



Shoulder Muscle Strength in Patients With Subacromial Impingement Syndrome: Its Relationship With Duration of Quality of Life and Emotional Status

Subakromiyal Sıkışma Sendromu Olan Hastalarda Omuz Kas Gücü: El Kavrama Gücü, Ağrı, Disabilite, Yaşam Kalitesi ve Emosyonel Durum ile İlişkisi

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Summary

Objective: The purpose of this study was to compare the shoulder rotator strength (SRS) and handgrip strength (HS) in affected side with that in unaffected side in patients with unilateral subacromial impingement syndrome (SIS), and to evaluate the relationship of SRS with duration of symptoms, handgrip strength, pain, disability, quality of life (QOL), and emotional status.

Materials and Methods: Forty-five patients with unilateral SIS were included. SRS and HS were assessed bilaterally (affected and unaffected side) by isokinetic dynamometer and handheld dynamometer, respectively. Shoulder pain was evaluated by the Visual Analogue Scale, disability with the Shoulder Pain and Disability Index, emotional status by the Beck Depression Inventory, and QOL was assessed by the Short Form-36 in all patients.

Results: SRS and HS values of the affected side were significantly lower than the unaffected side ($p<0.05$). On the affected side, SRS was positively correlated with HS and negatively correlated with depression ($p<0.05$). QOL parameters were positively correlated with peak torque value of affected shoulder external rotators at $180^\circ/\text{sec}$ ($p<0.05$). However, there was no relationship of SRS with duration of symptoms, pain, and disability levels ($p>0.05$).

Conclusion: The results of this study showed that SRS and HS deficits could be detected in patients with SIS. In these patients, duration of symptoms, pain intensity and level of disability may not have any impact on SRS. Decreased SRS may adversely affect HS, emotional status, and QOL. *Turk J Phys Med Rehab 2013;59:176-81.*

Key Words: Subacromial impingement syndrome, disability, muscle strength, quality of life, depression

Özet

Amaç: Bu çalışmanın amacı tek taraflı subakromiyal impingement sendromu (SIS) olan hastalarda, hastalıktan etkilenen ve etkilenmeyen taraf omuz rotator gücü (OG) ve el kavrama gücü (EG)'nü karşılaştırmak, OG ile EG, ağrı, disabilite, yaşam kalitesi (YK), emosyonel durum arasındaki ilişkiyi değerlendirmektir.

Gereç ve Yöntem: Çalışmaya tek taraflı SIS'i olan 45 hasta dahil edildi. OG ve EG bilateral olarak ölçüldü. Hastalarda omuz ağrısı Vizüel Anolog Skala, disabilite Omuz Ağrı ve Disabilite İndeksi, emosyonel durum Beck Depresyon Ölçeği, YK Kısa Form-36 ile belirlendi.

Bulgular: Etkilenen tarafta OG ve EG değerleri etkilenmeyen taraftan daha düşüktü ($p<0,05$). Etkilenen tarafta; OG, EG ile pozitif, depresyon ile negatif olarak koreleydi ($p<0,05$). YK parametreleri, etkilenen omuz dış rotatorlarının $180^\circ/\text{s}$ açılma hızındaki pik tork değerleri ile pozitif koreleydi ($p<0,05$). OG ile semptom süresi, ağrı, ve disabilite seviyesi arasında korelasyon yoktu ($p>0,05$).

Sonuç: Bu çalışmanın sonuçları SIS'li hastalarda OG ve EG kayıpları tespit edilebileceğini göstermiştir. Bu hastalarda, semptom süresi, ağrı şiddeti ve disabilite düzeyinin OG üzerine etkisi olmayabilir. Hastaların OG'sindeki azalma, EG, emosyonel durum ve YK'larını olumsuz yönde etkileyebilir. *Türk Fiz Tıp Rehab Derg 2013;59:176-81.*

Anahtar Kelimeler: Subakromiyal sıkışma sendromu, disabilite, kas gücü, yaşam kalitesi, depresyon

Introduction

Subacromial impingement syndrome (SIS) is one of the major causes of shoulder pain and may lead to functional disability and reduction in quality of life (QOL) (1, 2). Multiple factors have been proposed to contribute to the development of SIS. These factors include abnormal acromial morphology (3), aberrant kinematics patterns due to poor rotator cuff or scapular muscle function (4), shoulder capsular abnormalities (5), poor posture (6), and overuse secondary to repetitive eccentric loading or sustained use of the arm above 90 degrees of elevation (7). The specific diagnosis of SIS is often based on a thorough history and clinical examination; radiological examination methods such as magnetic resonance imaging (MRI) and/or ultrasonography are often not used in the first instance (8), as their diagnostic accuracy is yet to be validated (9, 10). Additionally, it is well known that the impingement test with injection of 10 cc of 1% lidocaine into the subacromial space is useful in distinguishing impingement lesions from other causes of shoulder pain (11).

