoulder Periarthritis	2 (8.7%)	-	
Supraspinatus Rupture	2 (8.7%)	-	

*p<0.05. $^{\phi}$Student *t*-test for between-group comparison, $^{\delta}$Mann Whitney U test for between-group comparison, †Chi-Square test for between-group comparison, CPP: Conventional Physiotherapy Program; STM: Soft Tissue Mobilization, BMI: Body Mass Index.

Table 2: Results of Visual Analogue Scale, Flexion Range of Motion, External Rotation Range of Motion, and Over Head Reach Test Scores.

Assessment	Group	Baseline (a)	End of treatment (b)	3-weeks Follow up (c)	p^{δ}	Effect Size
		Mean±SD	Mean±SD	Mean±SD		
VAS	CPP	7.39±1.37	6.91±1.41	2.04±2.00$^{\delta}$	**0.001***	0.920
	STM	6.68±1.18	4.84±1.10	1.40±1.15$^{\delta}$	**0.001***	0.980
	p^{ϕ}	0.081	**<0.001***	0.397		
Flexion ROM	CPP	153.04±23.14	155.22±20.69	173.04±17.30$^{\delta}$	**0.001***	0.800
	STM	147.40±18.09	155±13.99	172.60±5.97$^{\delta}$	**0.001***	0.760
	p^{ϕ}	0.092	0.412	**0.013***		
External Rotation ROM	CPP	61.96±6.69	63.17±6.28	86.74±6.50$^{\delta}$	**0.001***	0.890
	STM	57.40±9.47	63.6±7.00	80.20±5.09$^{\delta}$	**0.001***	0.940
	p^{ϕ}	0.083	0.966	**<0.001***		
Overhead Reach Test	CPP	182.43±12.99	182.39±13.26	191.57±13.64$^{\delta}$	**0.001***	0.860
	STM	182.20±10.24	185.92±9.71	192.40±10.66$^{\delta}$	**0.001***	0.970
	p^{ϕ}	0.951	0.347	0.951		

*p<0.05. $^{\delta}$Two-way Analysis of Variance (ANOVA), $^{\phi}$Mann Whitney-U Test. $^{\delta}$p<0.05 for Wilcoxon Signed-Rank Test between a and b, between a and c, and between b and c. CPP: Conventional Physiotherapy Program, STM: Soft Tissue Mobilization, VAS: Visual Analogue Scale, ROM: Range of motion.

compared before treatment, immediately after the treatment, and after three weeks, both the CPP and STM groups showed statistical improvement in VAS, flexion range of motion, external rotation range of motion, overhead reach test (p<0.05) (Table 2). When we compared the groups, there were statistically significant differences in all variables (p<0.05). Effect sizes were large in VAS, external rotation range of motion, overhead reach test parameters for the STM group. However, the flexion range of motion results was smaller in the STM group than the CPP group (Table 2).

There was a significant difference in SPADI pain scores between the two groups before and after treatment (p<0.05). There was no significant difference in SPADI disability scores between groups before and after treatment (p>0.05). Total SPADI scores showed significant differences between groups before and after treatment (p <0.05) (Table 3).

DISCUSSION

The study aimed to determine STM or CPP's effects on pain intensity, range of motion, and functionality in patients with shoulder disabilities. As a result of this study, improvements were observed in pain, shoulder flexion, and external rotation range of motion, and overhead reach in both groups. When the

Table 3: Shoulder Pain and Disability Index Scores.

SPADI		CPP (n=23) Mean±SD	STM (n=25) Mean±SD	p^{2}
Pain	Baseline	68.43±15.20	54.08±13.15	**0.001***
	3-weeks Follow-up	44.87±13.92	33.60±12.31	**0.007***
	p^{1}	**<0.001***	**<0.001***	
Disability	Baseline	53.69±18.71	52.36±13.85	0.756
	3-weeks Follow-up	35.73±17.23	39.68±13.85	0.634
	p^{1}	**<0.001***	**<0.001***	
Total	Baseline	59.39±16.69	86.56±18.15	**<0.001***
	3-weeks Follow up	39.28±15.12	58.94±18.09	**0.001***
	p^{1}	**<0.001***	**<0.001***	

*p<0.05, p^{1}: Wilcoxon test, p^{2}: Mann Whitney-U Test, SPADI: Shoulder Pain and Disability Index, CPP: Conventional Physiotherapy Program, STM: Soft Tissue Mobilization.

groups' effects were compared after three weeks; pain, external rotation range of motion, and overhead reaching were more significant in the STM group than in the CPP group. Although improvement was observed in both treatments in shoulder disability, more improvement was observed in the STM group than the CPP group.