Muscle weakness is frequently believed to lead to SIS, however, it is not clear in the literature if subjects with SIS present with muscle weakness. Some investigations have demonstrated that SIS does not affect muscle torque of the shoulder (12,13,14), nevertheless, some authors reported that shoulder rotator strength (SRS) of patients with SIS was weaker than normal shoulder (15,16).

There are only a few studies that have measured isokinetic strength of the shoulder rotator muscle, and evaluated its relationship with pain, disability, and QOL, but their results are conflicting (14,17). To our knowledge, the relationship of SRS with duration of symptoms, handgrip strength (HS), and emotional status in patients with SIS has not been reported previously; and there is also no clinical study comparing HS in subjects with and without SIS. The aim of this clinical trial was to compare SRS and HS in the affected and unaffected side in patients with unilateral SIS, and to evaluate the relationship of SRS with HS, pain, disability, QOL, emotional status.

Materials and Methods

A total of forty-five subjects (35 females and 10 males; age range: 21-78 years), who had been experiencing unilateral shoulder pain consistent with SIS for at least 3 months, were enrolled in this study. In order to have statistical power of 0.99 and $p < 0.05$, it was calculated that 45 subjects were required to detect a difference in muscle strength between shoulder with and without SIS. The criteria for inclusion in the study were shoulder pain aggravating with overhead activity, painful range of motion, and positive impingement tests (Neer, Hawkins-Kennedy) (11,18). Exclusion criteria included acute shoulder pain (less than three months), the presence of frozen shoulder, disorders of the acromioclavicular joint, degenerative arthritis of the glenohumeral joint, calcific tendinopathy, shoulder instability, posttraumatic disorders, or shoulder surgery and/or elbow, hand, wrist and cervical spine disorders. All participants underwent MRI and, diagnosis of SIS was confirmed by MRI. Additionally, patients with partial or full-thickness rotator cuff tear determined by MRI were also excluded from the study.

All participants were initially examined by the same physician with regard to the selection criteria, and, if found to be appropriate, the participants were included in the study. Socio-demographic data including age, weight, height, body mass index (BMI, kg/m²), duration of symptoms (month), occupation, and educational level were obtained. SRS and HS were performed bilaterally (affected and unaffected side). Additionally, shoulder pain, disability, emotional status, and QOL were gathered. All participants gave their written consent for this study. The study received the approval of the local Ethics Committee.

Clinical Assessments

Pain

The shoulder pain (rest pain- activity pain-pain disturbing sleep) in the patients was assessed by Visual Analogue Scale (VAS) pain score (0-10 cm, with higher scores indicating more pain) (19).

Functional Capacity

Function was assessed by using the Shoulder Pain and Disability Index (SPADI). This self-administered questionnaire uses 13 questions, 5 of which deal with the severity of pain on various arm movements, the pain being assessed by using VAS. The other 8 questions deal with functional impairment of the shoulder, assessed with a VAS ranging from 0 (no difficulty) to 10 (so difficult that I need help). An overall score was calculated for the 13 questions as a whole. Higher scores indicate a greater level of pain and disability (20).

Muscle Strength

Shoulder rotator strength; A computerized isokinetic dynamometer (Cybex Human Norm Testing & Rehabilitation System, CSMI Medical Solutions, Massachusetts, USA) was used for the testing procedures. The same examiner performed isokinetic dynamometric measurements using the same test protocols in all participants. Before the strength tests, the participant was firstly placed lying with the trunk well stabilized with his or her shoulder in the scapular plane (at 90° of abduction), elbow at 90° of flexion and forearm in the neutral position (21). After giving explanations, the subjects were familiarized with the procedure by performing three sub-maximal repetitions at each speed. The protocol of bilateral concentric/concentric shoulder internal rotation (IR) and external rotation (ER) at velocity of 60°/sec (5 repetitions) and 180°/sec (5 repetitions) were used. The movement range was set in the pain-free 45° of shoulder rotation around neutral (total range of 90°). Two minutes were permitted between testing at the different speeds. The non-affected shoulder was tested firstly to allow familiarity with testing procedures. The subjects were instructed to push the lever up, and pull it down, as hard and as fast as possible with extension undertaken first for concentric actions. All subjects were encouraged to give a maximal effort for each action via both visual feedback and strong verbal encouragement. During testing, no participants complained of pain or discomfort. The highest torque generated in each movement was recorded from strip chart recording. The effect of gravity was corrected. The maximum peak torque (PT) values in Newton-meters were calculated for each subject.