The results showed that the STM procedure improved overhead reach test results approximately 3.72 cm immediately after the treatment. Almost similar results were found in both treatments three weeks later. In a similar study, after a single session (STM and Proprioceptive neuromuscular facilitation group), an average increase of 9.60 cm was achieved overhead reach test distance by Godges et al. (4). These results showed that STM might be a useful treatment option when conventional end range stretching may cause inconvenience, muscle protection, or are contraindicated.

In this study, it was found that the STM and CPP are effective in treating pain, range of motion, and functionality in shoulder disabilities. However, STM was found more effective on pain and external rotation. Besides, CPP applications were found that more beneficial than STM on flexion range of motion. Additionally, the effect sizes of our applications were large.

The literature supports therapeutic exercise to strengthen the rotator cuff and scapular muscles, and stretch the soft tissues in the anterior and posterior shoulder. The STM is the administration of definite and advanced manual forces to support the replace in the myofascia, allowing for lengthening of shortened the structures (14). In our study, effect sizes were large for the STM group in VAS, external rotation range of motion, and overhead reach test parameters. This study's results were consistent with Godges et al. and Al Dajah (4,5) results. Al Dajah investigated the immediate effect of STM with PNF. They found that pain, glenohumeral external rotation and overhead reach results were improved with STM and PNF (5). The main reason for the improvement in the range of motion and overhead reach activity was that the STM reduces the tightness and supports changes in myofascia, which allows the shortened structures to prolong (4,5). Coviello et al. demonstrated improvements in active pain-free flexion ROM in each of the three treatment sessions after the STM. They also found a reduction in pain and improvement in DASH score. The authors reported that STM might be an immediate beneficial effect on pain-free shoulder flexion and improve function (13).

In our study, the CPP leads to more effective improvements in the flexion range of motion. Additionally, it led to improvements in motion and VAS flexion range, external rotation range of motion, and overhead reach activity. Analan et al. reported that physiotherapy interventions (Therapeutic ultrasound, TENS, hot pack, Codman exercises and stretching exercises) effectively treat the pain, improve the clinical status, and muscle strength of the shoulder in patients with rotator cuff disease (15).

The decreased ROM causes activity limitation. Due to pain, an individual's adaptation to physical activities might be restricted (16). It is known that limitation of movement, shoulder pain, and decreased functionality affect the individual negatively. Decreasing or eliminating the upper extremity participation during activities due to shoulder pain leads to functional losses (17). Akyol et al. examined the relationship between shoulder muscle strength, pain, handgrip strength, disability, quality of life, and emotional state in patients with upper motor neuron syndrome. They measured the shoulder strength and handgrip strength of the patients' affected and intact sides, and the reduction in shoulder muscle strength was reported to affect the strength and emotional state adversely (18). In our study, although the SPADI total scores were higher in the STM group before treatment than in the CPP group, more improvement was observed in the STM group than in the CPP group after treatment. Significant increases in flexion and external rotation range of motion in the STM group were also observed in the STM group after three weeks compared to the CPP group. The STM applied to the subscapularis muscle increased the range of motion and decreased fuctional losses.

There were some limitations in our study. The first limitation was that our patients' diagnoses were different. Therefore, the result of this study could not be generalized for a particular problem however, it points out the importance of symptomatic

treatment interventions. Further research is needed to examine the patients with the specific particular diagnosis. Furthermore, patients of the CPP group were older and taller, and so with higher BMI than the STM group.