Handgrip strength; Grip strength was measured using a hydraulic handheld dynamometer (Saehan Corporation, MSD

Europr bvba, 2006, Belgium/Europe) following published procedures (22). For performing the test, the subjects were seated on a high plinth without supporting the forearms. The shoulder was kept in adduction and neutral rotation; elbow flexed at 90° forearm in neutral position. The grip bar was adjusted to fit comfortably in the subjects' hand with the middle phalanges under the grip handle. The subjects were requested to squeeze as hard as they could while exhaling. Each hand was tested, alternating back and forth for three trials. The highest force production (in kilograms) for each hand was recorded.

Table 1. Socio-demographic and clinical characteristics of the patients.

Characteristics	The patients with unilateral SIS (n=45, female/male: 35/10)	
	Mean ± SD	Med (min-max)
Age (years)	52.69±11.99	52 (21-78)
Height (cm)	162.60±7.41	161 (149-178)
Weight (kg)	76.36± 3.15	77 (45-115)
Body mass index (kg/m ²)	28.93±4.91	28.8 (19-40)
Duration of symptoms (months)	11.47±13.69	8 (3-84)
Shoulder Pain		
Rest pain VAS (0-10)	4.60±2.99	5 (0-10)
Activity pain VAS (0-10)	7.91±1.67	8 (2-10)
Pain disturbing sleep VAS (0-10)	7.24±2.00	8 (2-10)
Disability		
SPADI pain score (0-50)	37.26±8.14	39 (18-50)
SPADI disability score (0-80)	49.04±15.32	49 (8-78)
SPADI total score (0-130)	86.31±2.23	89 (26-128)
Depression		
BDI score (0-63)	9.89 ± 7.47	9 (0-32)
Quality of Life SF-36 subscale		
Physical function	0.54±0.24	0.6 (0-0.95)
Social function	0.48±0.27	0.55 (0-0.8)
Physical role	0.22±0.38	0 (0-1)
Emotional role	0.57±0.48	1 (0-1)
Mental health	0.65±0.21	0.68 (0.16-1)
Energy	0.52±0.24	0.60 (0-0.90)
Pain	0.27±0.16	0.22 (0-0.55)
General health	0.53±0.23	0.55 (0-0.90)
	n (%)	
Education		
Literate	11 (24.4)	
Primary education	21 (46.7)	
Secondary education	7 (15.6)	
College	6 (13.3)	
Occupation		
Housewife	29 (64.4)	
Officer	4 (8.9)	
Retired	10 (22.2)	
Other	2 (4.4)	

SIS: Subacromial Impingement Syndrome
 Mean± SD: mean ± standard deviation
 Med (min-max): median (minimum-maximum)
 N (%): the number of patients (the percentage)
 SPADI: Shoulder Pain and Disability Index
 BDI: Beck Depression Index
 VAS: Visual Analogue scale

Quality of Life

Quality of life was assessed with the Short Form 36 (SF-36). The SF-36 is a widely used generic instrument for measuring health status and consists of eight dimensions: physical functioning, social functioning, physical role, emotional role, mental health, energy, bodily pain and general health perceptions. Scores range from 0 (worst) to 100 (best) with higher scores indicating better health status (23).

Emotional Status

Depression was assessed using the Beck Depression Inventory (BDI). The BDI is a 21-item test presented in multiple-choice format which purports to measure presence and degree of depression. Responses are made on a four-point, minimally anchored scale, ranging from 0 to 3, with 3 representing the most severe symptoms (24).

Statistical Analyses

The data were analyzed using SPSS for Windows, version 15. Data were presented as mean ± standard deviation (SD), median (minimum; maximum). The Shapiro-Wilk test was used to analyze normal distribution assumption of the quantitative outcomes. All outcomes were not normally distributed. To compare the SRS and HS outcomes between the affected and unaffected side, the Mann-Whitney U test was used. On the affected side, Spearman's correlation coefficients were calculated to assess the univariate relationship of SRS with duration of symptoms, HS, pain intensity, levels of disability, QOL, and depression. The socio-demographic characteristics of the participants were evaluated by the Chi-square test. P values of less than 0.05 were considered statistically significant.