The STM and CPP were effective in treating pain, range of motion, and functionality in patients with shoulder disabilities. Furthermore, patients treated with STM and CPP developed their capability to achieve overhead. However, the STM application was found to be more effective in glenohumeral externel rotation and reducing pain.

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Conflict of Interest: There is no conflict of interest.

Ethical Approval: The ethical approval of the study was obtained from the Human Research Ethics Committee of Başkent University (Approval Date: 09.07.2018 and Approval Number: 62310886-600).

Informed Consent: Written informed consent was obtained from all patients.

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REFERENCES

1. Greenberg DL. Evaluation and treatment of shoulder pain. Med Clin North Am. 2014;98:487-504.
2. Georgiannos D, Markopoulos G, Devetzi E, Bisbinas I. Adhesive capsulitis of the shoulder. Is there consensus regarding the treatment? A comprehensive review. Open Orthop J. 2017;11(1):65-76.
3. Rosa DP, Santos RV, Gava V, Borstad JD, Camargo PR. Shoulder external rotation range of motion and pectoralis minor length in individuals with and without shoulder pain. Physiother Theory Pract. 2019;35(10):986-94.
4. Godges JJ, Mattson-Bell M, Thorpe D, Shah D. The immediate effects of soft tissue mobilization with proprioceptive neuromuscular facilitation on glenohumeral external rotation and overhead reach. J Orthop Sports Phys Ther. 2003;33(12):713-8.
5. Al Dajah SB. Soft tissue mobilization and PNF improve range of motion and minimize pain level in shoulder impingement. J Phys Ther Sci. 2014;26(11):1803-5.
6. Myrtos CD. Functional soft-tissue examination and treatment by manual methods. J Can Chiropr Assoc. 2011;55(1):64.
7. Lee SY, Lee KJ, Kim W, Chung SG. Relationships between capsular stiffness and clinical features in adhesive capsulitis of the shoulder. PMR. 2015;7(12):1226-34.
8. Şenbursa G, Atay ÖA. The effectiveness of manual therapy in supraspinatus tendinopathy. Acta Orthop Traumatol Turc. 2011;45(3):162-7.
9. Myles PS, Troedel S, Boquest M, Reeves M. The pain visual analogue scale: is it linear or nonlinear? Anesth Analg. 1999;89(6):1517.
10. Hayes K, Walton JR, Szomor ZL, Murrell GA. Reliability of five methods for assessing shoulder range of motion. Aust J Physiother. 2001;47(4):289-94.
11. Bumin G, Tüzün EH, Tonga E. The Shoulder Pain and Disability Index (SPADI): cross-cultural adaptation, reliability, and validity of the Turkish version. J Back Musculoskelet Rehabil. 2008;21(1):57-62.
12. Breckenridge JD, McAuley JH. Shoulder Pain and Disability Index (SPADI). J Physiother. 2011;57(3):197.
13. Coviello JP, Kakar RS, Reynolds TJ. Short-term effects of instrument-assisted soft tissue mobilization on pain free range of motion in a weightlifter with subacromial pain syndrome. Int J Sports Phys Ther. 2017;12(1):144-54.
14. Robb A, Pajaczkowski J. Immediate effect on pain thresholds using active release technique on adductor strains: pilot study. J Bodyw Mov Ther. 2011;15(1):57-62.
15. Doruk P, Leblebici B. Effects of therapeutic ultrasound and exercise on pain, function, and isokinetic shoulder rotator strength of patients with rotator cuff disease. J Phys Ther Sci. 2015;27(10):3113-7.
16. Mayer J, Kraus T, Ochsmann E. Longitudinal evidence for the association between work-related physical exposures and neck and/or shoulder complaints: a systematic review. Int Arch Occup Environ Health. 2012;85(6):587-603.
17. Umer M, Qadir I, Azam M. Subacromial impingement syndrome. Orthop Rev (Pavia). 2012;4(2):e18.
18. Akyol Y, Yasemin U, Durmuş D, Tander B, Cantürk F, Bilgici A, et al. Shoulder muscle strength in patients with subacromial impingement syndrome: its relationship with duration of quality of life and emotional status. Turk J Phys Med Rehab. 2013;59:176-81.