Results

Socio-demographic and clinical characteristics of patients are shown in table 1. SRS and HS values of the affected side were significantly lower than the unaffected side (p<0.05) (Table 2). While SRS was positively correlated with HS, it was negatively correlated with depression. QOL subgroups parameters were positively correlated with some of the PT values of the affected shoulder (especially ER PT for speed of 180°/sec) (p<0.05) (Table 3). However, there was no association of SRS with duration of symptoms, pain, and disability levels (p>0.05) (Table 3).

Discussion

The main finding of this study was that SRS and HS values seem to differ between the patients' symptomatic (affected) and asymptomatic (unaffected) sides. On the affected side, SRS may not be associated with duration of symptoms, pain and disability. Reduction in SRS may adversely affect HS, emotional status and QOL.

Rotator cuff muscle weakness commonly leads to SIS, however, SRS measurements are not studied in details in these patients (4,5,25,26). Therefore, in this study, we investigated the SRS in patients with SIS. In several studies, to assess the shoulder muscle strength in SIS, hand-held and isokinetic dynamometers or electromyography were used and decreased or delayed muscle activation in SIS was shown (27-32).

Isokinetic dynamometry is considered the gold standard of muscle strength testing (33). PT is usually the most common outcome measure reported in isokinetic studies that assess SIS

Table 2. Comparison of patients' shoulder muscle and handgrip strength of affected side and unaffected side.

Characteristics	Affected side n=45		Unaffected side n=45		p
	Mean±SD	Med (minmax)	Mean±SD	Med (min-max)	
Handgrip strength (kg)	14.33±8.92	14 (2-47)	18.83±7.43	18(3-39)	0.003
Shoulder muscle strength (Peak torque, Newton-meters)					
60°/s IRPT	15.09±7.34	14 (1-38)	19.47±8.68	18 (3-47)	0.006
60°/s ERPT	11.24±5.75	11 (1-26)	16.27±6.18	15 (3-34)	0.001
180°/s IRPT	12.38±6.89	12 (2-37)	15.76±7.40	15 (4-38)	0.016
180°/s ERPT	8.69±5.14	8 (2-23)	11.53±4.78	11 (3-26)	0.003

SIS: Subacromial Impingement Syndrome
 IRPT: Internal Rotation Peak Torque
 ERPT: External Rotation Peak Torque
 Mean± SD: mean±standard Deviation
 Med (min-max): median (minimum-maximum)
 p value is significant when <0.05.

(13,34), therefore, PT parameters were used in this study. There are few trials on the measurement of SRS with isokinetic tests and comparison of shoulders with SIS and normal shoulders (5,13,17,19,15). Some authors reported that SRS in patients with SIS was weaker than normal shoulder (15,16). On the contrary, others reported that SRS values with SIS were found to be indifferent from normal shoulder (5,14,35). In the current study, it was shown that the muscle strength of the shoulders with SIS was significantly lower than those of the healthy side.

Handgrip strength measurement using hand-held dynamometers is a widely used method in the assessment of upper extremity muscle strength and function in musculoskeletal disorders (36,37). To the best of our knowledge, there is no clinical study comparing HS in the affected and unaffected side in patients with unilateral SIS. In the present study, the findings showed that the affected side has less HS when compared to the unaffected side.

It has been postulated that pain might be responsible for the muscle weakness with reflex inhibition, resulting in SIS. On the other hand, muscle weakness itself might also be the primary cause of SIS, resulting in pain (38). It has been demonstrated that chronic SIS results in significant functional disability and a reduction in QOL (2). In the literature, there are only few studies that evaluated the relationship of shoulder muscle strength with pain, disability, and QOL (14,17,19,38). In a work by Celik et al. (38), a relationship was shown between shoulder muscle weaknesses and severity of pain in subjects with SIS. Mac Dermid et al. (17) reported that isokinetic strength measurements were correlated with pain and disability; lower strength was associated with greater pain and disability, although the strength of this relationship ranged from low to moderate. On the contrary, we found no relationship of SRS with pain and disability scores. Erol et al. (14) reported that SRS moderately and negatively correlated with pain scores and QOL parameters, however, no significant correlations were found between SRS values and disability score. In their study, the study population consisted of early-stage patients as in our study, but their study sample was small and the scales

assessing pain intensity (SPADI pain subgroup score) and QOL (Nottingham Health Profile) were different from ours. In the current study, only a PT measurement of shoulder ER had low and positive correlation with SF-36 QOL parameters especially in velocity of 180°/sec. Based on these results, it seems that the relationship between SRS and clinical assessments (such as pain, disability, QOL) is still unclear, therefore, more studies are needed on patients with SIS.

Since the patients were in relatively early stages of SIS with the intact rotator cuff, they could have performed the isokinetic testing more easily. Using a range which was restricted to the pain-free arc also might have contributed to this result.

To the best of our knowledge, no clinical study testing the relationship of SRS with duration of symptoms, HS, and depression in patients with SIS has been reported in the literature yet. We found that SRS was not affected by duration of symptoms. In the present study, SRS was positively correlated with HS suggesting that HS measurement which is more easily evaluated in clinical practice may be a practical way for predicting the muscle strength in patients with SIS. Mental health problems and mood abnormalities such as depression may be associated with chronic musculoskeletal disorders. Depression may be associated with pain and disability; and it may cause a vicious cycle between poor emotional and physical health (39,40). In the present study, there was a significant correlation between SRS of shoulder with SIS and depression level. In the management of the patients with SIS who have shoulder muscle weakness, the emotional status should be considered.

The limitation of the current study may be the relatively small number of patients. Future studies with larger sample sizes including sex-, age- and BMI-matched healthy controls are needed. In this study, impingement test with lidokain injection was not used for the diagnosis of SIS, thus, in future trials this test can be performed besides other clinical assessments. The power of our study; patients with unilateral SIS, early-stage without partial or full-thickness rotator cuff tear determined by MRI were included. Another strength of this study was the

Table 3. Correlation between shoulder rotator strength of affected side and clinical findings in patients with subacromial impingement syndrome (SIS).

Affected side (n=45)	Shoulder 60°/s IRPT	Shoulder 60°/s ERPT	Shoulder 180°/s IRPT	Shoulder 180°/s ERPT
Duration of symptoms				
r	-0.227	-0.144	-0.119	-0.073
p	0.133	0.347	0.438	0.634
Rest pain VAS				
r	-0.025	-0.025	-0.006	-0.006
p	0.869	0.873	0.970	0.970
Activity pain VAS				
r	0.091	0.056	0.145	0.107
p	0.552	0.713	0.343	0.483
Pain disturbing sleep VAS				
r	-0.153	-0.230	-0.200	-0.253
p	0.315	0.128	0.189	0.094
SPADI pain score				
r	-0.065	-0.066	-0.11	-0.160
p	0.672	0.665	0.466	0.293
SPADI disability score				
r	-0.038	-0.087	-0.149	-0.175
p	0.805	0.571	0.328	0.251
SPADI total score				
r	0.023	-0.067	-0.004	-0.136
p	0.882	0.663	0.980	0.374
Handgrip strength				
r	0.408	0.531	0.537	0.732
p	0.005	0.001	0.001	0.001
BDI score				
r	-0.250	-0.477	-0.332	-0.526
p	0.098	0.001	0.026	0.001
Physical function				
r	0.068	0.124	0.126	0.139
p	0.658	0.419	0.410	0.364
Social function				
r	0.166	0.273	0.211	0.397
p	0.275	0.070	0.163	0.007
Physical role				
r	0.027	0.245	0.071	0.343
p	0.861	0.105	0.644	0.021
Emotional role				
r	0.187	0.285	0.264	0.410
p	0.220	0.057	0.080	0.005
Mental health				
r	0.273	0.345	0.196	0.361
p	0.069	0.020	0.196	0.015
Energy				
r	0.477	0.551	0.409	0.470
p	0.001	0.001	0.005	0.001
Pain				
r	-0.014	0.228	0.138	0.346
p	0.926	0.131	0.367	0.020
General health				
r	0.123	0.259	0.272	0.450
p	0.421	0.086	0.071	0.002

SPADI: Shoulder Pain and Disability Index, BDI: Beck Depression Index
VAS: Visual Analogue Scale, IRPT: Internal Rotation Peak Torque
ERPT: External Rotation Peak Torque
r: Spearman's correlation coefficient, p value is significant when <0.05.

evaluation parameters such as shoulder pain (rest, activity, and sleep), SRS, HS, disability, depression, and QOL values together.

The main finding of the study was that SRS and HS values of the affected side were significantly lower than the unaffected side in patients with unilateral SIS. SRS was not affected by duration of symptoms, pain, and disability levels in patients with SIS. Reduction in SRS may adversely affect HS, emotional status, and QOL. In conclusion, SRS and HS are objective outcome measures, therefore, these parameters as well as pain and disability should be evaluated in patients with SIS. These results highlight the importance of assessing upper extremity muscles strength and, if necessary, strengthening them during the conservative treatment of SIS.

Conflict of Interest

Authors reported no conflicts of interest.

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